| DOCKETED | |
| --- | --- |
| Docket Number: | 08-AFC-08A |
| Project Title: | Hydrogen Energy Center Application for Certification Amendment |
| TN #: | 233603-9 |
| Document Title: | Continuation of Amended AFC Volume III - HECA 9 |
| Description: | *** These documents supersedes TN 65049 which was just the cover letter due to the fact the Amended AFC was too large to docket at the time. *** - Document was on proceeding webpage and is now moved over to the docket log. |
| Filer: | Raquel Rodriguez |
| Organization: | California Energy Commission |
| Submitter Role: | Commission Staff |
| Submission Date: | 6/22/2020 12:59:32 PM |
| Docketed Date: | 6/22/2020 |

## $PM_{10}$ - Fugitives

**MONTHLY EMISSIONS (lbs/day)**

**ON-SITE**

| CONSTRUCTION VEHICLES | Round Trips per day per unit | Round Trip Distance (miles/vehicle/day) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **On-Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | |
| 18 cy fill mat'l haul truck | 1 | 1.8 | 0.0 | 0.0 | 9.3 | 9.3 | 18.7 | 18.7 | 18.7 | 18.7 | 9.3 | 9.3 | 9.3 | 9.3 | 4.7 | 4.7 | 4.7 | 4.7 | 4.7 | 4.7 | 0.0 | 0.0 | 0.0 |
| Bus | 1 | 0.75 | 0.6 | 0.6 | 0.6 | 0.6 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 2.0 | 2.0 | 2.0 | 2.8 | 2.8 |
| Concrete Pumper Truck | 2 | 0.75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 2.3 | 2.3 | 2.3 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Dump Truck | 8 | 0.75 | 6.8 | 9.1 | 9.1 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Diesel Tractor (Yard Dog) | 2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Service Truck - 1 ton | 10 | 0.5 | 3.8 | 3.8 | 3.8 | 7.6 | 7.6 | 7.6 | 7.6 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| Pile Driver Truck | 2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck - Fuel/Lube | 8 | 0.75 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 |
| Tractor Truck 5th Wheel | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trucks - Pickup 3/4 ton | 10 | 0.5 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 5.5 | 6.4 | 7.4 | 13.8 | 13.8 | 13.8 | 13.8 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 |
| Trucks - 3 ton | 2 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.7 | 0.7 | 0.7 | 1.3 | 1.3 | 1.3 | 1.3 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Truck - Water | 4 | 1 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 | 5.7 |
| **Off Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor 185 CFM | 1 | 0.01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Air Compressor 750 CFM | 1 | 0.01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Articulating Boom Platform | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bob cat loader | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozer D10R | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozer D6C | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Concrete Trowel Machine | 1 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Concrete Vibrators | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranes - Mobile 35 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Cranes - Mobile 45 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 |
| Crane - Mobile 65 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 |
| Cranes 100 / 150  ton cap | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Diesel Powered Welder | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Backhoe/loader | 0 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Earth Scraper 637 | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - loader | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Motor Grader (CAT140H) | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Trencher (CAT320) | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fired Heaters (2,000 BTU) | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Forklift | 5 | 0.5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Fusion Welder | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Heavy Haul / 600 tn Crane | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Heavy Haul / 1,000 tn Crane | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Light Plants | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Man lifts - telescoping | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| Man lift - scissor | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| Portable Compaction Roller | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Compaction - Vibratory Plate | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Compaction - Ram | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pumps | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Power Generators | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck Crane - Greater than 300 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 |
| Truck Crane - Greater than 200 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 |
| Vibratory Roller Ingersol-Rand 20 ton | 2 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **WORKER VEHICLES** | | | | | | | | | | | | | | | | | | | | | | | |
| Personal commuting vehicles | | | 0.8 | 1.4 | 1.8 | 2.4 | 3.5 | 4.4 | 5.3 | 7.1 | 7.9 | 9.5 | 11.7 | 13.1 | 15.6 | 18.3 | 22.0 | 24.8 | 27.1 | 28.8 | 30.3 | 32.1 | 33.6 |
| **DELIVERY TRUCKS** | | | | | | | | | | | | | | | | | | | | | | | |
| Light delivery truck (e.g. Fed-Ex) | | | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | | | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 |
| Import fill trucks | | | 121.5 | 121.5 | 121.5 | 121.5 | 121.5 | 121.5 | 121.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **CONSTRUCTION ACTIVITY** | | | | | | | | | | | | | | | | | | | | | | | |
| Dirt Piling - Bob cat loader | | | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Dirt Piling - Trencher (CAT320) | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt Piling - Backhoe/loader | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Dirt Piling - loader | | | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - Earth Scraper 637 | | | 0.8 | 0.8 | 0.8 | 0.8 | 0.5 | 0.5 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - Motor Grader (CAT140H) | | | 0.0 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozing - Bulldozer D10R | | | 25.1 | 25.1 | 25.1 | 16.7 | 16.7 | 16.7 | 16.7 | 16.7 | 16.7 | 8.4 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozing - Bulldozer D6C | | | 25.1 | 25.1 | 25.1 | 25.1 | 16.7 | 16.7 | 16.7 | 16.7 | 16.7 | 16.7 | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Covered Storage Piles | | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | | | | | | | | | | | | | |
| **ONSITE TOTAL (lbs/day)** | | | **228.4** | **231.3** | **241.2** | **234.9** | **237.1** | **241.0** | **238.4** | **115.7** | **112.7** | **106.1** | **98.4** | **91.9** | **99.5** | **103.2** | **107.1** | **97.1** | **99.8** | **101.5** | **98.6** | **101.5** | **103.1** |

Hydrogen Energy California Project
4/11/2012
Monthly Emissions of PM10 from Fugitive Sources

**OFF-SITE**

| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WORKER VEHICLES** | | | | | | | | | | | | | | | | | | | | | |
| Personal commuting vehicles | 0.2 | 0.3 | 0.4 | 0.5 | 0.7 | 0.8 | 1.0 | 1.4 | 1.5 | 1.8 | 2.2 | 2.5 | 3.0 | 3.5 | 4.2 | 4.8 | 5.2 | 5.5 | 5.8 | 6.1 | 6.4 |
| **DELIVERY TRUCKS** | | | | | | | | | | | | | | | | | | | | | |
| Light delivery truck (e.g. Fed-Ex) | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| Import fill trucks | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **LINEARS** | | | | | | | | | | | | | | | | | | | | | |
| **ON ROAD** | | | | | | | | | | | | | | | | | | | | | |
| Dump Truck | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.6 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 1.6 |
| Service Truck (MHD-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Pipe Haul Truck and Trailer (HHDT-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3/4 Ton Pickup (MHD-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Truck - water | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.0 |
| **OFF ROAD** | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor (185 CFM) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bore Machine (Hydraulic) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 Ton Hydra Crane | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.3 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.3 |
| Backhoe/loader | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Trencher | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Forklift | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Welding Generator | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 to 5 Ton AC Roller | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Pipe Bending Machine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **CONSTRUCTION ACTIVITY** | | | | | | | | | | | | | | | | | | | | | |
| Dirt piling - Backhoe | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Dirt piling - Excavator | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT 325 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT 330 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT DOZER D-6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT RUBBER TIRE LOADER 966 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - CAT MODEL 12 MOTOR GRADER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - CAT SCRAPER 615 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Storage Piles | | | | | | | | | | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| **RAIL** | | | | | | | | | | | | | | | | | | | | | |
| AIR COMPRESSOR 185 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BOOM TRUCK 12 TON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT 325 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT 330 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT DOZER D-6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT MODEL 12 MOTOR GRADER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT ROLLER-COMPACTOR 563 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT RUBBER TIRE LOADER 966 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT SCRAPER 615 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CRANE-ROUGH TERRAIN 45T | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GENSET 5KW | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| JOHN DEERE TRACTOR 9400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| PICK-UP CRAFT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| PICK-UP OVERHEAD | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 1.9 | 1.9 | 1.6 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL BALLAST REGULATOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL CLIP MACHINE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL MOVER-SHUTTLE WAGON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL TAMPER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL WELDER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAMEX WALK BEHIND COMPACTOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRI-AXLE DUMP TRUCK | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 2.4 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRUCK FLATBED 14 FOOT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.9 | 0.9 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRUCK TRACTOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| WATER TRUCK, 4M ON-ROAD | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| WELDING MACHINE 350 AMP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **LINEARS TOTAL (lbs/day)** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **4.7** | **5.7** | **13.3** | **15.7** | **15.4** | **14.2** | **14.2** | **8.6** | **8.6** | **8.6** | **6.6** |
| **OFFSITE VEHICLES TOTAL (lbs/day)** | **14.0** | **14.1** | **14.2** | **14.3** | **14.5** | **14.7** | **14.9** | **5.0** | **5.1** | **5.4** | **5.9** | **6.1** | **6.6** | **7.1** | **7.8** | **8.4** | **8.8** | **9.1** | **9.4** | **9.8** | **10.1** |
| **TOTAL PROJECT (lbs/day)** | 242.4 | 245.5 | 255.4 | 249.2 | 251.7 | 255.7 | 253.3 | 120.7 | 117.9 | 111.6 | 109.0 | 103.7 | 119.5 | 126.1 | 130.4 | 119.7 | 122.8 | 119.2 | 116.6 | 119.8 | 119.8 |

Notes:

1. According to schedules provided by Fluor, Linear construction (except rail) takes place in months 11-22.
2. According to schedules provided by Fluor, Rail construction occurs in months 13-17.
3. According to schedule on "onsite equipment" tab, site prep/pilling occurs in months 1-8. Assume onsite covered storage piles are only present during these months.
4. Assume linear covered storage piles are present during entire 12 months of linear construction, months 11-22.

| 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 | 2.8 | 2.8 | 2.8 | 0.9 | 0.9 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2.8 | 2.8 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.4 | 3.4 | 3.4 | 2.8 | 2.8 | 1.4 | 1.4 | 0.9 | 0.9 | 0.6 | 0.6 | 0.6 | 0.3 | 0.3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 6.8 | 6.8 | 6.8 | 4.6 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 23.0 | 13.8 | 13.8 | 9.2 | 9.2 | 9.2 | 9.2 | 4.6 |
| 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.3 | 1.0 | 1.0 | 1.0 | 1.0 | 0.7 | 0.7 | 0.7 | 0.3 | 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 |
| 5.7 | 5.7 | 3.8 | 5.7 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 | 1.9 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 |
| 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 37.6 | 40.5 | 43.5 | 46.3 | 46.8 | 51.5 | 55.1 | 56.9 | 57.2 | 57.8 | 57.0 | 56.4 | 53.9 | 51.0 | 49.4 | 44.9 | 43.5 | 36.9 | 30.0 | 23.7 | 16.2 | 12.9 | 12.9 | 12.9 | 11.9 | 10.1 | 9.3 | 7.0 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 | 20.4 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.3 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.2 | 0.2 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.4 | 0.4 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 8.4 | 8.4 | 8.4 | 8.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **105.6** | **108.4** | **111.0** | **115.3** | **113.9** | **118.5** | **136.0** | **137.8** | **137.9** | **138.3** | **127.7** | **127.1** | **124.5** | **120.7** | **121.0** | **118.8** | **117.4** | **110.0** | **96.1** | **86.1** | **78.5** | **58.9** | **58.9** | **54.0** | **50.6** | **45.9** | **44.8** | **37.9** |

Hydrogen Energy California Project
4/11/2012
Monthly Emissions of PM10 from Fugitive Sources

| 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.2 | 7.7 | 8.3 | 8.9 | 9.0 | 9.8 | 10.5 | 10.9 | 11.0 | 11.1 | 10.9 | 10.8 | 10.3 | 9.8 | 9.5 | 8.6 | 8.3 | 7.1 | 5.7 | 4.5 | 3.1 | 2.5 | 2.5 | 2.5 | 2.3 | 1.9 | 1.8 | 1.3 |
| 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **6.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **10.8** | **11.4** | **11.9** | **12.5** | **12.6** | **13.5** | **14.2** | **14.5** | **14.6** | **14.7** | **14.5** | **14.4** | **13.9** | **13.4** | **13.1** | **12.2** | **11.9** | **10.7** | **9.4** | **8.2** | **6.7** | **6.1** | **6.1** | **6.1** | **5.9** | **5.6** | **5.4** | **5.0** |
| 122.4 | 119.8 | 123.0 | 127.8 | 126.5 | 132.0 | 150.2 | 152.3 | 152.4 | 153.0 | 142.2 | 141.6 | 138.4 | 134.1 | 134.1 | 131.0 | 129.3 | 120.7 | 105.5 | 94.3 | 85.3 | 65.0 | 65.0 | 60.1 | 56.5 | 51.5 | 50.2 | 42.8 |

## $PM_{2.5}$ - Fugitives

MONTHLY EMISSIONS (lbs/day)

ON-SITE

| CONSTRUCTION VEHICLES | Round Trips per day per unit | Round Trip Distance (miles/vehicle/day) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **On-Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 cy fill mat'l haul truck | 1 | 1.8 | 0.0 | 0.0 | 0.9 | 0.9 | 1.9 | 1.9 | 1.9 | 1.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bus | 1 | 0.75 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 |
| Concrete Pumper Truck | 2 | 0.75 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dump Truck | 8 | 0.75 | 0.7 | 0.9 | 0.9 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 |
| Diesel Tractor (Yard Dog) | 2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Service Truck - 1 ton | 10 | 0.5 | 0.4 | 0.4 | 0.4 | 0.8 | 0.8 | 0.8 | 0.8 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Pile Driver Truck | 2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck - Fuel/Lube | 8 | 0.75 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 |
| Tractor Truck 5th Wheel | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trucks - Pickup 3/4 ton | 10 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 1.4 | 1.4 | 1.4 | 1.4 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 1.4 | 1.4 | 0.9 | 0.9 | 0.9 | 0.9 | 0.5 |
| Trucks - 3 ton | 2 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck - Water | 4 | 1 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.4 | 0.6 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Off Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor 185 CFM | 1 | 0.01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Air Compressor 750 CFM | 1 | 0.01 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Articulating Boom Platform | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bob cat loader | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozer D10R | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozer D6C | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Concrete Trowel Machine | 1 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Concrete Vibrators | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranes - Mobile 35 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranes - Mobile 45 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Crane - Mobile 65 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cranes 100 / 150 ton cap | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Diesel Powered Welder | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Backhoe/loader | 0 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Earth Scraper 637 | 0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - loader | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Motor Grader (CAT140H) | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Trencher (CAT320) | 0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fired Heaters (2,000 BTU) | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Forklift | 5 | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Fusion Welder | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Heavy Haul / 600 tn Crane | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Heavy Haul / 1,000 tn Crane | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Light Plants | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Man lifts - telescoping | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Man lift - scissor | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Compaction Roller | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Compaction - Vibratory Plate | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Compaction - Ram | 0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pumps | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Portable Power Generators | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck Crane - Greater than 300 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck Crane - Greater than 200 ton | 1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Vibratory Roller Ingersol-Rand 20 ton | 2 | 0.25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **WORKER VEHICLES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Personal commuting vehicles | | | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.7 | 0.8 | 0.9 | 1.2 | 1.3 | 1.6 | 1.8 | 2.2 | 2.5 | 2.7 | 2.9 | 3.0 | 3.2 | 3.4 | 3.8 | 4.0 | 4.4 | 4.6 | 4.7 | 5.1 | 5.5 | 5.7 | 5.7 | 5.8 | 5.7 | 5.6 | 5.4 | 5.1 | 4.9 | 4.5 | 4.3 | 3.7 | 3.0 | 2.4 | 1.6 | 1.3 | 1.3 | 1.3 | 1.2 | 1.0 | 0.9 | 0.7 |
| **DELIVERY TRUCKS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Light delivery truck (e.g. Fed-Ex) | | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | | | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Import fill trucks | | | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 12.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **CONSTRUCTION ACTIVITY** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dirt Piling - Bob cat loader | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt Piling - Trencher (CAT320) | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt Piling - Backhoe/loader | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt Piling - loader | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - Earth Scraper 637 | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - Motor Grader (CAT140H) | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozing - Bulldozer D10R | | | 8.3 | 8.3 | 8.3 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 2.8 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bulldozing - Bulldozer D6C | | | 8.3 | 8.3 | 8.3 | 8.3 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 | 2.8 | 2.8 | 2.8 | 2.8 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 | 2.8 | 2.8 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Covered Storage Piles | | | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ONSITE TOTAL (lbs/day)** | | | **34.6** | **34.9** | **35.9** | **33.3** | **31.6** | **32.0** | **31.8** | **19.5** | **19.0** | **16.4** | **13.7** | **11.1** | **11.9** | **12.3** | **12.7** | **9.7** | **10.0** | **10.2** | **9.9** | **10.2** | **10.3** | **10.6** | **10.9** | **11.1** | **11.5** | **11.4** | **11.8** | **15.6** | **15.7** | **15.7** | **15.8** | **12.8** | **12.7** | **12.4** | **12.1** | **12.1** | **11.9** | **11.8** | **11.0** | **9.6** | **8.6** | **7.9** | **5.9** | **5.9** | **5.4** | **5.1** | **4.6** | **4.5** | **3.8** |

Hydrogen Energy California Project
4/11/2012
Monthly Emissions of PM2.5 from Fugitive Sources

OFF-SITE

| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WORKER VEHICLES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Personal commuting vehicles | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 | 0.6 | 0.6 | 0.7 | 0.9 | 1.0 | 1.2 | 1.3 | 1.4 | 1.4 | 1.5 | 1.6 | 1.8 | 1.9 | 2.0 | 2.2 | 2.2 | 2.4 | 2.6 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.5 | 2.4 | 2.3 | 2.1 | 2.0 | 1.7 | 1.4 | 1.1 | 0.8 | 0.6 | 0.6 | 0.6 | 0.6 | 0.5 | 0.4 | 0.3 |
| **DELIVERY TRUCKS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Light delivery truck (e.g. Fed-Ex) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Import fill trucks | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **LINEARS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ON ROAD** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dump Truck | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Service Truck (MHD-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pipe Haul Truck and Trailer (HHDT-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3/4 Ton Pickup (MHD-DSL) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Truck - water | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **OFF ROAD** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor (185 CFM) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Bore Machine (Hydraulic) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 Ton Hydra Crane | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Backhoe/loader | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Excavator - Trencher | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Forklift | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Welding Generator | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 to 5 Ton AC Roller | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pipe Bending Machine | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **CONSTRUCTION** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dirt piling - Backhoe | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - Excavator | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT 325 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT 330 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT DOZER D-6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dirt piling - CAT RUBBER TIRE LOADER 966 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - CAT MODEL 12 MOTOR GRADER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Grading - CAT SCRAPER 615 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Storage Piles | | | | | | | | | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **RAIL** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AIR COMPRESSOR 185 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| BOOM TRUCK 12 TON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT 325 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT 330 BACKHOE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT DOZER D-6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT MODEL 12 MOTOR GRADER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT ROLLER-COMPACTOR 563 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT RUBBER TIRE LOADER 966 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CAT SCRAPER 615 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| CRANE-ROUGH TERRAIN 45T | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GENSET 5KW | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| JOHN DEERE TRACTOR 9400 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| PICK-UP CRAFT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| PICK-UP OVERHEAD | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL BALLAST REGULATOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL CLIP MACHINE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL MOVER-SHUTTLE WAGON | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL TAMPER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAIL WELDER | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| RAMEX WALK BEHIND COMPACTOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRI-AXLE DUMP TRUCK | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRUCK FLATBED 14 FOOT | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| TRUCK TRACTOR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| WATER TRUCK, 4M ON-ROAD | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| WELDING MACHINE 350 AMP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **LINEARS TOTAL (lbs/day)** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.5** | **0.6** | **1.4** | **1.6** | **1.6** | **1.5** | **1.5** | **0.9** | **0.9** | **0.9** | **0.7** | **0.7** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **OFFSITE VEHICLES TOTAL (lbs/day)** | **3.4** | **3.5** | **3.5** | **3.5** | **3.6** | **3.6** | **3.7** | **1.2** | **1.3** | **1.3** | **1.4** | **1.5** | **1.6** | **1.7** | **1.9** | **2.1** | **2.2** | **2.2** | **2.3** | **2.4** | **2.5** | **2.7** | **2.8** | **2.9** | **3.1** | **3.1** | **3.3** | **3.5** | **3.6** | **3.6** | **3.6** | **3.6** | **3.5** | **3.4** | **3.3** | **3.2** | **3.0** | **2.9** | **2.6** | **2.3** | **2.0** | **1.6** | **1.5** | **1.5** | **1.5** | **1.4** | **1.4** | **1.3** | **1.2** |
| **TOTAL PROJECT (lbs/day)** | 38.1 | 38.4 | 39.4 | 36.9 | 35.2 | 35.6 | 35.4 | 20.7 | 20.3 | 17.8 | 15.7 | 13.3 | 14.9 | 15.7 | 16.2 | 13.3 | 13.6 | 13.3 | 13.1 | 13.5 | 13.5 | 13.9 | 13.7 | 14.1 | 14.6 | 14.5 | 15.2 | 19.0 | 19.3 | 19.3 | 19.4 | 16.3 | 16.3 | 15.9 | 15.4 | 15.3 | 14.9 | 14.7 | 13.6 | 11.9 | 10.6 | 9.5 | 7.4 | 7.4 | 6.9 | 6.5 | 6.0 | 5.8 | 5.0 |

Notes:

1. According to schedules provided by Fluor, Linear construction (except rail) takes place in months 11-22.
2. According to schedules provided by Fluor, Rail construction occurs in months 13-17.
3. According to schedule on "onsite equipment" tab, site prep/pilling occurs in months 1-8. Assume covered storage piles are only present during these months.
4. Assume linear covered storage piles are present during entire 12 months of linear construction, months 11-22.

**PROJECT MONTHLY EMISSIONS (lbs/month)**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJECT EMISSIONS (on-site + linears) | CO | 3,222 | 3,320 | 3,952 | 3,991 | 4,067 | 4,408 | 3,847 | 3,371 | 3,186 | 3,290 | 4,650 | 4,916 | 6,641 | 7,324 | 7,225 | 7,394 | 7,670 | 6,382 | 6,299 | 6,551 | 6,233 | 6,091 |
| | CO2 | 703,040 | 719,044 | 830,245 | 828,597 | 800,494 | 859,890 | 733,697 | 600,356 | 555,736 | 546,695 | 784,578 | 827,886 | 1,247,557 | 1,329,371 | 1,356,321 | 1,356,399 | 1,413,544 | 1,114,617 | 1,110,530 | 1,172,230 | 1,117,660 | 1,097,139 |
| | CH4 | 62 | 64 | 73 | 73 | 70 | 75 | 63 | 58 | 57 | 61 | 87 | 94 | 127 | 139 | 139 | 147 | 150 | 127 | 127 | 133 | 128 | 125 |
| | N2O | 13 | 13 | 15 | 15 | 15 | 16 | 14 | 12 | 11 | 11 | 16 | 17 | 20 | 21 | 22 | 23 | 24 | 25 | 25 | 27 | 25 | 25 |
| | NOx | 6,550 | 6,711 | 7,829 | 7,819 | 7,657 | 8,282 | 7,121 | 5,796 | 5,326 | 5,286 | 7,469 | 7,879 | 11,316 | 12,114 | 12,101 | 12,084 | 12,612 | 10,347 | 10,259 | 10,813 | 10,275 | 10,061 |
| | PM10 - comb + fug | 5,362.0 | 5,439.8 | 5,736.1 | 5,603.1 | 5,676.4 | 5,807.0 | 5,691.5 | 2,931.3 | 2,836.7 | 2,705.6 | 2,781.5 | 2,688.9 | 3,205.3 | 3,400.2 | 3,461.5 | 3,221.3 | 3,305.3 | 3,103.7 | 3,027.8 | 3,121.3 | 3,076.8 | 3,101.8 |
| | PM2.5 - comb + fug | 1,070.8 | 1,088.6 | 1,183.4 | 1,132.3 | 1,115.6 | 1,165.1 | 1,105.5 | 780.7 | 744.1 | 699.9 | 781.8 | 753.1 | 951.8 | 1,021.6 | 1,012.7 | 952.5 | 980.7 | 866.5 | 849.2 | 883.1 | 847.9 | 838.3 |
| | SO2 | 7 | 7 | 8 | 8 | 8 | 9 | 8 | 6 | 6 | 6 | 9 | 9 | 14 | 14 | 15 | 15 | 15 | 12 | 12 | 13 | 12 | 12 |
| | ROG | 1,017 | 1,046 | 1,268 | 1,289 | 1,384 | 1,507 | 1,350 | 1,134 | 1,032 | 1,076 | 1,511 | 1,615 | 2,074 | 2,240 | 2,228 | 2,264 | 2,361 | 2,047 | 1,986 | 2,095 | 1,985 | 1,932 |
| | CO2e | 708,343 | 724,467 | 836,506 | 834,869 | 806,541 | 866,396 | 739,285 | 605,201 | 560,370 | 551,369 | 791,452 | 835,251 | 1,256,345 | 1,338,945 | 1,366,145 | 1,366,549 | 1,424,275 | 1,124,895 | 1,120,929 | 1,183,254 | 1,128,243 | 1,107,556 |

**12-month Rolling Emissions (tons/yr)**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROJECT EMISSIONS (on-site + linears) | CO | - | - | - | - | - | - | - | - | - | - | - | 23 | 25 | 27 | 28 | 30 | 32 | 33 | 34 | 36 | 37 | 39 |
| | CO2 | - | - | - | - | - | - | - | - | - | - | - | 4395 | 4667 | 4973 | 5236 | 5499 | 5806 | 5933 | 6122 | 6408 | 6689 | 6964 |
| | CH4 | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | N2O | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | NOx | - | - | - | - | - | - | - | - | - | - | - | 42 | 44 | 47 | 49 | 51 | 54 | 55 | 56 | 59 | 61 | 64 |
| | PM10 - comb + fug | - | - | - | - | - | - | - | - | - | - | - | 26.6 | 25.6 | 24.5 | 23.4 | 22.2 | 21.0 | 19.7 | 18.3 | 18.4 | 18.5 | 18.7 |
| | PM2.5 - comb + fug | - | - | - | - | - | - | - | - | - | - | - | 5.8 | 5.8 | 5.7 | 5.6 | 5.5 | 5.5 | 5.3 | 5.2 | 5.2 | 5.3 | 5.4 |
| | SO2 | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ROG | - | - | - | - | - | - | - | - | - | - | - | 8 | 8 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 |
| | CO2e | - | - | - | - | - | - | - | - | - | - | - | 4430 | 4704 | 5011 | 5276 | 5542 | 5851 | 5980 | 6171 | 6460 | 6744 | 7022 |

Construction days per month: 22

**ONSITE MONTHLY EMISSIONS (lbs/month)**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ONSITE EMISSIONS (no linears) | CO | 3,222 | 3,320 | 3,952 | 3,991 | 4,067 | 4,408 | 3,847 | 3,371 | 3,186 | 3,290 | 3,411 | 3,481 | 3,491 | 3,759 | 3,822 | 4,078 | 4,251 | 4,317 | 4,291 | 4,653 | 4,706 | 4,659 |
| | CO2 | 703,040 | 719,044 | 830,245 | 828,597 | 800,494 | 859,890 | 733,697 | 600,356 | 555,736 | 546,695 | 578,374 | 584,527 | 600,074 | 636,327 | 660,620 | 688,647 | 740,771 | 764,687 | 765,299 | 839,744 | 857,402 | 846,445 |
| | CH4 | 62 | 64 | 73 | 73 | 70 | 75 | 63 | 58 | 57 | 61 | 63 | 64 | 63 | 69 | 71 | 80 | 82 | 84 | 86 | 95 | 96 | 96 |
| | N2O | 13 | 13 | 15 | 15 | 15 | 16 | 14 | 12 | 11 | 11 | 12 | 12 | 12 | 13 | 14 | 15 | 16 | 17 | 17 | 19 | 20 | 19 |
| | NOx | 6,550 | 6,711 | 7,829 | 7,819 | 7,657 | 8,282 | 7,121 | 5,796 | 5,326 | 5,286 | 5,545 | 5,616 | 5,694 | 6,058 | 6,254 | 6,503 | 6,914 | 7,105 | 7,066 | 7,732 | 7,867 | 7,742 |
| | PM10 - comb + fug | 5,362.0 | 5,439.8 | 5,736.1 | 5,603.1 | 5,676.4 | 5,807.0 | 5,691.5 | 2,931.3 | 2,836.7 | 2,705.6 | 2,545.7 | 2,410.1 | 2,576.2 | 2,687.3 | 2,777.8 | 2,579.9 | 2,653.7 | 2,697.0 | 2,626.1 | 2,727.2 | 2,768.0 | 2,814.2 |
| | PM2.5 - comb + fug | 1,070.8 | 1,088.6 | 1,183.4 | 1,132.3 | 1,115.6 | 1,165.1 | 1,105.5 | 780.7 | 744.1 | 699.9 | 648.7 | 599.1 | 614.3 | 649.6 | 662.6 | 618.5 | 637.3 | 647.2 | 634.5 | 675.3 | 683.5 | 682.0 |
| | SO2 | 7 | 7 | 8 | 8 | 8 | 9 | 8 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 8 | 8 | 8 | 8 | 9 | 9 | 9 |
| | ROG | 1,017 | 1,046 | 1,268 | 1,289 | 1,384 | 1,507 | 1,350 | 1,134 | 1,032 | 1,076 | 1,112 | 1,156 | 1,117 | 1,200 | 1,220 | 1,295 | 1,386 | 1,405 | 1,365 | 1,499 | 1,514 | 1,488 |
| | CO2e | 708,343 | 724,467 | 836,506 | 834,869 | 806,541 | 866,396 | 739,285 | 605,201 | 560,370 | 551,369 | 583,325 | 589,594 | 605,257 | 641,919 | 666,468 | 694,913 | 747,446 | 771,617 | 772,428 | 847,622 | 865,481 | 854,479 |

**12-month Rolling Emissions (tons/yr)**

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ONSITE EMISSIONS (no linears) | CO | - | - | - | - | - | - | - | - | - | - | - | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 23 | 24 | 24 |
| | CO2 | - | - | - | - | - | - | - | - | - | - | - | 4170 | 4119 | 4078 | 3993 | 3923 | 3893 | 3845 | 3861 | 3981 | 4132 | 4281 |
| | CH4 | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | N2O | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | NOx | - | - | - | - | - | - | - | - | - | - | - | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 37 | 38 | 39 | 40 |
| | PM10 - comb + fug | - | - | - | - | - | - | - | - | - | - | - | 26.4 | 25.0 | 23.6 | 22.1 | 20.6 | 19.1 | 17.5 | 16.0 | 15.9 | 15.9 | 15.9 |
| | PM2.5 - comb + fug | - | - | - | - | - | - | - | - | - | - | - | 5.7 | 5.4 | 5.2 | 5.0 | 4.7 | 4.5 | 4.2 | 4.0 | 3.9 | 3.9 | 3.9 |
| | SO2 | - | - | - | - | - | - | - | - | - | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ROG | - | - | - | - | - | - | - | - | - | - | - | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 8 |
| | CO2e | - | - | - | - | - | - | - | - | - | - | - | 4203 | 4152 | 4110 | 4025 | 3955 | 3926 | 3878 | 3895 | 4016 | 4169 | 4320 |

Construction days per month: 22

ONSITE EMISSIONS (no linears)

| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4,903 | 5,250 | 5,061 | 4,949 | 4,808 | 5,185 | 5,206 | 4,968 | 4,840 | 4,426 | 4,305 | 4,173 | 3,853 | 3,464 | 3,485 | 3,662 | 3,384 | 2,860 | 2,484 | 2,407 | 1,437 | 1,437 | 1,338 | 939 | 800 | 726 | 510 |
| CO | 880,652 | 936,225 | 916,053 | 881,339 | 845,114 | 910,216 | 901,616 | 849,028 | 809,862 | 732,331 | 709,759 | 688,585 | 628,670 | 573,042 | 569,938 | 595,888 | 557,441 | 469,766 | 397,598 | 384,283 | 222,503 | 222,493 | 201,234 | 150,808 | 129,251 | 116,660 | 84,708 |
| CO2 | 104 | 111 | 106 | 103 | 100 | 106 | 105 | 100 | 96 | 88 | 85 | 82 | 76 | 66 | 66 | 69 | 63 | 51 | 46 | 45 | 30 | 30 | 30 | 18 | 15 | 14 | 9 |
| CH4 | 20 | 21 | 21 | 20 | 19 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 13 | 12 | 12 | 12 | 12 | 10 | 8 | 8 | 5 | 5 | 4 | 3 | 3 | 2 | 2 |
| N2O | 8,056 | 8,590 | 8,374 | 8,080 | 7,745 | 8,382 | 8,324 | 7,837 | 7,482 | 6,761 | 6,557 | 6,354 | 5,780 | 5,241 | 5,238 | 5,511 | 5,159 | 4,367 | 3,691 | 3,595 | 2,058 | 2,058 | 1,870 | 1,383 | 1,188 | 1,074 | 795 |
| NOx | 2,900.4 | 2,995.6 | 3,069.7 | 3,027.4 | 3,109.9 | 3,540.1 | 3,583.2 | 3,557.7 | 3,552.7 | 3,275.3 | 3,250.5 | 3,178.1 | 3,054.8 | 3,023.9 | 2,978.5 | 2,968.0 | 2,778.9 | 2,419.1 | 2,155.7 | 1,983.3 | 1,443.5 | 1,443.0 | 1,324.0 | 1,211.0 | 1,093.6 | 1,061.2 | 889.1 |
| PM10 - comb + fug | 709.6 | 750.1 | 740.3 | 726.1 | 720.0 | 842.0 | 849.9 | 825.1 | 813.0 | 705.3 | 693.1 | 674.6 | 629.5 | 595.9 | 593.8 | 610.4 | 569.9 | 489.1 | 427.5 | 405.8 | 264.6 | 264.5 | 243.4 | 200.3 | 177.4 | 168.0 | 134.1 |
| PM2.5 - comb + fug | 10 | 10 | 10 | 10 | 9 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 4 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| SO2 | 1,574 | 1,715 | 1,669 | 1,630 | 1,589 | 1,693 | 1,688 | 1,625 | 1,586 | 1,480 | 1,444 | 1,415 | 1,322 | 1,130 | 1,143 | 1,181 | 1,084 | 911 | 783 | 770 | 458 | 458 | 438 | 304 | 257 | 228 | 172 |
| ROG | 889,059 | 945,130 | 924,702 | 889,662 | 853,056 | 918,660 | 909,963 | 856,806 | 817,263 | 739,019 | 716,209 | 694,806 | 634,294 | 578,153 | 575,014 | 601,197 | 562,328 | 473,842 | 401,124 | 387,689 | 224,549 | 224,539 | 203,152 | 152,170 | 130,393 | 117,693 | 85,447 |
| CO2e | | | | | | | | | | | | | | | | | | | | | | | | | | | |

ONSITE EMISSIONS (no linears)

| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 39 | 38.98 | 38.19 | 37.00 | 36 | 35 | 33 | 33 | 32 | 31 | 30 | 29 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 20 | 18 | 17 | 15 | 14 | 12 | 11 |
| CO | 7012 | 7066 | 6900 | 6676 | 6421 | 6198 | 5942 | 5809 | 5659 | 5439 | 5235 | 5030 | 4904 | 4723 | 4550 | 4407 | 4263 | 4043 | 3791 | 3559 | 3265 | 3010 | 2756 | 2487 | 2237 | 2009 | 1766 |
| CO2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CH4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N2O | 64 | 64 | 63 | 61 | 59 | 57 | 55 | 53 | 52 | 50 | 48 | 46 | 45 | 43 | 42 | 41 | 39 | 37 | 35 | 33 | 30 | 28 | 25 | 23 | 21 | 19 | 16 |
| NOx | 18.8 | 19.0 | 18.9 | 18.7 | 18.5 | 18.7 | 18.8 | 19.1 | 19.3 | 19.4 | 19.5 | 19.5 | 19.6 | 19.6 | 19.6 | 19.5 | 19.4 | 18.8 | 18.1 | 17.3 | 16.3 | 15.3 | 14.4 | 13.4 | 12.4 | 11.4 | 10.4 |
| PM10 - comb + fug | 5.3 | 5.3 | 5.2 | 5.1 | 4.9 | 4.9 | 4.8 | 4.8 | 4.8 | 4.7 | 4.6 | 4.5 | 4.5 | 4.4 | 4.3 | 4.3 | 4.2 | 4.0 | 3.8 | 3.6 | 3.3 | 3.1 | 2.9 | 2.6 | 2.4 | 2.2 | 2.0 |
| PM2.5 - comb + fug | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SO2 | 12.20 | 12.25 | 12.05 | 11.74 | 11.42 | 11.14 | 10.80 | 10.59 | 10.39 | 10.08 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 4 |
| ROG | 7071 | 7126 | 6960 | 6735 | 6479 | 6255 | 5998 | 5864 | 5712 | 5490 | 5284 | 5077 | 4950 | 4766 | 4591 | 4447 | 4302 | 4079 | 3825 | 3590 | 3294 | 3037 | 2780 | 2509 | 2257 | 2027 | 1782 |
| CO2e | | | | | | | | | | | | | | | | | | | | | | | | | | | |

ONSITE EMISSIONS (no linears)

| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4,903 | 5,250 | 5,061 | 4,949 | 4,808 | 5,185 | 5,206 | 4,968 | 4,840 | 4,426 | 4,305 | 4,173 | 3,853 | 3,464 | 3,485 | 3,662 | 3,384 | 2,860 | 2,484 | 2,407 | 1,437 | 1,437 | 1,338 | 939 | 800 | 726 | 510 |
| CO | 880,652 | 936,225 | 916,053 | 881,339 | 845,114 | 910,216 | 901,616 | 849,028 | 809,862 | 732,331 | 709,759 | 688,585 | 628,670 | 573,042 | 569,938 | 595,888 | 557,441 | 469,766 | 397,598 | 384,283 | 222,503 | 222,493 | 201,234 | 150,808 | 129,251 | 116,660 | 84,708 |
| CO2 | 104 | 111 | 106 | 103 | 100 | 106 | 105 | 100 | 96 | 88 | 85 | 82 | 76 | 66 | 66 | 69 | 63 | 51 | 46 | 45 | 30 | 30 | 30 | 18 | 15 | 14 | 9 |
| CH4 | 20 | 21 | 21 | 20 | 19 | 20 | 20 | 18 | 17 | 16 | 15 | 15 | 13 | 12 | 12 | 12 | 12 | 10 | 8 | 8 | 5 | 5 | 4 | 3 | 3 | 2 | 2 |
| N2O | 8,056 | 8,590 | 8,374 | 8,080 | 7,745 | 8,382 | 8,324 | 7,837 | 7,482 | 6,761 | 6,557 | 6,354 | 5,780 | 5,241 | 5,238 | 5,511 | 5,159 | 4,367 | 3,691 | 3,595 | 2,058 | 2,058 | 1,870 | 1,383 | 1,188 | 1,074 | 795 |
| NOx | 2,900.4 | 2,995.6 | 3,069.7 | 3,027.4 | 3,109.9 | 3,540.1 | 3,583.2 | 3,557.7 | 3,552.7 | 3,275.3 | 3,250.5 | 3,178.1 | 3,054.8 | 3,023.9 | 2,978.5 | 2,968.0 | 2,778.9 | 2,419.1 | 2,155.7 | 1,983.3 | 1,443.5 | 1,443.0 | 1,324.0 | 1,211.0 | 1,093.6 | 1,061.2 | 889.1 |
| PM10 - comb + fug | 709.6 | 750.1 | 740.3 | 726.1 | 720.0 | 842.0 | 849.9 | 825.1 | 813.0 | 705.3 | 693.1 | 674.6 | 629.5 | 595.9 | 593.8 | 610.4 | 569.9 | 489.1 | 427.5 | 405.8 | 264.6 | 264.5 | 243.4 | 200.3 | 177.4 | 168.0 | 134.1 |
| PM2.5 - comb + fug | 10 | 10 | 10 | 10 | 9 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 4 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| SO2 | 1,574 | 1,715 | 1,669 | 1,630 | 1,589 | 1,693 | 1,688 | 1,625 | 1,586 | 1,480 | 1,444 | 1,415 | 1,322 | 1,130 | 1,143 | 1,181 | 1,084 | 911 | 783 | 770 | 458 | 458 | 438 | 304 | 257 | 228 | 172 |
| ROG | 889,059 | 945,130 | 924,702 | 889,662 | 853,056 | 918,660 | 909,963 | 856,806 | 817,263 | 739,019 | 716,209 | 694,806 | 634,294 | 578,153 | 575,014 | 601,197 | 562,328 | 473,842 | 401,124 | 387,689 | 224,549 | 224,539 | 203,152 | 152,170 | 130,393 | 117,693 | 85,447 |
| CO2e | | | | | | | | | | | | | | | | | | | | | | | | | | | |

ONSITE EMISSIONS (no linears)

| | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | 26.09 | 26.88 | 27.47 | 28 | 29 | 29 | 29 | 30 | 29 | 29 | 29 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 20 | 18 | 17 | 15 | 14 | 12 | 11 |
| CO | 4433 | 4608 | 4766 | 4889 | 4981 | 5092 | 5172 | 5215 | 5237 | 5183 | 5109 | 5030 | 4904 | 4723 | 4550 | 4407 | 4263 | 4043 | 3791 | 3559 | 3265 | 3010 | 2756 | 2487 | 2237 | 2009 | 1766 |
| CO2 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CH4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N2O | 41 | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 48 | 48 | 47 | 46 | 45 | 43 | 42 | 41 | 39 | 37 | 35 | 33 | 30 | 28 | 25 | 23 | 21 | 19 | 16 |
| NOx | 16.1 | 16.4 | 16.6 | 16.8 | 17.0 | 17.5 | 17.9 | 18.4 | 18.8 | 19.1 | 19.3 | 19.5 | 19.6 | 19.6 | 19.6 | 19.5 | 19.4 | 18.8 | 18.1 | 17.3 | 16.3 | 15.3 | 14.4 | 13.4 | 12.4 | 11.4 | 10.4 |
| PM10 - comb + fug | 3.9 | 4.0 | 4.0 | 4.1 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.4 | 4.3 | 4.3 | 4.2 | 4.0 | 3.8 | 3.6 | 3.3 | 3.1 | 2.9 | 2.6 | 2.4 | 2.2 | 2.0 |
| PM2.5 - comb + fug | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SO2 | 8.11 | 8.39 | 8.66 | 8.88 | 9.06 | 9.26 | 9.41 | 9.52 | 9.64 | 9.63 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 4 |
| ROG | 4473 | 4651 | 4811 | 4935 | 5028 | 5140 | 5221 | 5264 | 5286 | 5232 | 5157 | 5077 | 4950 | 4766 | 4591 | 4447 | 4302 | 4079 | 3825 | 3590 | 3294 | 3037 | 2780 | 2509 | 2257 | 2027 | 1782 |
| CO2e | | | | | | | | | | | | | | | | | | | | | | | | | | | |

### Emission Factors for Onroad Vehicles

| ONSITE - 5 MPH | | | | | | | EF (lbs/mile) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onroad Vehicle | Fuel Type | Vehicle Type | Daily Vehicle Count | Round Trip Distance (miles/vehicle/day) | Trips per day | VMT (Daily Total) | TOC | CO | NOx | $PM_{10}$ | $SO_2$ | $PM_{2.5}$ | $CO_2$ | $N_2O$ | $CH_4$ | $CO_2e$ |
| Personal Commuting Vehicles | G/D | LDA/ LDT | | 0.2 | 1 | - | 0.0012 | 0.0154 | 0.0012 | 0.0002 | 2.43E-05 | 0.0001 | 2.57E+00 | 9.55E-05 | 1.90E-04 | 2.604 |
| Light delivery truck (e.g. Fed-Ex) | D | LHDT | 10 | 0.5 | 1 | 5 | 0.0011 | 0.0073 | 0.0174 | 0.0003 | 1.10E-05 | 0.0003 | 1.16E+00 | 6.61E-05 | 2.20E-05 | 1.178 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | D | HHDT | 50 | 1 | 1 | 50 | 0.0271 | 0.0434 | 0.1010 | 0.0063 | 8.16E-05 | 0.0057 | 8.48E+00 | 1.10E-04 | 1.76E-04 | 8.515 |
| Import Fill Trucks - gravel | D | HHDT | 160 | 1 | 1 | 160 | 0.0271 | 0.0434 | 0.1010 | 0.0063 | 0.0001 | 0.0057 | 8.4774 | 0.0001 | 0.0002 | 8.5153 |
| Import Fill Trucks - dirt | D | HHDT | 160 | 0.5 | 1 | 80 | 0.0271 | 0.0434 | 0.1010 | 0.0063 | 0.0001 | 0.0057 | 8.4774 | 0.0001 | 0.0002 | 8.5153 |

| OFFSITE - 50 MPH | | | | | | | EF (lbs/mile) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onroad Vehicle | Fuel Type | Vehicle Type | Daily Vehicle Count | Round Trip Distance (miles/vehicle/day) | Trips per day | VMT (Daily Total) | TOC | CO | NOx | $PM_{10}$ | $SO_2$ | $PM_{2.5}$ | $CO_2$ | $N_2O$ | $CH_4$ | $CO_2e$ |
| Personal Commuting Vehicles | G/D | LDA/ LDT | | 39.8 | 1 | - | 0.0002 | 0.0065 | 0.0008 | 0.0001 | 7.72E-06 | 0.0000 | 8.04E-01 | 9.55E-05 | 1.90E-04 | 0.838 |
| Light delivery truck (e.g. Fed-Ex) | D | LHDT | 10 | 39.5 | 1 | 395 | 0.0003 | 0.0013 | 0.0116 | 0.0001 | 1.10E-05 | 0.0001 | 1.16E+00 | 6.61E-05 | 2.20E-05 | 1.178 |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | D | HHDT | 50 | 39.0 | 1 | 1950 | 0.0017 | 0.0076 | 0.0377 | 0.0014 | 3.53E-05 | 0.0012 | 3.68E+00 | 1.10E-04 | 1.76E-04 | 3.721 |
| Import Fill Trucks | D | HHDT | 160 | 38 | 1 | 6080 | 0.0017 | 0.0076 | 0.0377 | 0.0014 | 0.0000 | 0.0012 | 3.6832 | 0.0001 | 0.0002 | 3.7210 |

Onsite distance for worker vehicles based on parking areas of 100m x 250 m. Assume average one way trip is 175m, round trip of 350 m, or 0.22 miles.
Emission factors from EMFAC2007 (version 2.3) for year 2010
Emission factors for personal commuting vehicles are based on the assumption 50% LDA and 50% LDT
$CH_4$ and $N_2O$ emission factor for personal commuting vehicles is based on the average factor for gasoline and diesel passenger vehicles from CCAR, GRP Version 3.0, Table C.5
$CH_4$ and $N_2O$ emission factor for light delivery trucks is based on the factor for diesel light duty trucks from CCAR, GRP Version 3.0, Table C.5
$CH_4$ and $N_2O$ emission factor for heavy duty tucks is based on the factor for diesel heavy duty trucks from CCAR, GRP Version 3.0, Table C.5

| Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of Worker/ Day | 34 | 59 | 79 | 101 | 149 | 188 | 224 | 301 | 335 | 403 | 500 | 559 | 663 | 777 | 935 | 1057 | 1154 | 1224 | 1289 | 1366 | 1432 | 1603 | 1723 | 1853 |
| Avg Daily Vehicles/ Day | 26 | 45 | 60 | 78 | 114 | 145 | 173 | 232 | 258 | 310 | 385 | 430 | 510 | 598 | 720 | 813 | 887 | 942 | 992 | 1051 | 1102 | 1233 | 1325 | 1425 |
| Light delivery trucks | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Heavy delivery trucks | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Import fill trucks | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 1993 | 2192 | 2347 | 2423 | 2437 | 2461 | 2425 | 2403 | 2295 | 2172 | 2104 | 1912 | 1850 | 1570 | 1276 | 1011 | 688 | 549 | 548 | 548 | 507 | 430 | 394 | 297 |
| 1516 | 1533 | 1686 | 1805 | 1864 | 1874 | 1893 | 1865 | 1848 | 1765 | 1671 | 1618 | 1471 | 1423 | 1208 | 982 | 778 | 529 | 422 | 422 | 422 | 390 | 331 | 303 | 228 |
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Number of workers per commuter vehicle = 1.3
Actual worker schedule data updated 4/3/12 with data from Table 2-28 HECA Manpower R5 04 02 12.xls
Vehicle occupancy rate is based on information from Section 2.0 Project Description.

**Assumptions:**
Assumed average distance traveled off site for all employees commuting will be 20 miles
times 2 for return trip = 40 miles
22 days per month of construction, average

$CO_2$ GWP (SAR, 1996) = 1
$CH_4$ GWP (SAR, 1996) = 21
$N_2O$ GWP (SAR, 1996) = 310

(2) grams to pounds conversion = 0.00220459

## Onsite Fugitive Dust Emissions

ASSUMPTIONS:
1 month of dirt moving
22 construction days per month
10 construction hours per day

### Dirt Piling or Material Handling

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ — USEPA AP42 Chapter 13.2.4 (Aggregate Handling And Storage Piles)

0.35 k for $PM_{10}$
0.053 k for $PM_{2.5}$
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
0.00006 lb of $PM_{10}$/ ton of material
0.00001 lb of $PM_{2.5}$/ ton of material

| MATERIAL HANDLED (tons/day) | Mitigation Efficiency[1] | MONTH: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # pieces of equip: | 4 | 4 | 6 | 7 | 7 | 9 | 9 | 12 | 12 | 12 | 12 | 10 |
| Bob cat loader | 67% | tons/day material handled: | 0 | 0 | 3,017 | 2,586 | 2,586 | 2,011 | 2,011 | 6,034 | 6,034 | 6,034 | 6,034 | 7,241 |
| Excavator - Trencher (CAT320) | 67% | | 0 | 0 | 0 | 0 | 0 | 4,023 | 4,023 | 3,017 | 3,017 | 3,017 | 3,017 | 3,620 |
| Excavator - Backhoe/loader | 67% | | 9,051 | 9,051 | 9,051 | 10,344 | 10,344 | 8,045 | 8,045 | 6,034 | 6,034 | 6,034 | 6,034 | 3,620 |
| Excavator - loader | 67% | | 9,051 | 9,051 | 6,034 | 5,172 | 5,172 | 4,023 | 4,023 | 3,017 | 3,017 | 3,017 | 3,017 | 3,620 |
| | | TOTAL material handled | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 |

| MATERIAL HANDLED (tons/day) | MONTH: | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # pieces of equip: | 8 | 8 | 7 | 7 | 4 | 4 | 3 | 3 | 3 | 3 | 3 |
| Bob cat loader | | 6,788 | 6,788 | 7,758 | 7,758 | 13,577 | 13,577 | 12,068 | 12,068 | 12,068 | 12,068 | 12,068 |
| Excavator - Trencher (CAT320) | | 4,526 | 4,526 | 5,172 | 5,172 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Excavator - Backhoe/loader | | 4,526 | 4,526 | 5,172 | 5,172 | 4,526 | 4,526 | 6,034 | 6,034 | 6,034 | 6,034 | 6,034 |
| Excavator - loader | | 2,263 | 2,263 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | TOTAL material handled | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 |

| 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 |
| 12,068 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,034 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12,068 |
| 0 | 0 | 0 | 0 | 18,102 | 18,102 | 18,102 | 18,102 | 0 | 0 | 0 | 0 | 0 |
| 18,102 | 0 | 0 | 0 | 18,102 | 18,102 | 18,102 | 18,102 | 0 | 0 | 0 | 0 | 18,102 |

| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 4 | 4 | 3 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,034 | 4,526 | 4,526 | 6,034 | 9,051 | 9,051 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12,068 | 9,051 | 9,051 | 6,034 | 9,051 | 9,051 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 4,526 | 4,526 | 6,034 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 18,102 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Do not include capacity factor because emissions are based on material handled, not hours of operation.

15,341 $yd^3$/day — 18,102 ton/day — 2,360 density of soil ($lb/yd^3$)
337,500 $yd^3$ — 398,250 tons — (USDA NRCS Physical Soil Properties from Kern County for Lockern-Buttonwillow clay)

Excavation 850,000 Cubic yds
Imported Fill 500,000 Cubic yds (assume 25% of entire site in any given month)

### Grading Emissions Factor

To be used for all scraping and grading activities

$E = 0.051(S)^{2.0}$ for particles ≤ 15 um — USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 0.040(S)^{2.5}$ for TSP ≤ 30 um — USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

multiply by 0.60 for $PM_{10}$
multiply TSP equation by 0.031 for $PM_{2.5}$
S = mean vehicle speed (mph)
S = 4.0 mph
1.28 lb ≤ 30 µm/VMT
0.82 lb ≤ 15 µm/VMT
$PM_{10}$ = 0.49 lb $PM_{10}$/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

| Equipment | Daily VMT | Mitigation Efficiency[1] | PM10 Emissions (lb/day) | PM2.5 Emissions (lb/day) |
|---|---|---|---|---|
| Excavator - Earth Scraper 637 | 0.7 | 67% | 0.113 | 0.009 |
| Excavator - Motor Grader (CAT140H) | 0.7 | 67% | 0.113 | 0.009 |
| | | **Total** | **0.23** | **0.02** |

Formula based on lbs per VMT, not hours, so no capacity factor included.

### Bulldozing/Earth clearing

$E = 1.0(s)^{1.5}/(M)^{1.4}$ for particles ≤ 15 um — USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 5.7(s)^{1.2}/(M)^{1.3}$ for TSP ≤ 30 um — USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1, 11.9-3

multiply by 0.75 for $PM_{10}$
multiply TSP equation by 0.105 for $PM_{2.5}$
50 s = Silt content (%) (from soil boring B-4)
19 M = Moisture content of surface material (%) (average of soil borings taken onsite at 5 ft)
4.30 lb/hr of PM10
1.42 lb/hr of PM2.5

| Equipment | Hours per day | Capacity Factor | Mitigation Efficiency[1] | PM10 Emissions (lb/hr) | PM10 Emissions (lb/day) | PM2.5 Emissions (lb/hr) | PM2.5 Emissions (lb/day) |
|---|---|---|---|---|---|---|---|
| Bulldozer D10R | 10 | 59.0% | 67% | 1.42 | 8.37 | 0.47 | 2.77 |
| Bulldozer D6C | 10 | 59.0% | 67% | 1.42 | 8.37 | 0.47 | 2.77 |
| | | | **Total** | **2.84** | **16.74** | **0.94** | **5.54** |

### Cover Storage Pile

SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre
50 G = Silt content (%) (from soil boring B-4)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height (wind speed percentage and average based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station)
0.5 J = Fraction of TSP that is $PM_{10}$ = 0.5
0.791 lb/acre/day

| Source | Quantity | Size of Pile (acre) | Hours/Day | Mitigation Efficiency[1] | PM10 Emissions (lb/hr) | PM10 Emissions (lb/day) | PM2.5 Emissions (lb/hr) | PM2.5 Emissions (lb/day) |
|---|---|---|---|---|---|---|---|---|
| Cover Storage Pile | 25 | 0.25 | 24 | 67% | 0.07 | 1.63 | 0.014 | 0.339 |

Pile size and number are assumed

**Travel on unpaved roads**

E = k * (s/12)^a * (W/3)^b     USEPA AP42 Chapter 13.2.2 (Unpaved Roads)

Size specific emission factor for vehicle travel on unpaved roads at industrial sites (eqn 1a; lb/VMT)

| Constants: | PM2.5 | PM10 | TSP |
|---|---|---|---|
| k (lb/VMT) | 0.15 | 1.5 | 4.9 |
| a | 0.9 | 0.9 | 0.7 |
| b | 0.45 | 0.45 | 0.45 |

4 s = Surface material silt content (%) (value for gravel road)
50 s = Surface material silt content (%) (value for dirt surfaces)
value listed in table W = Mean vehicle weight (ton)

| Vehicle Type | Mean Vehicle Weight (tons)[2] | PM2.5 EF (lbs/VMT) | PM10 EF (lbs/VMT) | Mitigation Efficiency[1] | If weight = 0, where is source included |
|---|---|---|---|---|---|
| 18 cy fill mat'l haul truck | 30 | 0.16 | 1.57 | 67% | |
| Bus | 15 | 0.12 | 1.15 | 67% | |
| Concrete Pumper Truck | 30 | 0.16 | 1.57 | 67% | |
| Dump Truck | 15 | 0.12 | 1.15 | 67% | |
| Diesel Tractor (Yard Dog) | 11 | 0.10 | 1.00 | 67% | |
| Service Truck - 1 ton | 15 | 0.12 | 1.15 | 67% | |
| Pile Driver Truck | 15 | 0.12 | 1.15 | 67% | |
| Truck - Fuel/Lube | 15 | 0.12 | 1.15 | 67% | |
| Tractor Truck 5th Wheel | 11 | 0.10 | 1.00 | 67% | |
| Trucks - Pickup 3/4 ton | 3 | 0.06 | 0.56 | 67% | |
| Trucks - 3 ton | 11 | 0.10 | 1.00 | 67% | |
| Truck - Water | 25 | 0.14 | 1.45 | 67% | |
| Air Compressor 185 CFM | 0.5 | 0.02 | 0.25 | 67% | |
| Air Compressor 750 CFM | 0.5 | 0.02 | 0.25 | 67% | |
| Articulating Boom Platform | 5 | 0.07 | 0.70 | 67% | |
| Bob cat loader | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Bulldozer D10R | 0 | 0.00 | 0.00 | 67% | Bulldozing/earth clearing |
| Bulldozer D6C | 0 | 0.00 | 0.00 | 67% | Bulldozing/earth clearing |
| Concrete Trowel Machine | 15 | 0.12 | 1.15 | 67% | |
| Concrete Vibrators | 0.25 | 0.02 | 0.18 | 67% | |
| Cranes - Mobile 35 ton | 25 | 0.14 | 1.45 | 67% | |
| Cranes - Mobile 45 ton | 35 | 0.17 | 1.69 | 67% | |
| Crane - Mobile 65 ton | 45 | 0.19 | 1.89 | 67% | |
| Cranes 100 / 150 ton cap | 50 | 0.20 | 1.98 | 67% | |
| Diesel Powered Welder | 0.5 | 0.02 | 0.25 | 67% | |
| Excavator - Backhoe/loader | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Excavator - Earth Scraper 637 | 0 | 0.00 | 0.00 | 67% | Grading |
| Excavator - loader | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Excavator - Motor Grader (CAT140H) | 0 | 0.00 | 0.00 | 67% | Grading |
| Excavator - Trencher (CAT320) | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Fired Heaters (2,000 BTU) | 0.25 | 0.02 | 0.18 | 67% | |
| Forklift | 10 | 0.10 | 0.96 | 67% | |
| Fusion Welder | 0.25 | 0.02 | 0.18 | 67% | |
| Heavy Haul / 600 tn Crane | 75 | 0.24 | 2.38 | 67% | |
| Heavy Haul / 1,000 tn Crane | 75 | 0.24 | 2.38 | 67% | |
| Light Plants | 0.5 | 0.02 | 0.25 | 67% | |
| Man lifts - telescoping | 7 | 0.08 | 0.82 | 67% | |
| Man lift - scissor | 2.5 | 0.05 | 0.51 | 67% | |
| Portable Compaction Roller | 3 | 0.06 | 0.56 | 67% | |
| Portable Compaction - Vibratory Plate | 0.1 | 0.01 | 0.12 | 67% | |
| Portable Compaction - Ram | 0.25 | 0.02 | 0.18 | 67% | |
| Pumps | 0.1 | 0.01 | 0.12 | 67% | |
| Portable Power Generators | 0.5 | 0.02 | 0.25 | 67% | |
| Truck Crane - Greater than 200 ton | 50 | 0.20 | 1.98 | 67% | |
| Truck Crane - Greater than 300 ton | 60 | 0.21 | 2.15 | 67% | |
| Vibratory Roller Ingersol-Rand 20 ton | 20 | 0.13 | 1.31 | 67% | |
| worker personal vehicles | 1.6 | 0.04 | 0.42 | 67% | |
| Light delivery truck (e.g. Fed-Ex) | 9 | 0.09 | 0.91 | 67% | |
| Heavy delivery truck (e.g. flat beds carrying construction eqp) | 17.5 | 0.12 | 1.23 | 67% | |
| Import Fill Trucks - gravel | 25 | 0.14 | 1.45 | 67% | |
| Import Fill Trucks - dirt | 25 | 1.41 | 14.07 | 96% | |

| Mitigation Measure[1] | Unpaved Roads | Soil import areas[3] |
|---|---|---|
| Apply water three times daily to all unpaved road surfaces[4] | 45% | 85% |
| Traffic speeds on all unpaved roads to be reduced to 15 mph or less[5] | 40% | 70% |
| **Combined Mitigation Efficiency** | **67%** | **96%** |

**Notes:**

1. Mitigation efficiencies from CEQA Table 11-4 (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for $PM_{10}$ Emissions - Constrution.")
2. Equipment weight from SCAQMD Table A9-9-D-3 and various websites.
3. Because the areas where soil is being imported are known to be subject to large amounts of fugitive emissions, extra care will be taken to keep the area watered and speeds extremely low. Thus, the upper value of the efficiency range has been assumed.
4. Water trucks operate at least 4 times per day.
5. Assumed maximum travel speed is 5 mph.

## Off-Site Linears Fugitive Dust Emissions

ASSUMPTIONS:
12 months of soil disturbance
10 total construction hours per work day
22 construction days per month

**Dirt Piling or Material Handling**

$E = k * (0.0032) * (U/5)^{1.3} / (M/2)^{1.4}$ PM Emissions from Dirt Piling or Material Handling (lb/ton) from USEPA AP42, Chapter 13.2.4 (Aggregate Handling and Storage Piles)

0.053 k for PM2.5
0.35 k for PM10
6.25 U = Mean Wind speed (mph) average for Bakersfield Airport 2000-2004
15 M = Moisture content of surface material (%) (from SCAQMD Table A9-9-G-1 for moist dirt)
0.00001 lb of $PM_{2.5}$/ ton of material
0.00009 lb of $PM_{10}$/ ton of material

| MATERIAL HANDLED (tons/day) | Mitigation Efficiency[1] | MONTH: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | # pieces of equip: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Backhoe | 67% | tons/day material handled: | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Excavator | 67% | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CAT 325 BACKHOE | 67% | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CAT 330 BACKHOE | 67% | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CAT DOZER D-6 | 67% | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CAT RUBBER TIRE LOADER 966 | 67% | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | TOTAL material handled | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 7 | 14 | 14 | 14 | 13 | 14 | 11 | 11 | 11 | 7 | 7 | 0 |
| 5454 | 4675 | 3896 | 3896 | 3896 | 4195 | 3896 | 4958 | 4958 | 4958 | 4675 | 4675 | 0 |
| 0 | 779 | 390 | 390 | 390 | 420 | 390 | 496 | 496 | 496 | 779 | 779 | 0 |
| 0 | 0 | 390 | 390 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 390 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 779 | 779 | 0 | 0 | 390 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 779 | 839 | 779 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 5454 | 0 |

| 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Disturbed Acreage**

| | Length (miles) | ROW width (ft) | Area (ft2) | Area (acres) |
|---|---|---|---|---|
| Electrical transmission line | 2.1 | 100 | 1108800 | 25.45 |
| Natural gas linear | 13 | 50 | 3432000 | 78.78 |
| Process water pipeline | 14.4 | 50 | 3801600 | 87.27 |
| $CO_2$ pipeline | 3.4 | 50 | 897600 | 20.61 |
| Potable water pipeline | 1.2 | 10 | 63360 | 1.45 |
| Railway | 5.3 | 60 | 1679040 | 38.54 |
| | | | TOTAL: | **252.11** |

miles to feet conversion: 5280 ft/mile
ft2 to acres conversion: 0.000022956 acre / ft2

Sources:
Lengths: email from William Becktel, 3/26/12
ROW Width: Table 2-01 March 20 from Fluor.doc

Assume tons/day of material is evenly split among the number of pieces of equipment operating in a given month.
Do not include capacity factor because emissions are based on material handled, not hours of operation.

4622 $yd^3$/day 5454 ton/day
1,220,222 $yd^3$ 1,439,862 tons 2360 density of soil ($lb/yd^3$)
(USDA NRCS Physical Soil Properties from Kern County Lockern-Buttonwillow clay soil)
252.11 acres = 1,220,222 cubic yds, assume depth of soils moved is 1 yd

**Grading Emissions Factor** To be used for all scraping and grading activities

$E = 0.051(S)^{2.0}$ for particles ≤ 15 um USEPA AP42 Chapter 13.2.3 (Heavy Construction Operations), Table 13.2.3-1 - refers to
$E = 0.040(S)^{2.5}$ for TSP ≤ 30 um USEPA AP42 Chapter 11.9 (Western Surface Coal Mining), Table 11.9-1

multiply by 0.60 for $PM_{10}$
multiply TSP equation by 0.031 for $PM_{2.5}$
S = mean vehicle speed (mph)

S = 4.0 mph
1.28 lb ≤ 30 μm/VMT
0.82 lb ≤ 15 μm/VMT
$PM_{10}$ = 0.49 lb $PM_{10}$/VMT
$PM_{2.5}$ = 0.04 lb $PM_{2.5}$/VMT

| Equipment | Daily VMT | Mitigation Efficiency[1] | PM10 Emissions (lb/day) | PM2.5 Emissions (lb/day) |
|---|---|---|---|---|
| CAT MODEL 12 MOTOR GRADER | 0.7 | 67% | 0.113 | 0.009 |
| CAT SCRAPER 615 | 0.7 | 67% | 0.113 | 0.009 |
| | | **Total** | **0.23** | **0.02** |

Formula based on lbs per VMT, not hours, so no capacity factor included.

**Storage Piles**
SCAQMD Table A9-9-E
E = 1.7 * G/1.5 * (365-H)/235 * I/15 * J
PM10 Emission factor from wind erosion of storage piles per day per acre

50 G = Silt content (%) (from Geotechnical Investigaion, AFC Appendix P)
37 H = Mean number of days per year with at least 0.01 inches of precipitation (from WRCC for Bakersfield Airport Station)
0.3 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height (based on 2000-04 (5 yrs) of wind speed data as recorded at Bakersfield Airport station)
0.5 J = Fraction of TSP that is $PM_{10}$ = 0.5
0.791 lb/acre/day

| Source | Quantity | Size of Pile (acre) | Mitigation Efficiency[1] | $PM_{10}$ Emissions (lbs/day) | $PM_{2.5}$ Emissions (lbs/day) |
|---|---|---|---|---|---|
| Storage Piles | 8 | 0.25 | 67% | 0.52 | 0.109 |

Pile size and number are assumed
Days per year accounts for weekend days also, not just work days
Assume PM2.5 is 20.8% of PM10

**Travel on unpaved roads**
E = k * (s/12)^a * (W/3)^b — USEPA AP42 Chapter 13.2.2 (Unpaved Roads)
Size specific emission factor for vehicle travel on unpaved roads at industrial sites (eqn 1a; lb/VMT)

| Constants: | PM2.5 | PM10 | TSP |
|---|---|---|---|
| k (lb/VMT) | 0.15 | 1.5 | 4.9 |
| a | 0.9 | 0.9 | 0.7 |
| b | 0.45 | 0.45 | 0.45 |

4 s = Surface material silt content (%) (value for gravel road)
value listed in table W = Mean vehicle weight (ton)

| Vehicle Type | Round Trips /Day/ Unit | Round Trip Distance on Dirt Surface (mile) | Mean Vehicle Weight (tons)[2] | PM2.5 EF (lbs/VMT) | $PM_{10}$ EF (lbs/VMT) | Mitigation Efficiency[1] | If weight = 0, where is source included |
|---|---|---|---|---|---|---|---|
| **ON ROAD** | | | | | | | |
| Dump Truck | 4 | 0.25 | 17 | 0.12 | 1.22 | 67% | |
| Service Truck (MHD-DSL) | 1 | 0.125 | 4 | 0.06 | 0.64 | 67% | |
| Pipe Haul Truck and Trailer (HHDT-DSL) | | | 15 | 0.12 | 1.15 | 67% | |
| Truck (Pickup 3/4 Ton) - MHD-DSL | 2 | 0.25 | 1 | 0.03 | 0.34 | 67% | |
| Truck - water | 4 | 0.25 | 25 | 0.14 | 1.45 | 67% | |
| **OFF ROAD** | | | | | | | |
| Air Compressor | 0 | | | 0.00 | 0.00 | 67% | |
| Bore Machine (Hydraulic) | 0 | | | 0.00 | 0.00 | 67% | |
| Crane | 1 | 0.25 | 12 | 0.10 | 1.04 | 67% | |
| Backhoe | 0 | | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Excavator | 1 | 0.25 | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| Forklift | 4 | 0.25 | 10 | 0.10 | 0.96 | 67% | |
| Welding Generator | 0 | | | 0.00 | 0.00 | 67% | |
| Roller | 4 | 0.25 | 20 | 0.13 | 1.31 | 67% | |
| Pipe Bending Machine | 0 | | | 0.00 | 0.00 | 67% | |
| **RAIL** | | | | | | | |
| AIR COMPRESSOR 185 | 0 | 0 | 1 | 0.03 | 0.34 | 67% | |
| BOOM TRUCK 12 TON | 4 | 0.25 | 12 | 0.10 | 1.04 | 67% | |
| CAT 325 BACKHOE | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| CAT 330 BACKHOE | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| CAT DOZER D-6 | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| CAT MODEL 12 MOTOR GRADER | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Grading |
| CAT ROLLER-COMPACTOR 563 | 4 | 0.25 | 3 | 0.06 | 0.56 | 67% | |
| CAT RUBBER TIRE LOADER 966 | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Dirt piling |
| CAT SCRAPER 615 | 4 | 0.25 | 0 | 0.00 | 0.00 | 67% | Grading |
| CRANE-ROUGH TERRAIN 45T | 4 | 0.25 | 45 | 0.19 | 1.89 | 67% | |
| GENSET 5KW | 0 | 0 | 0.5 | 0.02 | 0.25 | 67% | |
| JOHN DEERE TRACTOR 9400 | 4 | 0.25 | 20 | 0.13 | 1.31 | 67% | |
| PICK-UP CRAFT | 4 | 0.25 | 10 | 0.10 | 0.96 | 67% | |
| PICK-UP OVERHEAD | 4 | 0.25 | 10 | 0.10 | 0.96 | 67% | |
| RAIL BALLAST REGULATOR | 4 | 0.25 | 1 | 0.03 | 0.34 | 67% | |
| RAIL CLIP MACHINE | 4 | 0.25 | 0.3 | 0.02 | 0.20 | 67% | |
| RAIL MOVER-SHUTTLE WAGON | 4 | 0.25 | 27.5 | 0.15 | 1.51 | 67% | |
| RAIL TAMPER | 4 | 0.25 | 27 | 0.15 | 1.50 | 67% | |
| RAIL WELDER | 0 | 0 | 0.5 | 0.02 | 0.25 | 67% | |
| RAMEX WALK BEHIND COMPACTOR | 4 | 0.25 | 0.1 | 0.01 | 0.12 | 67% | |
| TRI-AXLE DUMP TRUCK | 4 | 0.25 | 17 | 0.12 | 1.22 | 67% | |
| TRUCK FLATBED 14 FOOT | 4 | 0.25 | 10 | 0.10 | 0.96 | 67% | |
| TRUCK TRACTOR | 4 | 0.25 | 10 | 0.10 | 0.96 | 67% | |
| WATER TRUCK, 4M ON-ROAD | 4 | 0.25 | 25 | 0.14 | 1.45 | 67% | |
| WELDING MACHINE 350 AMP | 0 | 0 | 0.5 | 0.02 | 0.25 | 67% | |

| Mitigation Measure[1] | Unpaved Roads |
|---|---|
| Apply water three times daily to all unpaved road surfaces[3] | 45% |
| Traffic speeds on all unpaved roads to be reduced to 15 mph or less[4] | 40% |
| **Combined Mitigation Efficiency** | **67%** |

**Notes:**
1. Mitigation efficiencies from CEQA Table 11-4 (South Coast Air Quality Management District, 1993, CEQA Air Quality Handbook, Table 11-4: Mitigation for $PM_{10}$ Emissions - Constrution.")
2. Equipment weight from SCAQMD Table A9-9-D-3 and various websites.
3. Water trucks operate at least 4 times per day.
4. Assumed maximum travel speed is 5 mph.

## Fugitive Dust on Paved Roads

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [ k (sL)^0.91 x (W)^1.02](1-P/4N) equation (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles treaveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)
N = number of days in the averaging period

| | k |
|---|---|
| | **lb/VMT** |
| **PM2.5** | 0.00054 |
| **PM10** | 0.00 |

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

**Heavy Duty Trucks**

| | | | Empty | Full | |
|---|---|---|---|---|---|
| W= | 17.5 | tons, average | 5 | 30 | tons |
| sL= | 0.031 | g/m2 Default value from URBEMIS 9.2 for Kern County | | | |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | | | |

E=
0.00041 lb/VMT PM2.5 large delivery trucks
0.00169 lb/VMT PM10 large delivery trucks

**Light Duty (Delivery) Trucks**

W= 9 tons, average
sL= 0.031 g/m2 Default value from URBEMIS 9.2 for Kern County
P= 36 days/year Buttonwillow Station 1940-2011, WRCC

E=
0.00021 lb/VMT PM2.5 large delivery trucks
0.00086 lb/VMT PM10 large delivery trucks

**Worker Vehicles**

W= 1.6 tons
sL= 0.031 g/m2 Default value from URBEMIS 9.2 for Kern County
P= 36 days/year Buttonwillow Station 1940-2011, WRCC

E=
0.00004 lb/VMT PM2.5 O&M vehicles
0.00015 lb/VMT PM10 O&M vehicles

### Emission Factors for Onsite Equipment

| Equipment Description | EMFAC designation | Horsepower | Source | Capacity Factor[1] | Emission Factors (lbs/hr) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CO | $CO_2$ | $CH_4$ | $N_2O$ | $NO_x$ | $PM_{10}$ | $PM_{2.5}$ | $SO_x$ | ROG[2] | $CO_2e$ |
| **On-Road Vehicles** | | | | | | | | | | | | | | |
| 18 cy fill mat'l haul truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Bus | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Concrete Pumper Truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Dump Truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Diesel Tractor (Yard Dog) | HHD-DSL | | EMFAC | 46.5% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Service Truck - 1 ton | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Pile Driver Truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Truck - Fuel/Lube | MHD-DSL | | EMFAC | 41.0% | 0.155 | 33.180 | 0.0002 | 0.001 | 0.279 | 0.017 | 0.015 | 3.09E-04 | 0.014 | 33.39 |
| Tractor Truck 5th Wheel | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Trucks - Pickup 3/4 ton | MHD-DSL | | EMFAC | 41.0% | 0.155 | 33.180 | 0.0002 | 0.001 | 0.279 | 0.017 | 0.015 | 3.09E-04 | 0.014 | 33.39 |
| Trucks - 3 ton | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| Truck - Water | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0013 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.16 |
| **Off Road Vehicles** | **Fuel Type** | | | | | | | | | | | | | |
| Air Compressor 185 CFM | D | 50 | OFFROAD - Air Compressors | 48.0% | 0.269 | 22.251 | 0.009 | 0.001 | 0.227 | 0.024 | 0.022 | 0.000 | 0.102 | 22.619 |
| Air Compressor 750 CFM | D | 120 | OFFROAD - Air Compressors | 48.0% | 0.331 | 46.908 | 0.008 | 0.001 | 0.529 | 0.050 | 0.046 | 0.001 | 0.090 | 47.498 |
| Articulating Boom Platform | D | 50 | OFFROAD - Aerial Lifts | 50.5% | 0.246 | 38.038 | 0.006 | 0.001 | 0.396 | 0.032 | 0.030 | 0.000 | 0.061 | 38.328 |
| Bobcat Loader | D | 50 | OFFROAD - Rubber Tired Loaders | 54.0% | 0.363 | 31.122 | 0.011 | 0.001 | 0.311 | 0.029 | 0.027 | 0.000 | 0.120 | 31.523 |
| Bulldozer D10R | D | 500 | OFFROAD - Crawler Tractors | 59.0% | 0.951 | 258.997 | 0.023 | 0.006 | 2.236 | 0.087 | 0.080 | 0.003 | 0.254 | 261.224 |
| Bulldozer D6.C | D | 120 | OFFROAD - Crawler Tractors | 59.0% | 0.485 | 65.751 | 0.012 | 0.001 | 0.767 | 0.067 | 0.062 | 0.001 | 0.129 | 66.415 |
| Concrete Trowel Machine | D | 50 | OFFROAD - Surfacing Equipment | 49.0% | 0.140 | 14.095 | 0.004 | 0.001 | 0.136 | 0.012 | 0.011 | 0.000 | 0.048 | 14.360 |
| Concrete Vibrators | Electric | 50 | N/A | 43.0% | | | | | | | | | | |
| Cranes - Mobile 35 ton | D | 120 | OFFROAD - Cranes | 43.0% | 0.361 | 50.103 | 0.008 | 0.001 | 0.550 | 0.049 | 0.045 | 0.001 | 0.092 | 50.696 |
| Cranes - Mobile 45 ton | D | 175 | OFFROAD - Cranes | 43.0% | 0.482 | 80.272 | 0.009 | 0.002 | 0.775 | 0.044 | 0.041 | 0.001 | 0.103 | 81.078 |
| Crane - Mobile 65 ton | D | 175 | OFFROAD - Cranes | 43.0% | 0.482 | 80.272 | 0.009 | 0.002 | 0.775 | 0.044 | 0.041 | 0.001 | 0.103 | 81.078 |
| Cranes 100 / 150 ton cap | D | 250 | OFFROAD - Cranes | 43.0% | 0.295 | 112.058 | 0.009 | 0.003 | 0.993 | 0.035 | 0.032 | 0.001 | 0.104 | 113.128 |
| Diesel Powered Welder | D | 25 | OFFROAD - Welders | 45.0% | 0.060 | 11.276 | 0.002 | 0.000 | 0.104 | 0.007 | 0.006 | 0.000 | 0.022 | 11.404 |
| Backhoe/loader | D | 120 | OFFROAD - Tractors/Loaders/Backhoes | 46.5% | 0.352 | 51.682 | 0.006 | 0.001 | 0.455 | 0.038 | 0.035 | 0.001 | 0.069 | 52.232 |
| Earth Scraper | D | 500 | OFFROAD - Scrapers | 66.0% | 1.212 | 321.140 | 0.029 | 0.006 | 2.826 | 0.110 | 0.101 | 0.003 | 0.319 | 323.489 |
| Loader | D | 120 | OFFROAD - Rubber Tired Loaders | 54.0% | 0.415 | 58.861 | 0.009 | 0.001 | 0.600 | 0.052 | 0.048 | 0.001 | 0.097 | 59.463 |
| Motor Grader | D | 120 | OFFROAD - Graders | 57.5% | 0.530 | 74.898 | 0.011 | 0.001 | 0.771 | 0.067 | 0.062 | 0.001 | 0.125 | 75.553 |
| Excavator - Trencher | D | 120 | OFFROAD - Trenchers | 69.5% | 0.468 | 64.837 | 0.012 | 0.001 | 0.785 | 0.067 | 0.061 | 0.001 | 0.128 | 65.498 |
| Fired Heaters | D | 25 | OFFROAD - Other Construction Equipment | 62.0% | 0.054 | 13.205 | 0.001 | 0.000 | 0.101 | 0.004 | 0.004 | 0.000 | 0.016 | 13.323 |
| Forklift | D | 50 | OFFROAD - Forklifts | 30.0% | 0.167 | 14.659 | 0.004 | 0.001 | 0.145 | 0.013 | 0.012 | 0.000 | 0.048 | 14.925 |
| Fusion Welder | Electric | 50 | N/A | 45.0% | | | | | | | | | | |
| Heavy Haul / Cranes | D | 750 | OFFROAD - Cranes | 43.0% | 0.891 | 302.773 | 0.024 | 0.008 | 2.451 | 0.088 | 0.081 | 0.003 | 0.262 | 305.888 |
| Heavy Haul / Cranes | D | 750 | OFFROAD - Cranes | 43.0% | 0.891 | 302.773 | 0.024 | 0.008 | 2.451 | 0.088 | 0.081 | 0.003 | 0.262 | 305.888 |
| Light Plants | D | 25 | OFFROAD - Other Construction Equipment | 62.0% | 0.054 | 13.205 | 0.001 | 0.000 | 0.101 | 0.004 | 0.004 | 0.000 | 0.016 | 13.323 |
| Man lifts - telescoping | D | 50 | OFFROAD - Aerial Lifts | 50.5% | 0.184 | 19.595 | 0.006 | 0.001 | 0.188 | 0.017 | 0.015 | 0.000 | 0.065 | 19.893 |
| Man lift - scissor | Electric | | N/A | 50.5% | | | | | | | | | | |
| Portable Compaction Roller | D | 120 | OFFROAD - Rollers | 57.5% | 0.406 | 58.936 | 0.009 | 0.001 | 0.624 | 0.053 | 0.049 | 0.001 | 0.098 | 59.541 |
| Portable Compaction - Vibratory Plate | D | 15 | OFFROAD - Plate Compactors | 43.0% | 0.026 | 4.310 | 0.000 | 0.000 | 0.031 | 0.001 | 0.001 | 0.000 | 0.005 | 4.372 |
| Portable Compaction - Vibratory Ram | D | 50 | OFFROAD - Surfacing Equipment | 49.0% | 0.140 | 14.095 | 0.004 | 0.001 | 0.136 | 0.012 | 0.011 | 0.000 | 0.048 | 14.360 |
| Pumps | D | 25 | OFFROAD - Other Construction Equipment | 62.0% | 0.054 | 13.205 | 0.001 | 0.000 | 0.101 | 0.004 | 0.004 | 0.000 | 0.016 | 13.323 |
| Portable Power Generators | D | 50 | OFFROAD - Generator Sets | 74.0% | 0.276 | 30.595 | 0.009 | 0.001 | 0.291 | 0.025 | 0.023 | 0.000 | 0.097 | 30.953 |
| Truck Crane - Greater than 300 ton | D | 500 | OFFROAD - Cranes | 43.0% | 0.529 | 179.940 | 0.014 | 0.006 | 1.421 | 0.052 | 0.048 | 0.002 | 0.155 | 181.979 |
| Truck Crane - Greater than 200 ton | D | 250 | OFFROAD - Cranes | 43.0% | 0.295 | 112.058 | 0.009 | 0.003 | 0.993 | 0.035 | 0.032 | 0.001 | 0.104 | 113.128 |
| Vibratory Roller 20 ton | D | 175 | OFFROAD - Rollers | 43.0% | 0.619 | 108.049 | 0.011 | 0.002 | 1.009 | 0.055 | 0.050 | 0.001 | 0.124 | 108.896 |

**Notes:**

[1] Capacity factors from SCAQMD Table A9-8-D

[2] Assuming ROGs are equivalent to VOCs

- Emission factors for on-road vehicles are based on results from Emfac Emissions Model 2007 Version 2.3 (HHDT-DSL=heavy heavy-duty trucks-diesel; MHD-DSL=medium heavy duty-diesel). EMFAC scenario year was 2010 and the selected area was Kern County. $PM_{10}$ values include break wear and tire wear.

- Emission factors for off-road vehicles are based on output from Offroad 2007, calendar year 2013 for Kern County.

On-Road Vehicles:

- $PM_{2.5}$ Fraction of $PM_{10}$, Diesel: 0.920

Off-Road Vehicles:

- PM2.5 Fraction of PM10, Diesel: 0.920

- $CH_4$ and $N_2O$ factors are derived from California Climate Action Registry General Reporting Protocol Version 3.0 (April 2008), Table C.5 for LDT, MHD, and HHD diesel fueled trucks in the San Joaquin Valley Air Basin (MHD =HHD). These emissions are in g/mile. On-road vehicles are limited to 10 mph, which is used to convert to lb/hr. (See GHG Reference Info tab)

- $N_2O$ factors for off-road vehicles are derived from California Climate Action Registry General Reporting Protocol Version 3.0 (April 2008), Table C.5 (distillate fuel factors for the industrial sector) using the following to convert from kg/gallon to lb/hp-hour, and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu, 7,000 Btu/hp-hour, and 2.2046 lb/kg. $CH_4$ factors are from the SCAQMD data.

| | |
|---|---|
| $CO_2$ GWP (SAR, 1996) = | 1 |
| $CH_4$ GWP (SAR, 1996) = | 21 |
| $N_2O$ GWP (SAR, 1996) = | 310 |

## Construction Equipment Usage Schedule (on-site)

Month (1–25)

| EQUIPMENT | # of units | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **On Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 cy fill mat'l haul truck | 185 | | | 10 | 10 | 20 | 20 | 20 | 20 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 5 | | | | | | | |
| Bus | 365 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 7 | 7 | 7 | 10 | 10 | 10 | 10 | 14 | 14 |
| Concrete Pumper Truck | 39 | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | |
| Dump Truck | 76 | 3 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | |
| Diesel Tractor (Yard Dog) | 236 | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 10 | 10 |
| Service Truck - 1 ton | 99 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Pile Driver Truck | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Truck - Fuel/Lube | 85 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Tractor Truck 5th Wheel | 0 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Trucks - Pickup 3/4 ton | 931 | 5 | 5 | 5 | 5 | 5 | 6 | 7 | 8 | 15 | 15 | 15 | 15 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| Trucks - 3 ton | 185 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Truck - Water | 127 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |
| **Off Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor 185 CFM | 327 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 6 | 6 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 12 | 12 |
| Air Compressor 750 CFM | 98 | | | | | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Articulating Boom Platform | 0 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bob cat loader | 62 | | | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Bulldozer D10R | 23 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | | | | | | | | | | | | | |
| Bulldozer D6C | 33 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| Concrete Trowel Machine | 58 | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Concrete Vibrators | 140 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 |
| Cranes - Mobile 35 ton | 176 | | | | | | | 1 | 1 | 1 | 4 | 4 | 4 | 4 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Cranes - Mobile 45 ton | 84 | | | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Crane - Mobile 65 ton | 126 | | | | | | | | | | | | 1 | 1 | 2 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Cranes 100 / 150 ton cap | 70 | | | | | | | | | | | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Diesel Powered Welder | 643 | | | | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 20 | 20 | 20 | 20 | 20 | 25 | 25 |
| Excavator - Backhoe/loader | 68 | 2 | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Excavator - Earth Scraper 637 | 38 | 7 | 7 | 7 | 7 | 4 | 4 | 2 | | | | | | | | | | | | | | | | | | |
| Excavator - loader | 33 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | | | | | | | | | | |
| Excavator - Motor Grader (CAT140H) | 24 | | 1 | 1 | 1 | 3 | 3 | | | | | | | | | | | | | | | | | | | |
| Excavator - Trencher (CAT320) | 22 | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | |
| Fired Heaters (2,000 BTU) | 166 | | | | | 4 | 4 | 4 | 4 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Forklift | 285 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Fusion Welder | 83 | | | | | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Heavy Haul / 600 tn Crane | 9 | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Heavy Haul / 1,000 tn Crane | 6 | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| Light Plants | 433 | 1 | 1 | 2 | 4 | 8 | 8 | 8 | 8 | 4 | 4 | 6 | 6 | 8 | 8 | 10 | 10 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| Man lifts - telescoping | 506 | | | | | | | | | 5 | 5 | 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 20 | 20 |
| Man lift - scissor | 540 | | | | | | | | 5 | 5 | 5 | 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 20 | 20 |
| Portable Compaction Roller | 82 | | | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Portable Compaction - Vibratory Plate | 126 | | | | | | | | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | | | |
| Portable Compaction - Ram | 0 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pumps | 182 | 3 | 3 | 3 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Portable Power Generators | 608 | 4 | 4 | 4 | 4 | 6 | 6 | 6 | 6 | 6 | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 20 | 20 | 20 |
| Truck Crane - Greater than 200 ton | 68 | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 4 | 4 | 4 |
| Truck Crane - Greater than 300 ton | 34 | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 |
| Vibratory Roller Ingersol-Rand 20 ton | 53 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | | | | |
| **Onsite Total** | **7534** | **60** | **62** | **80** | **96** | **119** | **129** | **124** | **136** | **133** | **142** | **149** | **160** | **168** | **176** | **180** | **190** | **202** | **196** | **198** | **215** | **214** | **212** | **212** | **234** | **230** |

Month (26–49)

| EQUIPMENT | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **On Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 cy fill mat'l haul truck | | | | | | | | | | | 3 | 3 | 3 | 3 | 1 | 1 | 1 | | | | | | | |
| Bus | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 10 | 10 | 5 | 5 | 3 | 3 | 2 | 2 | 2 | 1 | 1 |
| Concrete Pumper Truck | | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | |
| Dump Truck | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | | | | |
| Diesel Tractor (Yard Dog) | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | | | | | | | |
| Service Truck - 1 ton | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Pile Driver Truck | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Truck - Fuel/Lube | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Tractor Truck 5th Wheel | | | | | | | | | | | | | | | | | | | | | | | | |
| Trucks - Pickup 3/4 ton | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 15 | 15 | 10 | 10 | 10 | 10 | 5 |
| Trucks - 3 ton | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | |
| Truck - Water | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Off Road Vehicles** | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor 185 CFM | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 8 | 8 | 8 | 6 | 6 | 6 | 6 | 4 | 4 | 4 | 2 | 2 | 1 | 1 |
| Air Compressor 750 CFM | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Articulating Boom Platform | | | | | | | | | | | | | | | | | | | | | | | | |
| Bob cat loader | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Bulldozer D10R | | | | | | | | | | | | | | | | | | | | | | | | |
| Bulldozer D6C | | | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | |
| Concrete Trowel Machine | 2 | 2 | 2 | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | |
| Concrete Vibrators | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | |
| Cranes - Mobile 35 ton | 7 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| Cranes - Mobile 45 ton | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | | | | | | | |
| Crane - Mobile 65 ton | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 4 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| Cranes 100 / 150 ton cap | 4 | 4 | 4 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | |
| Diesel Powered Welder | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 15 | 15 | 15 | 15 | 15 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 3 | 3 | 2 |
| Excavator - Backhoe/loader | | | | | | | | | | | 2 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | | |
| Excavator - Earth Scraper 637 | | | | | | | | | | | | | | | | | | | | | | | | |
| Excavator - loader | | | 1 | 1 | 1 | 1 | | | | | | | 1 | 1 | 1 | | | | | | | | | |
| Excavator - Motor Grader (CAT140H) | | | 1 | 1 | 1 | 1 | | | | | 2 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | | |
| Excavator - Trencher (CAT320) | | | | | | | | | | | | | | | | | | | | | | | | |
| Fired Heaters (2,000 BTU) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| Forklift | 8 | 8 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 2 | 2 | 2 | 2 | 1 | 1 | 1 |
| Fusion Welder | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| Heavy Haul / 600 tn Crane | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| Heavy Haul / 1,000 tn Crane | | | | | | | | | | | | | | | | | | | | | | | | |
| Light Plants | 14 | 14 | 14 | 14 | 14 | 14 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 2 | 2 |
| Man lifts - telescoping | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 15 | 15 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 5 | 2 | 2 | 2 |
| Man lift - scissor | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 15 | 15 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 |
| Portable Compaction Roller | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | | 2 | 2 | 2 | 1 | 1 | | | | | | | |
| Portable Compaction - Vibratory Plate | | | 3 | 3 | 3 | 3 | | | | | 4 | 4 | 4 | 4 | 4 | 2 | 2 | | | | | | | |
| Portable Compaction - Ram | | | | | | | | | | | | | | | | | | | | | | | | |
| Pumps | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Portable Power Generators | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 15 | 15 | 15 | 15 | 10 | 10 | 10 | 10 | 10 | 10 | 5 | 5 | 5 | 2 |
| Truck Crane - Greater than 200 ton | 4 | 4 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | |
| Truck Crane - Greater than 300 ton | 3 | 3 | 3 | 3 | 2 | | | | | | | | | | | | | | | | | | | |
| Vibratory Roller Ingersol-Rand 20 ton | | | 2 | 2 | 2 | 2 | | | | | | | 1 | 1 | 1 | 1 | | | | | | | | |
| **Onsite Total** | **228** | **225** | **234** | **230** | **224** | **220** | **206** | **193** | **190** | **180** | **163** | **165** | **164** | **149** | **136** | **120** | **119** | **72** | **72** | **66** | **55** | **41** | **37** | **28** |

| Schedule | |
|---|---|
| Site Mobilization | |
| Site Prep/Piling | |
| Construction | |
| Commissioning & Start-up | |

Notes: Preliminary and Confidential
1 These are approximate values

### Emission Factors for Off-Site Linears Equipment

| | | | | | Emission Factors (lbs/hr) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Equipment Description* | **EMFAC designation** | **Horsepower** | **Source** | **Capacity Factor[1]** | **CO** | **$CO_2$** | **$CH_4$** | **$N_2O$** | **$NO_x$** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_x$** | **ROG[2]** | **$CO_2e$** |
| **On-Road Vehicles** | | | | | EMFAC | | | | | | | | | |
| Dump Truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0018 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| Service Truck | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0018 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| Pipe Haul Truck and Trailer (HHDT-DSL | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0018 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| Trucks - Pickup 3/4 ton | MHD-DSL | | EMFAC | 41.0% | 0.155 | 33.180 | 0.0018 | 0.001 | 0.279 | 0.017 | 0.015 | 0.000 | 0.014 | 33.558 |
| Truck - Water | HHD-DSL | | EMFAC | 41.0% | 0.320 | 69.786 | 0.0018 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| **Off Road Vehicles** | **Fuel Type** | | | | | | | | | | | | | |
| Air Compressor | D | 50 | OFFROAD - Air Compressors | 48.0% | 0.269 | 22.251 | 0.009 | 0.001 | 0.227 | 0.024 | 0.022 | 0.000 | 0.102 | 22.619 |
| Bore Machine (Hydraulic) | D | 50 | OFFROAD - Bore/Drill Rigs | 75.0% | 0.228 | 31.009 | 0.003 | 0.001 | 0.257 | 0.012 | 0.011 | 0.000 | 0.029 | 31.238 |
| Crane | D | 250 | OFFROAD - Cranes | 43.0% | 0.295 | 112.058 | 0.009 | 0.003 | 0.993 | 0.035 | 0.032 | 0.001 | 0.104 | 113.128 |
| Backhoe | D | 120 | OFFROAD - Tractors/Loaders/Backhoes | 46.5% | 0.352 | 51.682 | 0.006 | 0.001 | 0.455 | 0.038 | 0.035 | 0.001 | 0.069 | 52.232 |
| Excavator | D | 120 | OFFROAD - Excavators | 58.0% | 0.517 | 73.557 | 0.010 | 0.001 | 0.678 | 0.058 | 0.054 | 0.001 | 0.108 | 74.181 |
| Forklift | D | 50 | OFFROAD - Forklifts | 30.0% | 0.167 | 14.659 | 0.004 | 0.001 | 0.145 | 0.013 | 0.012 | 0.000 | 0.048 | 14.925 |
| Generator (Welding) | D | 50 | OFFROAD - Generator Sets | 74.0% | 0.276 | 30.595 | 0.009 | 0.001 | 0.291 | 0.025 | 0.023 | 0.000 | 0.097 | 30.953 |
| Roller | D | 50 | OFFROAD - Rollers | 57.5% | 0.291 | 25.960 | 0.009 | 0.001 | 0.258 | 0.024 | 0.022 | 0.000 | 0.102 | 26.328 |
| Pipe Bending Machine | D | 50 | OFFROAD - Other Construction Equipment | 62.0% | 0.265 | 27.964 | 0.007 | 0.001 | 0.258 | 0.020 | 0.019 | 0.000 | 0.075 | 28.281 |
| **RAIL** | | | | | | | | | | | | | | |
| AIR COMPRESSOR 185 | D | 49 | OFFROAD - Air Compressors | 48.0% | 0.269 | 22.251 | 0.009 | 0.001 | 0.227 | 0.024 | 0.022 | 0.000 | 0.102 | 22.616 |
| BOOM TRUCK 12 TON | D | 300 | EMFAC | 41.0% | 0.320 | 69.786 | 0.002 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| CAT 325 BACKHOE | D | 168 | OFFROAD - Tractors/Loaders/Backhoes | 46.5% | 0.585 | 101.296 | 0.009 | 0.000 | 0.768 | 0.043 | 0.039 | 0.001 | 0.098 | 101.482 |
| CAT 330 BACKHOE | D | 222 | OFFROAD - Tractors/Loaders/Backhoes | 46.5% | 0.366 | 171.583 | 0.011 | 0.000 | 1.163 | 0.037 | 0.034 | 0.002 | 0.120 | 171.811 |
| CAT DOZER D-6 | D | 185 | OFFROAD - Crawler Tractors | 59.0% | 0.744 | 121.079 | 0.015 | 0.000 | 1.250 | 0.071 | 0.065 | 0.001 | 0.167 | 121.395 |
| CAT MODEL 12 MOTOR GRADER | D | 140 | OFFROAD - Graders | 57.5% | 0.530 | 74.898 | 0.011 | 0.000 | 0.771 | 0.067 | 0.062 | 0.001 | 0.125 | 75.134 |
| CAT ROLLER-COMPACTOR 563 | D | 145 | OFFROAD - Rollers | 57.5% | 0.406 | 58.936 | 0.009 | 0.000 | 0.624 | 0.053 | 0.049 | 0.001 | 0.098 | 59.122 |
| CAT RUBBER TIRE LOADER 966 | D | 253 | OFFROAD - Rubber Tired Loaders | 54.0% | 0.368 | 148.843 | 0.011 | 0.000 | 1.210 | 0.042 | 0.038 | 0.002 | 0.126 | 149.081 |
| CAT SCRAPER 615 | D | 265 | OFFROAD - Scrapers | 66.0% | 0.641 | 209.282 | 0.020 | 0.000 | 2.044 | 0.079 | 0.073 | 0.002 | 0.225 | 209.709 |
| CRANE-ROUGH TERRAIN 45T | D | 173 | OFFROAD - Cranes | 43.0% | 0.482 | 80.272 | 0.009 | 0.000 | 0.775 | 0.044 | 0.041 | 0.001 | 0.103 | 80.467 |
| GENSET 5KW | D | 5 | OFFROAD - Generator Sets | 74.0% | 0.069 | 10.198 | 0.001 | 0.000 | 0.105 | 0.006 | 0.006 | 0.000 | 0.015 | 10.228 |
| JOHN DEERE TRACTOR 9400 | D | 410 | OFFROAD - Tractors/Loaders/Backhoes | 46.5% | 0.744 | 344.544 | 0.021 | 0.000 | 2.062 | 0.070 | 0.064 | 0.004 | 0.229 | 344.977 |
| PICK-UP CRAFT | D | 385 | OFFROAD - Other Construction Equipment | 62.0% | 0.523 | 254.010 | 0.013 | 0.000 | 1.516 | 0.049 | 0.045 | 0.002 | 0.145 | 254.285 |
| PICK-UP OVERHEAD | D | 260 | OFFROAD - Other Construction Equipment | 62.0% | 0.587 | 106.420 | 0.008 | 0.000 | 0.799 | 0.042 | 0.038 | 0.001 | 0.093 | 106.597 |
| RAIL BALLAST REGULATOR | D | 240 | OFFROAD - Other Construction Equipment | 62.0% | 0.587 | 106.420 | 0.008 | 0.000 | 0.799 | 0.042 | 0.038 | 0.001 | 0.093 | 106.597 |
| RAIL CLIP MACHINE | D | 80 | OFFROAD - Other Construction Equipment | 62.0% | 0.265 | 27.964 | 0.007 | 0.000 | 0.258 | 0.020 | 0.019 | 0.000 | 0.075 | 28.107 |
| RAIL MOVER-SHUTTLE WAGON | D | 250 | OFFROAD - Other Construction Equipment | 62.0% | 0.587 | 106.420 | 0.008 | 0.000 | 0.799 | 0.042 | 0.038 | 0.001 | 0.093 | 106.597 |
| RAIL TAMPER | D | 260 | OFFROAD - Other Construction Equipment | 62.0% | 0.587 | 106.420 | 0.008 | 0.000 | 0.799 | 0.042 | 0.038 | 0.001 | 0.093 | 106.597 |
| RAIL WELDER | D | 58 | OFFROAD - Welders | 45.0% | 0.060 | 11.276 | 0.002 | 0.000 | 0.104 | 0.007 | 0.006 | 0.000 | 0.022 | 11.317 |
| RAMEX WALK BEHIND COMPACTOR | D | 10 | OFFROAD - Plate Compactors | 43.0% | 0.026 | 4.310 | 0.000 | 0.000 | 0.031 | 0.001 | 0.001 | 0.000 | 0.005 | 4.319 |
| TRI-AXLE DUMP TRUCK | D | 450 | EMFAC | 41.0% | 0.320 | 69.786 | 0.002 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| TRUCK FLATBED 14 FOOT | D | 362 | EMFAC | 41.0% | 0.320 | 69.786 | 0.002 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| TRUCK TRACTOR | D | 450 | OFFROAD - Off-Highway Trucks | 41.0% | 0.636 | 272.089 | 0.020 | 0.000 | 1.783 | 0.063 | 0.058 | 0.003 | 0.217 | 272.500 |
| WATER TRUCK, 4M ON-ROAD | D | 300 | EMFAC | 41.0% | 0.320 | 69.786 | 0.002 | 0.001 | 0.694 | 0.043 | 0.039 | 0.001 | 0.151 | 70.165 |
| WELDING MACHINE 350 AMP | D | 25 | OFFROAD - Welders | 45.0% | 0.060 | 11.276 | 0.002 | 0.000 | 0.104 | 0.007 | 0.006 | 0.000 | 0.022 | 11.317 |

**Notes:**

[1] Capacity factors from SCAQMD Table A9-8-D

[2] Assuming ROGs are equivalent to VOCs

- Emission factors for on-road vehicles are based on results from Emfac Emissions Model 2010 Version 2.3 (LDT-DSL=light duty class II trucks-diesel; HHDT-DSL=heavy heavy-duty trucks-diesel; MHD-DSL=medium heavy duty-diesel). EMFAC scenario year was 2010.

- Emission factors for off-road vehicles are based on output from Offroad 2007, calendar year 2013 for Kern County.
  On-Road Vehicles:
    - $PM_{2.5}$ Fraction of $PM_{10}$, Diesel: 0.920
  Off-Road Vehicles:
    - PM2.5 Fraction of PM10, Diesel: 0.920

- $CH_4$ and $N_2O$ factors are derived from California Climate Action Registry General Reporting Protocol Version 3.0 (April 2008), Table C.5 for LDT, MHD, and HHD diesel fueled trucks in the San Joaquin Valley Air Basin (MHD =HHD). These emissions are in g/mile. On-road vehicles are limited to 10 mph, which is used to convert to lb/hr. (See GHG Reference Info tab)
- $N_2O$ factors for off-road vehicles are derived from California Climate Action Registry General Reporting Protocol Version 3.0 (April 2008), Table C.5 (distillate fuel factors for the industrial sector) using the following to convert from kg/gallon to lb/hp-hour, and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu, 7,000 Btu/hp-hour, and 2.2046 lb/kg. $CH_4$ factors are from the SCAQMD data.

| | |
|---|---|
| $CO_2$ GWP (SAR, 1996) = | 1 |
| $CH_4$ GWP (SAR, 1996) = | 21 |
| $N_2O$ GWP (SAR, 1996) = | 310 |

**Construction Equipment Usage Schedule (off-site linears)**

| EQUIPMENT | Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of units | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **ON ROAD** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dump Truck | 64 | | | | | | | | | | | 4 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Service Truck (MHD-DSL) | | | | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pipe Haul Truck and Trailer (HHDT-DSL | 30 | | | | | | | | | | | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Truck (Pickup 3/4 Ton) - MHD-DSL | 150 | | | | | | | | | | | 10 | 10 | 10 | 10 | 10 | 10 | 15 | 15 | 15 | 15 | 15 | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Truck - water | 40 | | | | | | | | | | | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **OFF ROAD** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air Compressor | 48 | | | | | | | | | | | 2 | 2 | 4 | 4 | 6 | 6 | 6 | 6 | 4 | 4 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bore Machine (Hydraulic) | 5 | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Crane | 60 | | | | | | | | | | | 2 | 4 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Backhoe | 104 | | | | | | | | | | | 6 | 6 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 6 | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Excavator | 11 | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Forklift | 42 | | | | | | | | | | | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Welding Generator | 96 | | | | | | | | | | | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Roller | 22 | | | | | | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pipe Bending Machine | 36 | | | | | | | | | | | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **RAIL** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AIR COMPRESSOR 185 | 8 | | | | | | | | | | | | | 0 | 2 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BOOM TRUCK 12 TON | 3 | | | | | | | | | | | | | 0 | 0 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT 325 BACKHOE | 2 | | | | | | | | | | | | | 1 | 1 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT 330 BACKHOE | 1 | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT DOZER D-6 | 5 | | | | | | | | | | | | | 2 | 2 | 0 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT MODEL 12 MOTOR GRADER | 7 | | | | | | | | | | | | | 2 | 2 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT ROLLER-COMPACTOR 563 | 5 | | | | | | | | | | | | | 2 | 2 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT RUBBER TIRE LOADER 966 | 6 | | | | | | | | | | | | | 0 | 0 | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT SCRAPER 615 | 3 | | | | | | | | | | | | | 2 | 1 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CRANE-ROUGH TERRAIN 45T | 2 | | | | | | | | | | | | | 0 | 1 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GENSET 5KW | 6 | | | | | | | | | | | | | 0 | 4 | 2 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JOHN DEERE TRACTOR 9400 | 1 | | | | | | | | | | | | | 1 | 0 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PICK-UP CRAFT | 15 | | | | | | | | | | | | | 3 | 3 | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PICK-UP OVERHEAD | 24 | | | | | | | | | | | | | 2 | 6 | 6 | 5 | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAIL BALLAST REGULATOR | 2 | | | | | | | | | | | | | 0 | 0 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAIL CLIP MACHINE | 2 | | | | | | | | | | | | | 0 | 0 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAIL MOVER-SHUTTLE WAGON | 3 | | | | | | | | | | | | | 0 | 0 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAIL TAMPER | 2 | | | | | | | | | | | | | 0 | 0 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAIL WELDER | 3 | | | | | | | | | | | | | 0 | 0 | 0 | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RAMEX WALK BEHIND COMPACTOR | 1 | | | | | | | | | | | | | 0 | 1 | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TRI-AXLE DUMP TRUCK | 12 | | | | | | | | | | | | | 4 | 6 | 2 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TRUCK FLATBED 14 FOOT | 11 | | | | | | | | | | | | | 1 | 1 | 3 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TRUCK TRACTOR | 2 | | | | | | | | | | | | | 0 | 0 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WATER TRUCK, 4M ON-ROAD | 5 | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WELDING MACHINE 350 AMP | 5 | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TOTAL** | **874** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **43** | **48** | **84** | **98** | **96** | **93** | **97** | **72** | **70** | **67** | **55** | **51** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |

Notes: Preliminary and Confidential
1 These are approximate values
2 Construction Equipment Assumptions - Natural Gas line work begins in month 11 and ends in month 20. Process water line work begins in month 11 and ends in month 17 Potable Water line work begins in month 17 and ends in month 20. CO2 line work begins in month 17 and ends in month 22. Transmission line work begins in month 17 and ends in month 22. Rail spur line work begins in month 13 and ends in month 17

## MODEL INPUTS
## COMBUSTION - Short-term (Month 6)

| equipment / vehicles | TOTAL EMISSION RATE (lb/day) | | | | |
|---|---|---|---|---|---|
| | $PM_{2.5}$ | $PM_{10}$ | CO | $NO_2$ | $SO_2$ |
| Worker vehicles | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 |
| Delivery trucks | 0.3 | 0.3 | 2.2 | 5.1 | 0.0 |
| Soil import | 1.4 | 1.5 | 10.4 | 24.2 | 0.0 |
| Construction equip | 19.3 | 21.1 | 187.3 | 347.0 | 0.4 |

| equipment / vehicles | number of sources in the model | operating hours per day in the model | MODEL EMISSION RATE per source (lb/hr/source) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ 24hr | $PM_{10}$ 24hr | CO 1 & 8 hr | $NO_2$ 1-hr | $SO_2$ 1,3 & 24 hr |
| Worker vehicles | 36 | 10 | 1.30E-05 | 1.67E-05 | 1.36E-03 | 1.09E-04 | 2.14E-06 |
| Delivery trucks | 26 | 10 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import | 67 | 10 | 2.04E-03 | 2.25E-03 | 1.55E-02 | 3.62E-02 | 2.92E-05 |
| Construction equip | 58 | 10 | 3.32E-02 | 3.64E-02 | 3.23E-01 | 5.98E-01 | 6.57E-04 |

### SOURCE PARAMETERS

| Source ID | Source Description | Easting (m) | Northing (m) | Base elevation (m) | Stack Height (m) | Temperature K | Exit Velocity (m/s) | Stack diameter (m) | Emissions per source: $PM_{2.5}$ 24hr lb/hr | $PM_{10}$ 24hr lb/hr | CO 1hr & 8hr lb/hr | $NO_2$ 1hr lb/hr | $SO_2$ 1, 3 and 24hr lb/hr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker vehicles[1] | Worker vehicles for commuting to/from site | | | 87.9348 | 0.3 | 622 | 0.001 | 0.051 | 1.30E-05 | 1.67E-05 | 1.36E-03 | 1.09E-04 | 2.14E-06 |
| Delivery trucks[2] | Light and heavy duty delivery trucks | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import[2] | Importing soil for fill | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 2.04E-03 | 2.25E-03 | 1.55E-02 | 3.62E-02 | 2.92E-05 |
| Construction equipment[2] | All construction equipment | | | 87.9348 | 3 | 622 | 59.9 | 0.102 | 3.32E-02 | 3.64E-02 | 3.23E-01 | 5.98E-01 | 6.57E-04 |

Notes:

1. Stack parameters for worker vehicles modified to reflect realistic stack height and stack diameter for a typical passenger vehicle. Exit velocity was set at 0.001 m/s, per guidance from SJVAPCD for horizontal stacks.
2. Reference for truck stack parameters and worker vehicle temperature: Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines, California EPA-Air Resources Board, October 2000.

| | Average horsepower: | HP used for stack params |
|---|---|---|
| Worker vehicles | 195.5 | 200 |
| Delivery trucks | 275 | 300 |
| Construction equipment | 170 | 200 |

## MODEL INPUTS
## COMBUSTION - Long-term (Months 1-12)

| equipment / vehicles | TOTAL EMISSION RATE (tons/year) $PM_{2.5}$ | $PM_{10}$ | CO | $NO_2$ | $SO_2$ |
|---|---|---|---|---|---|
| Worker vehicles | 0.00 | 0.00 | 0.08 | 0.01 | 0.00 |
| Delivery trucks | 0.14 | 0.16 | 1.09 | 2.54 | 0.00 |
| Soil import | 0.11 | 0.12 | 0.80 | 1.87 | 0.00 |
| Construction equip | 2.07 | 2.26 | 20.60 | 37.22 | 0.04 |

| equipment / vehicles | number of sources in the model | Annual Hours of Operation | MODEL EMISSION RATE per source (lb/hr/source) $PM_{2.5}$ annual | $PM_{10}$ annual | CO annual | $NO_2$ annual | $SO_2$ annual |
|---|---|---|---|---|---|---|---|
| Worker vehicles | 36 | 2640 | 1.68E-05 | 2.17E-05 | 1.76E-03 | 1.41E-04 | 2.79E-06 |
| Delivery trucks | 26 | 2640 | 4.17E-03 | 4.60E-03 | 3.18E-02 | 7.41E-02 | 5.98E-05 |
| Soil import | 67 | 2640 | 1.19E-03 | 1.31E-03 | 9.06E-03 | 2.11E-02 | 1.70E-05 |
| Construction equip | 142 | 2640 | 1.10E-02 | 1.21E-02 | 1.10E-01 | 1.99E-01 | 2.21E-04 |

**SOURCE PARAMETERS**

| Source ID | Source Description | Easting (m) | Northing (m) | Base elevation (m) | Stack Height (m) | Temperature K | Exit Velocity (m/s) | Stack diameter (m) | Emissions per source $PM_{2.5}$ annual lb/hr | $PM_{10}$ annual lb/hr | CO annual lb/hr | $NO_2$ annual lb/hr | $SO_2$ annual lb/hr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker vehicles[1] | Worker vehicles for commuting to/from site | | | 87.9348 | 0.3 | 622 | 0.001 | 0.051 | 1.68E-05 | 2.17E-05 | 1.76E-03 | 1.41E-04 | 2.79E-06 |
| Delivery trucks[2] | Light and heavy duty delivery trucks | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 4.17E-03 | 4.60E-03 | 3.18E-02 | 7.41E-02 | 5.98E-05 |
| Soil import[2] | Importing soil for fill | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 1.19E-03 | 1.31E-03 | 9.06E-03 | 2.11E-02 | 1.70E-05 |
| Construction equipment[2] | All construction equipment | | | 87.9348 | 3 | 622 | 59.9 | 0.102 | 1.10E-02 | 1.21E-02 | 1.10E-01 | 1.99E-01 | 2.21E-04 |

Notes:

1. Stack parameters for worker vehicles modified to reflect realistic stack height and diameter for a typical passenger vehicle. Exit velocity was set at 0.001 m/s, per guidance from SJVAPCD for horizontal stacks.

2. Reference for truck stack parameters and worker vehicle temperature: Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines, California EPA-Air Resources Board, October 2000.

| | Average horsepower: | HP used for stack params |
|---|---|---|
| Construction equipment | 170 | 200 |
| Worker vehicles | 195.5 | 200 |
| Delivery trucks | 275 | 300 |

# MODEL INPUTS
## COMBUSTION - Short-term (Month 24)

| equipment / vehicles | TOTAL EMISSION RATE (lb/day) | | | | |
|---|---|---|---|---|---|
| | $PM_{2.5}$ | $PM_{10}$ | CO | $NO_2$ | $SO_2$ |
| Worker vehicles | 0.0 | 0.1 | 4.8 | 0.4 | 0.0 |
| Delivery trucks | 0.3 | 0.3 | 2.2 | 5.1 | 0.0 |
| Soil import | - | - | - | - | - |
| Construction equip | 22.6 | 24.8 | 231.6 | 384.9 | 0.5 |

| equipment / vehicles | number of sources in the model | operating hours per day in the model | MODEL EMISSION RATE per source (lb/hr/source) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ 24hr | $PM_{10}$ 24hr | CO 1 & 8 hr | $NO_2$ 1-hr | $SO_2$ 1,3 & 24 hr |
| Worker vehicles | 36 | 10 | 1.28E-04 | 1.64E-04 | 1.34E-02 | 1.07E-03 | 2.11E-05 |
| Delivery trucks | 26 | 10 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import | - | - | - | - | - | - | - |
| Construction equip | 58 | 10 | 3.90E-02 | 4.27E-02 | 3.99E-01 | 6.64E-01 | 7.81E-04 |

**SOURCE PARAMETERS**

| Source ID | Source Description | Easting (m) | Northing (m) | Base elevation (m) | Stack Height (m) | Temperature K | Exit Velocity (m/s) | Stack diameter (m) | Emissions per source: $PM_{2.5}$ 24hr lb/hr | $PM_{10}$ 24hr lb/hr | CO 1hr & 8hr lb/hr | $NO_2$ 1hr lb/hr | $SO_2$ 1, 3 and 24hr lb/hr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker vehicles[1] | Worker vehicles for commuting to/from site | | | 87.9348 | 0.3 | 622 | 0.001 | 0.051 | 1.28E-04 | 1.64E-04 | 1.34E-02 | 1.07E-03 | 2.11E-05 |
| Delivery trucks[2] | Light and heavy duty delivery trucks | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import[2] | Importing soil for fill | | | - | - | - | - | - | - | - | - | - | - |
| Construction equipment[2] | All construction equipment | | | 87.9348 | 3 | 622 | 59.9 | 0.102 | 3.90E-02 | 4.27E-02 | 3.99E-01 | 6.64E-01 | 7.81E-04 |

Notes:

1. Stack parameters for worker vehicles modified to reflect realistic stack height and diameter for a typical passenger vehicle. Exit velocity was set at 0.001 m/s, per guidance from SJVAPCD for horizontal stacks.
2. Reference for truck stack parameters and worker vehicle temperature: Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines, California EPA-Air Resources Board, October 2000.

| | Average horsepower: | HP used for stack params |
|---|---|---|
| Worker vehicles | 195.5 | 200 |
| Delivery trucks | 275 | 300 |
| Construction equipment | 170 | 200 |

## MODEL INPUTS
## COMBUSTION - Long-term (Months 20-31)

| equipment / vehicles | TOTAL EMISSION RATE (tons/year) | | | | |
|---|---|---|---|---|---|
| | $PM_{2.5}$ | $PM_{10}$ | CO | $NO_2$ | $SO_2$ |
| Worker vehicles | 0.01 | 0.01 | 0.68 | 0.05 | 0.00 |
| Delivery trucks | 0.04 | 0.04 | 0.29 | 0.68 | 0.00 |
| Soil import | - | - | - | - | - |
| Construction equip | 2.81 | 3.07 | 28.62 | 47.37 | 0.06 |

| equipment / vehicles | number of sources in the model | Annual Hours of Operation | MODEL EMISSION RATE per source (lb/hr/source) | | | | |
|---|---|---|---|---|---|---|---|
| | | | $PM_{2.5}$ annual | $PM_{10}$ annual | CO annual | $NO_2$ annual | $SO_2$ annual |
| Worker vehicles | 36 | 2640 | 1.37E-04 | 1.76E-04 | 1.43E-02 | 1.15E-03 | 2.26E-05 |
| Delivery trucks | 26 | 2640 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import | - | 2640 | - | - | - | - | - |
| Construction equip | 142 | 2640 | 1.50E-02 | 1.64E-02 | 1.53E-01 | 2.53E-01 | 2.96E-04 |

**SOURCE PARAMETERS**

| Source ID | Source Description | Easting (m) | Northing (m) | Base elevation (m) | Stack Height (m) | Temperature K | Exit Velocity (m/s) | Stack diameter (m) | Emissions per source $PM_{2.5}$ annual lb/hr | $PM_{10}$ annual lb/hr | CO annual lb/hr | $NO_2$ annual lb/hr | $SO_2$ annual lb/hr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Worker vehicles[1] | Worker vehicles for commuting to/from site | | | 87.9348 | 0.3 | 622 | 0.001 | 0.051 | 1.37E-04 | 1.76E-04 | 1.43E-02 | 1.15E-03 | 2.26E-05 |
| Delivery trucks[2] | Light and heavy duty delivery trucks | | | 87.9348 | 3 | 622 | 57.5 | 0.127 | 1.10E-03 | 1.22E-03 | 8.48E-03 | 1.98E-02 | 1.59E-05 |
| Soil import[2] | Importing soil for fill | | | - | - | - | - | - | - | - | - | - | - |
| Construction equipment[2] | All construction equipment | | | 87.9348 | 3 | 622 | 59.9 | 0.102 | 1.50E-02 | 1.64E-02 | 1.53E-01 | 2.53E-01 | 2.96E-04 |

Notes:

1. Stack parameters for worker vehicles modified to reflect realistic stack height and diameter for a typical passenger vehicle. Exit velocity was set at 0.001 m/s, per guidance from SJVAPCD for horizontal stacks.

2. Reference for truck stack parameters and worker vehicle temperature: Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines, California EPA-Air Resources Board, October 2000.

| | Average horsepower: | HP used for stack params |
|---|---|---|
| Construction equipment | 170 | 200 |
| Worker vehicles | 195.5 | 200 |
| Delivery trucks | 275 | 300 |

# MODEL INPUTS
## FUGITIVES - Short-term (Month 6)

| Location | X (m) | Y (m) | AREA (m2) |
|---|---|---|---|
| Parking1 | 215 | 100 | 21500 |
| Parking2 | 215 | 100 | 21500 |
| Parking3 | 215 | 100 | 21500 |
| Parking4 | 215 | 100 | 21500 |
| Parking5 | 215 | 100 | 21500 |
| Parking6 | 215 | 100 | 21500 |
| Delivery / Construction Laydown | 1075 | 290 | 311750 |
| Soil import | 600 | 600 | 360000 |
| Construction area | 677 | 677 | 458,306 |

| | | | |
|---|---|---|---|
| Project Site | 453 | acres | (from Project Description section 2.1.8) |
| % disturbed in one month | 25% | | |
| Acreage disturbed in one month | 113.25 | acres | |

| Fugitive Source | Operating Hours per day | TOTAL EMISSION RATE (lb/day) | | MODEL EMISSION RATE (g/s-m2) | |
|---|---|---|---|---|---|
| | | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ |
| Parking1 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Parking2 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Parking3 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Parking4 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Parking5 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Parking6 | 10 | 0.1 | 0.7 | 4.31E-08 | 4.31E-07 |
| Delivery Trucks | 10 | 2.2 | 21.9 | 8.84E-08 | 8.84E-07 |
| Soil import | 10 | 12.2 | 121.5 | 4.25E-07 | 4.25E-06 |
| Construction Equipment | 10 | 17.2 | 93.2 | 4.74E-07 | 2.56E-06 |

Construction Activity — Fugitives from these activities are included above with "Construction equipment"

- Dirt Piling / Material Handling
- Grading
- Bulldozing / Earth clearing
- Covered Storage Piles

# MODEL INPUTS
## FUGITIVES - Long-term (Months 1-12)

| Location | X (m) | Y (m) | AREA (m2) |
|---|---|---|---|
| Parking1 | 215 | 100 | 21500 |
| Parking2 | 215 | 100 | 21500 |
| Parking3 | 215 | 100 | 21500 |
| Parking4 | 215 | 100 | 21500 |
| Parking5 | 215 | 100 | 21500 |
| Parking6 | 215 | 100 | 21500 |
| Delivery / Construction Laydown | 1075 | 290 | 311750 |
| Soil import | 600 | 600 | 360000 |
| Construction area | 1250 | 1100 | 1,374,919 |

| | | | |
|---|---|---|---|
| Project Site | 453 | acres | (from Project Description section 2.1.8) |
| % disturbed in one year | 75% | | |
| Acreage disturbed in one year | 339.75 | acres | |

| Fugitive Source | Annual hours of operation | TOTAL EMISSION RATE (tons/yr) | | MODEL EMISSION RATE (g/s-m2) | |
|---|---|---|---|---|---|
| | | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ |
| Parking1 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Parking2 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Parking3 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Parking4 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Parking5 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Parking6 | 2640 | 0.0 | 0.1 | 5.61E-08 | 5.61E-07 |
| Delivery Trucks | 2640 | 0.3 | 2.9 | 8.84E-08 | 8.84E-07 |
| Soil import | 2640 | 0.9 | 9.4 | 2.48E-07 | 2.48E-06 |
| Construction Equipment | 2640 | 2.2 | 10.9 | 1.50E-07 | 7.60E-07 |

Construction Activity — Fugitives from these activities are included above with "Construction equipment"

- Dirt Piling / Material Handling
- Grading
- Bulldozing / Earth clearing
- Covered Storage Piles

# MODEL INPUTS
## FUGITIVES - Short-term (Month 24)

| Location | X (m) | Y (m) | AREA (m2) |
|---|---|---|---|
| Parking1 | 215 | 100 | 21500 |
| Parking2 | 215 | 100 | 21500 |
| Parking3 | 215 | 100 | 21500 |
| Parking4 | 215 | 100 | 21500 |
| Parking5 | 215 | 100 | 21500 |
| Parking6 | 215 | 100 | 21500 |
| Delivery / Construction Laydown | 1075 | 290 | 311750 |
| Soil import | - | - | - |
| Construction area | 677 | 677 | 458,306 |

| | | | |
|---|---|---|---|
| Project Site | 453 | acres | (from Project Description section 2.1.8) |
| % disturbed in one month | 25% | | |
| Acreage disturbed in one month | 113.25 | acres | |

| Fugitive Source | Operating Hours per day | TOTAL EMISSION RATE (lb/day) | | MODEL EMISSION RATE (g/s-m2) | |
|---|---|---|---|---|---|
| | | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ |
| Parking1 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Parking2 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Parking3 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Parking4 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Parking5 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Parking6 | 10 | 0.7 | 7.3 | 4.25E-07 | 4.25E-06 |
| Delivery Trucks | 10 | 2.2 | 21.9 | 8.84E-08 | 8.84E-07 |
| Soil import | - | - | - | - | - |
| Construction Equipment | 10 | 4.6 | 45.6 | 1.26E-07 | 1.25E-06 |

Construction Activity — Fugitives from these activities are included above with "Construction equipment"

- Dirt Piling / Material Handling
- Grading
- Bulldozing / Earth clearing
- Covered Storage Piles

## MODEL INPUTS
## FUGITIVES - Long-term (Months 20-31)

| Location | X (m) | Y (m) | AREA (m2) |
|---|---|---|---|
| Parking1 | 215 | 100 | 21500 |
| Parking2 | 215 | 100 | 21500 |
| Parking3 | 215 | 100 | 21500 |
| Parking4 | 215 | 100 | 21500 |
| Parking5 | 215 | 100 | 21500 |
| Parking6 | 215 | 100 | 21500 |
| Delivery / Construction Laydown | 1075 | 290 | 311750 |
| Soil import | - | - | - |
| Construction area | 1250 | 1100 | 1,374,919 |

| | | | |
|---|---|---|---|
| Project Site | 453 | acres | (from Project Description section 2.1.8) |
| % disturbed in one year | 75% | | |
| Acreage disturbed in one year | 339.75 | acres | |

| Fugitive Source | Annual hours of operation | TOTAL EMISSION RATE (tons/yr) | | MODEL EMISSION RATE (g/s-m2) | |
|---|---|---|---|---|---|
| | | $PM_{2.5}$ | $PM_{10}$ | $PM_{2.5}$ | $PM_{10}$ |
| Parking1 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Parking2 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Parking3 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Parking4 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Parking5 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Parking6 | 2640 | 0.1 | 1.0 | 4.55E-07 | 4.55E-06 |
| Delivery Trucks | 2640 | 0.3 | 2.9 | 8.84E-08 | 8.84E-07 |
| Soil import | - | - | - | - | - |
| Construction Equipment | 2640 | 0.8 | 6.7 | 5.23E-08 | 4.63E-07 |

Construction Activity — Fugitives from these activities are included above with "Construction equipment"

- Dirt Piling / Material Handling
- Grading
- Bulldozing / Earth clearing
- Covered Storage Piles

# Appendix E-3

# Operational Criteria Pollutant Emissions

# Appendix E-3
# Hydrogen Energy California LLC
# HECA Project
# Operational Criteria Pollutant Emissions

4/24/2012

## HECA Total Combined Annual Criteria Pollutant Emissions

| Equipment \ Pollutant | $NO_X$ | CO | VOC | $SO_2$ | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|---|---|---|
| | tons/year | | | | | |
| **HRSG/CTG (1)** | 109.7 | 92.9 | 15.3 | 17.2 | 54.6 | 54.6 |
| **Coal Dryer(1)** | 17.4 | 13.3 | 2.4 | 2.8 | 5.6 | 5.6 |
| **Auxiliary Boiler** | 1.4 | 8.6 | 0.9 | 0.5 | 1.2 | 1.2 |
| **Tail Gas Thermal Oxidizer** | 13.4 | 11.2 | 0.3 | 8.3 | 0.4 | 0.4 |
| **$CO_2$ Vent** | | 124.1 | 2.8 | | | |
| **Gasification Flare** | 3.2 | 18.5 | 0.01 | 0.02 | 0.03 | 0.03 |
| **Rectisol Flare** | 1.2 | 0.8 | 0.01 | 0.3 | 0.03 | 0.03 |
| **SRU Flare** | 0.2 | 0.2 | 0.003 | 0.4 | 0.006 | 0.006 |
| **Cooling Towers (2)** | | | | | 25.5 | 15.3 |
| **Emergency Generators(3)** | 0.2 | 0.8 | 0.1 | 0.001 | 0.02 | 0.02 |
| **Fire Water Pump** | 0.09 | 0.2 | 0.01 | 0.0003 | 0.001 | 0.001 |
| **Nitric Acid Unit** | 17 | | | | | |
| **Urea Pastillation Unit** | | | | | 0.2 | 0.2 |
| **Ammonium Nitrate Unit** | | | | | 0.8 | 0.8 |
| **Ammonia Startup Heater** | 0.04 | 0.14 | 0.02 | 0.01 | 0.02 | 0.02 |
| **Material Handling (4)** | | | | | 1.9 | 1.9 |
| **Fugitives** | | 4.6 | 13.4 | | | |
| **Total Annual** | **163.7** | **275.2** | **35.4** | **29.5** | **90.3** | **80.2** |

Source: HECA Project

Notes:

(1) Total annual HRSG and Coal Dryer emissions represent the maximum annual emissions during normal operations plus startup and shutdown emissions

(2) Includes contributions from all three cooling towers

(3) Includes contributions from both emergency generators

(4) Material handling emissions are shown as the contribution of all dust collection points.

CO = carbon monoxide
HRSG=Heat Recovery Steam Generator
CTG = combustion turbine generator
$NO_X$ = nitrogen oxides
$PM_{10}$= particulate matter less than 10 microns in diameter
$PM_{2.5}$ =particulate matter less than 2.5 microns in diameter ($PM_{2.5}$ is assumed to equal $PM_{10}$)
$SO_2$ = sulfur dioxide
VOCs = volatile organic compounds

**Basis: MHI GT - Model: M501GAC**

**With PSA Off-gas and H2-rich Gas Duct Firing**
Maximum Emissions based on Case 1 - On-peak with duct-firing at 97F ambient

| | | |
|---|---|---|
| CGT Max Fuel Input = | 2583 | x 10^6 Btu/hr (HHV) of syngas |
| Duct Firing Max Fuel Input = | 278 | x 10^6 Btu/hr (HHV) of PSA Off-gas and H2-rich syngas |
| HRSG stack gas = | 255,463 | lbmol/hr, dry, corrected to 15% O2 |

**Total HRSG Flue Gas Emission Rates with Duct Firing of PSA Off-gas and H2-rich syngas**

| | Emission Factors lb/10^6 Btu (HHV) | Basis |
|---|---|---|
| NOx | 0.011 | 2.5 ppmc |
| CO | 0.008 | 3 ppmc |
| VOC | 0.0015 | 1 ppmc |
| $PM_{10}/PM_{2.5}$ | 0.008 | filterable (front-half) + condensible (back half) |
| SO2** | 0.0002 | 2 ppmv total sulfur in syngas, 10 ppmv sulfur in PSA Off-gas |
| NH3 | | 5 ppmc ammonia slip |

Notes: Emission Factors are based on the maximum emissions from all of the cases examined (On-peak and Off-peak)
ppmc denotes ppm by volume, dry, corrected to 15% O2
** Maximum SO2 emission occurs for OFF-peak, 97 deg F (Case 2)

**Maximum short-term emissions from HRSG stack, normal operations on peak**

| HRSG Emissions | lb/hr | Basis |
|---|---|---|
| NOx | 25.0 | Case 1 (ON Peak, 97 deg Ambient) |
| CO | 18.3 | Case 1 (ON Peak, 97 deg Ambient) |
| VOC | 3.5 | Case 1 (ON Peak, 97 deg Ambient) |
| $PM_{10}/PM_{2.5}$ | 12.9 | Case 3 (ON Peak, 39 deg Ambient) |
| SO2** | 4.1 | Case 2 (OFF Peak, 97 deg Ambient) |
| NH3 | 18.5 | Case 1 (ON Peak, 97 deg Ambient) |

| | Exhaust gas (lbmol/hr) | Exit velocity (m/s) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) |
|---|---|---|---|---|
| **min HRSG fluegas to HRSG stack during ON peak (Case 1) =** | 167,092 | 16.40 | 22,356.58 | 53.81 |
| **Min HRSG fluegas to HRSG stack during OFF Peak (Case 2) =** | 126,704 | 12.44 | 16,952.70 | 40.80 |
| **HRSG fluegas to HRSG stack during ON Peak (Case 3) =** | 176,804 | 17.35 | 23,655.98 | 56.94 |

**Annual average emissions from HRSG Stack**
**Basis:** Case 5 (ON Peak, Avg. Ambient)

| HRSG Emissions | lb/hr |
|---|---|
| NOx | 24.9 |
| CO | 18.2 |
| VOC | 3.5 |
| $PM_{10}/PM_{2.5}$ | 12.8 |
| SO2* | 4.1 |
| NH3 | 18.4 |

| | Exhaust gas (lbmol/hr) | Exit velocity (m/s) |
|---|---|---|
| **HRSG fluegas to HRSG stack (Case 5) =** | 171,498 | 16.83 |

**Maximum short-term emissions from coal dryer stack**

| Coal Dryer Emissions | lb/hr | Basis |
|---|---|---|
| NOx | 4.4 | Case 1 (ON Peak, 97 deg Ambient) |
| CO | 3.2 | Case 1 (ON Peak, 97 deg Ambient) |
| VOC | 0.6 | Case 1 (ON Peak, 97 deg Ambient) |
| $PM_{10}/PM_{2.5}$ | 1.4 | Case 3 (ON Peak, 39 deg Ambient) |
| SO2 | 0.9 | Case 2 (OFF Peak, 97 deg Ambient) |
| NH3 | 3.2 | Case 1 (ON Peak, 97 deg Ambient) |

*Baghouse PM control to 0.001 gr/dscf

| | Exhaust gas (lbmol/hr) | Exit velocity (m/s) |
|---|---|---|
| **Min HRSG fluegas to coal dryer (Case 4) =** | 28,788 | 5.84 |

Note: Coal dryer emission rates are relatively constant for both On- and OFF-peak operation.

**Annual average emissions from coal dryer stack**
**Basis:** Case 5 (ON Peak, Avg. Ambient)

| Coal Dryer Emissions | lb/hr |
|---|---|
| NOx | 4.2 |
| CO | 3.1 |
| VOC | 0.6 |
| $PM_{10}/PM_{2.5}$ | 1.4 |
| SO2 | 0.7 |
| NH3 | 3.1 |

*Baghouse PM control to 0.001 gr/dscf

| | Exhaust gas (lbmol/hr) | Exit velocity (m/s) |
|---|---|---|
| **HRSG fluegas to coal dryer (Case 5) =** | 29,102 | 5.90 |

**Startup/Shutdown - HRSG Stack & Coal Drying Stack**
Information provided by MHI

| Expected Emissions vs. CTG Load (Natural Gas) | | | | |
|---|---|---|---|---|
| | CTG load | | | |
| | 80% | 40% | 20% | units |
| NOx | 42 | 25 | 18 | ppmc |
| CO | 130 | 2900 | 5000 | ppmc |
| VOC | 1.1 | 9 | 50 | ppmc |
| $PM_{10}/PM_{2.5}$ | 15 | 15 | 15 | lb/hr |
| SOx* | 0.4 | 0.4 | 0.4 | ppmc |

* 0.4 ppmc SO2 in fluegas corresponds to about 12.6 ppmv total sulfur in natural gas fuel.

| Expected Emissions vs. CTG Load (Syngas) | | |
|---|---|---|
| | CTG load | |
| | 40% | units |
| NOx | 19 | ppmc |
| CO | 39 | ppmc |
| VOC | 2 | ppmc |
| $PM_{10}/PM_{2.5}$ | 13 | lb/hr |
| SOx | 2 | ppmvw |

| Compound | lb/lbmol |
|---|---|
| NO2 | 46.01 |
| CO | 28.01 |
| VOC | 16.04 |
| SO2 | 64.06 |
| NH3 | 17.03 |

| HRSG/Coal Drying Total Exhaust Flow Basis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Load/Fuel | 80% on NG | | 40% on NG | | 20% on NG | | 40% on Syngas | |
| O2 mol% (wet) | 11.41% | | 14.15% | | 15.22% | | 11.74% | |
| H2O mol% (wet) | 14.10% | | 10.63% | | 9.28% | | 10.50% | |
| MW | 27.79 | lb/lbmol | 28.05 | lb/lbmol | 28.16 | lb/lbmol | 27.66 | lb/lbmol |
| HRSG flue gas* | 167,600 | lbmol/hr | 138,400 | lbmol/hr | 127,400 | lbmol/hr | 140,200 | lbmol/hr |
| NOx Stack Conc (assumed) | 4 | ppmc | 25 | ppmc | 18 | ppmc | 10 | ppmc |
| CO Stack Conc (assumed) | 5 | ppmc | 400 | ppmc | 1000 | ppmc | 20 | ppmc |
| VOC Stack Conc (assumed) | 2 | ppmc | 9 | ppmc | 50 | ppmc | 2 | ppmc |
| NH3 slip | 5 | ppmc | 0 | | 0 | | 5 | ppmc |
| Turbine Fuel Flow | | | | | | | 14,218 | lbmol/hr |
| HRSG flue gas (wet) | 4,657,604 | lb/hr | 3,882,120 | lb/hr | 3,587,584 | lb/hr | 3,877,932 | lb/hr |
| HRSG flue gas (dry, corrected to 15% O2) | 185,516 | lbmol/hr | 106,371 | lbmol/hr | 81,062 | lbmol/hr | 165,183 | lbmol/hr |
| Duct Burner Gas HHV | | | | | | | 85 | MMBtu/hr |
| Coal Drying Flow (wet) | | | 480,180 | lb/hr | | | 480,180 | lb/hr |

*Includes gas routed to coal dryer.

| HRSG Startup | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | | SO2 | NOx | CO | $PM_{10}/PM_{2.5}$ | VOC | NH3 | Description | Flow (lbmol/hr) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) | Exit velocity (m/s) |
| 1. 20% on NG | 0.5 | lb/hr | 2.1 | 67.1 | 2270 | 15.0 | 65 | 0 | CTG ignition and synchronization | 127,400 | 17,045.88 | 41.03 | 12.51 |
| | | lb | 1.0 | 33.6 | 1135 | 7.5 | 32.4 | 0.0 | | | | | |
| 2. 40% on NG | 2 | lb/hr | 2.4 | 107.2 | 1044 | 13.1 | 13 | 0 | HRSG/STG Warm-up, Ramp CTG to 40% | 121,300 | 16,229.71 | 39.06 | 11.91 |
| | | lb | 4.8 | 214 | 2088 | 26.3 | 26.8 | 0.0 | | | | | |
| 3. 40% on Syngas | 50 | lb/hr | 2.4 | 66.6 | 81 | 13 | 4.6 | 0.0 | CTG fuel change over, Start up PSA/Ammonia/Urea Plant | 123,100 | 16,470.54 | 39.64 | 12.08 |
| | | lb | 120 | 3329 | 4052 | 657 | 232 | 0.0 | | | | | |
| **Tons/Startup** | | | **0.06** | **1.79** | **3.64** | **0.35** | **0.15** | **0.00** | | | | | |

*Coal drying starts at step 2 above.

``

| Coal Drying Startup | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | | SO2 | NOx | CO | $PM_{10}/PM_{2.5}$ | VOC | NH3 | Description | Flow (lbmol/hr) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) | Exit velocity (m/s) |
| 2. 40% on NG | 2 | lb/hr | 0.3 | 15.1 | 147.4 | 0.9 | 1.9 | 0.0 | Gasifier fuel changeover | 17,100 | 2,287.95 | 11.38 | 3.47 |
| | | lb | 0.7 | 30.3 | 294.7 | 1.9 | 3.8 | 0.0 | | | | | |
| 3. 40% on Syngas | 50 | lb/hr | 0.3 | 9.4 | 11.5 | 0.9 | 0.7 | 0.0 | GTG fuel change over, Start up PSA/Ammonia/Urea Plant | 17,400 | 2,328.09 | 11.58 | 3.53 |
| | | lb | 16.9 | 470 | 573 | 47 | 33 | 0.0 | | | | | |
| **Tons/Startup** | | | **0.01** | **0.25** | **0.43** | **0.02** | **0.02** | **0.00** | | | | | |

*PM emission rate based on 0.001 grain/dscf

| HRSG Shutdown | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | | SO2 | NOx | CO | $PM_{10}/PM_{2.5}$ | VOC | NH3 | Description | Flow (lbmol/hr) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) | Exit velocity (m/s) |
| 1. 40% on Syngas | 4 | lb/hr | 2.4 | 66.6 | 81.0 | 13 | 4.6 | 0.0 | PSA, Ammonia and Urea plant shutdown, Gasifier to 60%, CTG to 40% | 123,100 | 16,470.54 | 39.64 | 12.08 |
| | | lb | 9.6 | 266 | 324 | 52.6 | 18.5 | 0.0 | | | | | |
| 2. 40% on NG | 3 | lb/hr | 2.7 | 122 | 1191 | 15.0 | 15.3 | 0.0 | CTG fuel change over, Gasifier depressurization | 138,400 | 18,517.65 | 44.57 | 13.58 |
| | | lb | 8.2 | 367 | 3574 | 45.0 | 45.9 | 0.0 | | | | | |
| 3. 20% on NG | 2 | lb/hr | 2.1 | 67.1 | 2270 | 15.0 | 64.8 | 0.0 | Minimum plant load on NG | 127,400 | 17,045.88 | 41.03 | 12.51 |
| | | lb | 4.2 | 134 | 4539 | 30.0 | 129.7 | 0.0 | | | | | |
| **Tons/Shutdown** | | | **0.01** | **0.38** | **4.22** | **0.06** | **0.10** | **0.00** | | | | | |

| Coal Drying Shutdown | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | | SO2 | NOx | CO | $PM_{10}/PM_{2.5}$ | VOC | NH3 | Description | Flow (lbmol/hr) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) | Exit velocity (m/s) |
| 1. 40% on Syngas | 4 | lb/hr | 0.3 | 9.4 | 11.5 | 0.9 | 0.7 | 0.0 | PSA, Ammonia and Urea plant shutdown, Gasifier to 60%, CTG to 40% | 17,400 | 2,328.09 | 11.58 | 3.53 |
| | | lb | 1.4 | 37.6 | 45.8 | 3.8 | 2.6 | 0.0 | | | | | |
| **Tons/Startup** | | | **0.00** | **0.02** | **0.02** | **0.00** | **0.00** | **0.00** | | | | | |

*PM emission rate based on 0.001 grain/dscf

**CTG steady state operation at 80% load on natural gas for 2 weeks per year**

| HRSG Emissions - Natural Gas Operations | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | | SO2 | NOx (4 ppmc) | CO (5 ppmc) | $PM_{10}/PM_{2.5}$ | VOC (2 ppmc) | NH3 (5 ppmc) | Description | Flow (lbmol/hr) | Exhaust flow (ft3/sec) | Exit velocity (ft/sec) | Exit velocity (m/s) |
| 1. 80% on NG | 336 | lb/hr | 4.7 | 34.1 | 26.0 | 15.0 | 5.9 | 15.8 | CTG operation at 80% load on NG | 150,700 | 20,163.37 | 48.53 | 14.79 |
| | | lb | 1596 | 11469 | 8727 | 5040 | 1995 | 5298 | | | | | |
| **Tons/yr** | | | **0.80** | **5.73** | **4.36** | **2.52** | **1.00** | **2.65** | | | | | |
| Natural gas heat input (HHV) | 2400 | Emission Factors lb/MMBtu (HHV) | 0.002 | 0.015 | 0.011 | 0.007 | 0.003 | 0.007 | | | | | |

Heat Input = 2167x10^6 Btu/hr, LHV (approx 2400x10^6 btu/hr, HHV)

**HRSG & Coal Dryer Maximum Annual Operation Emissions**

| | HRSG, ton/yr | | | | Gasifier Coal Dryer, ton/yr | | |
|---|---|---|---|---|---|---|---|
| | **SU & SD** | **Normal Op** | **Nat Gas BU** | **Total** | **SU & SD** | **Normal Op** | **Total** |
| NOx | 4.34 | 99.6 | 5.73 | 109.7 | 0.54 | 16.9 | 17.4 |
| CO | 15.7 | 72.8 | 4.36 | 92.9 | 0.91 | 12.4 | 13.3 |
| VOC | 0.49 | 13.9 | 1.00 | 15.3 | 0.04 | 2.4 | 2.4 |
| $PM_{10}/PM_{2.5}$ | 0.82 | 51.3 | 2.52 | 54.6 | 0.05 | 5.6 | 5.6 |
| SO2* | 0.147 | 16.3 | 0.80 | 17.2 | 0.02 | 2.8 | 2.8 |
| NH3 | 0.00 | 73.6 | 2.65 | 76.3 | 0.00 | 12.5 | 12.5 |

**Maximum Annual Operation:**

| | | |
|---|---|---|
| SU & SD | 2 | per year |
| Normal op | 8000 | hr/yr |
| Nat gas op | 336 | hr/yr |

| Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS | | | | |
|---|---|---|---|---|
| **Source** | **HRSG** | | **Coal Dryer** | |
| Emission Scenario | Startup, Shutdown, Natural Gas | Normal On-peak (Case 1) | Startup, Shutdown | Normal On-peak (Case 1) |
| Emission rate (lb/hr) | 2.30 | 25.01 | 0.12 | 4.4 |

Normal operations are higher, therefore normal operating emissions used in NAAQS modeling

**CALCULATIONS FOR COMBINED CYCLE EMISSIONS**

**Basis: MHI Data for 501GAC, 1 on 1 with O2 Blown Gasifier (Lee Ranch Coal 75cal%/ Carson High Sulfur Coke 25cal%)**

| | **Case 1** | **Case 2** | **Case 3** | **Case 4** | **Case 5** | **Case 6** |
|---|---|---|---|---|---|---|
| Ambient temp, deg F | 97 | 97 | 39 | 39 | 65 | 65 |
| ON Peak/OFF Peak | ON | OFF | ON | OFF | ON | OFF |
| **HRSG Flue Gas Split to Coal Dryer** | | | | | | |
| Flue gas to coal dryer, lbmol/hr (wet) | 29,208 | 28,996 | 28,996 | 28,788 | 29,102 | 28,996 |
| Flue gas to HRSG stack, lbmol/hr (w) | 167,092 | 126,704 | 176,804 | 142,412 | 171,498 | 135,904 |
| **Coal Dryer Stack Emissions** | | | | | | |
| NOx, lb/hr | 4.4 | 4.3 | 4.1 | 3.8 | 4.2 | 4.0 |
| CO, lb/hr | 3.2 | 3.1 | 3.0 | 2.8 | 3.1 | 2.9 |
| VOC, lb/hr | 0.61 | 0.59 | 0.57 | 0.52 | 0.59 | 0.55 |
| Particulate, lb/hr (3) | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| SO2, lb/hr | 0.7 | 0.9 | 0.7 | 0.8 | 0.7 | 0.8 |
| NH3, lb/hr | 3.23 | 3.16 | 3.0 | 2.8 | 3.1 | 2.9 |
| **HRSG Stack Emissions** | | | | | | |
| NOx, lb/hr | 25.01 | 18.7 | 24.96 | 18.7 | 24.9 | 18.6 |
| CO, lb/hr | 18.3 | 13.6 | 18.2 | 13.6 | 18.2 | 13.6 |
| VOC, lb/hr | 3.48 | 2.60 | 3.47 | 2.59 | 3.47 | 2.59 |
| Particulate, lb/hr | 12.77 | 12.21 | 12.89 | 12.48 | 12.82 | 12.36 |
| SO2, lb/hr | 4.06 | 4.09 | 4.09 | 4.03 | 4.07 | 3.98 |
| NH3, lb/hr | 18.5 | 13.8 | 18.4 | 13.8 | 18.4 | 13.8 |

**Notes:**
(1) "ppmc" denotes parts per million by volume, dry, corrected to 15% O2
(2) Sulfur in the PSA Off-gas is based on the total sulfur quantity in the feed to the PSA
(3) PM emission from coal dryer based on stack baghouse outlet dust loading of 0.001 grain/dscf.

4/17/2012

**Description**

Mainly used for startups, could be used for other purposes, primarily during power block outages.

Maximum steam generation 150,000 lb/hr
Maximum heat release 213 10^6 Btu/hr, HHV
Natural gas fuel, only

| Emission factors | | |
|---|---|---|
| | **lb/10^6 Btu, HHV** | **Basis** |
| SO2 | 0.00204 | 12.65 ppmv total sulfur in pipeline natural gas (max short-term) |
| NOx | 0.006 | Low NOx burner and SCR, 5 ppmvd (3% O2) |
| CO | 0.037 | 50 ppmvd (3% O2) |
| $PM_{10}/PM_{2.5}$ | 0.005 | Similar equipment from previous project |
| VOC | 0.004 | Similar equipment from previous project |
| NH3 | 0.0022 | 5 ppmvd (3% O2) NH3 slip |

| Emissions | | |
|---|---|---|
| | **Max short-term lb/hr (1)** | **Annual average ton/yr (2)** |
| SO2 | 0.4 | 0.48 |
| NOx | 1.3 | 1.4 |
| CO | 7.9 | 8.6 |
| $PM_{10}/PM_{2.5}$ | 1.07 | 1.17 |
| VOC | 0.85 | 0.93 |
| NH3 | 0.47 | 0.51 |

Notes:

(1) Maximum 1-hr, 3-hr, 8-hr, and 24-hr average emission rates.

(2) Maximum annual capacity factor of 25% (i.e., annual fuel consumption less than 0.25 x 8760 hr/yr x 213 million Btu/hr = 466 billion Btu/yr)

4/17/2012

**Description**

The Tail Gas Thermal Oxidizer (TGTO) is primarily intended to safely dispose of SRU tail gas in the event of an emergency or upset. The TGTO will also be be used to dispose of waste gas during SRU startups and to futher dispose of miscellaneous vent streams from the gasification area. These vent streams may contain trace amounts of reduced sulfur compounds and/or ammonia that could cause nuisance odors if vented directly to the atmosphere.

**Process Vent Disposal**

Assume nominal natural gas fuel consumption = 13 million Btu/hr

Assume an allowance of 2 lb/hr SO2 emission to account for sulfur in the various vent streams plus fuel.

Emission Calculations

| | | |
|---|---|---|
| NOx = | 0.24 | lb/10^6 Btu, HHV (based on previous project, 54 ppmvd @ 3% O2) |
| = | 3.1 | lb/hr |
| CO = | 0.2 | lb/10^6 Btu, HHV (based on previous project, 74 ppmvd @ 3% O2) |
| = | 2.6 | lbhr |
| SO2 = | 2 | lb/hr |
| VOC = | 0.006 | lb/10^6 Btu, HHV (AP-42, Table1.4 -2) |
| = | 0.1 | lb/hr |
| $PM_{10}/PM_{2.5}$ = | 0.008 | lb/10^6 Btu, HHV (AP-42, Table1.4 -2) |
| = | 0.1 | lb/hr |

**SRU startup natural gas combustion products disposal**

Waste gas

Natural gas fuel 80 x 10^6 Btu/hr, HHV

Emission Calculations

(emission factors same as above)

| | | |
|---|---|---|
| NOx = | 0.24 | lb/10^6 Btu, HHV |
| = | 19.2 | lbhr |
| CO = | 0.2 | lb/10^6 Btu, HHV |
| = | 16.0 | lbhr |
| SO2 = | 0.00204 | lb/10^6 Btu, HHV |
| = | 0.16 | lbhr |
| VOC = | 0.006 | lb/10^6 Btu, HHV |
| = | 0.48 | lbhr |
| $PM_{10}/PM_{2.5}$ = | 0.008 | lb/10^6 Btu, HHV |
| = | 0.64 | lbhr |

**Maximum Short-term Emission Rates**

| | lb/hr |
|---|---|
| NOx | 22.3 |
| CO | 18.6 |
| SO2 | 2.2 |
| VOC | 0.6 |
| $PM_{10}/PM_{2.5}$ | 0.7 |

**Annualized Startup Emission rate for NO2 1-hr NAAQS**

lb/hr

0.1223

Normal operations are higher, therefore normal operating emissions used in NAAQS modeling

**Annual Emission Calculations**

Assumed annual operating scenario

TGTO normal operation for disposing miscellaneous vent gas

8314 hr/yr

| | | |
|---|---|---|
| NOx = | 13.0 | ton/yr |
| CO = | 10.8 | ton/yr |
| SO2 = | 8.3 | ton/yr |
| VOC = | 0.32 | ton/yr |
| $PM_{10}/PM_{2.5}$ = | 0.43 | ton/yr |

SRU startup hrs/yr = 48 (approx 2 events @ 80 x 10^6 Btu/hr)

| | | |
|---|---|---|
| NOx = | 0.461 | ton/yr |
| CO = | 0.3840 | ton/yr |
| SO2 = | 0.0039 | ton/yr |
| VOC = | 0.0115 | ton/yr |
| $PM_{10}/PM_{2.5}$ = | 0.0154 | ton/yr |

Total annual emission

| | | |
|---|---|---|
| NOx = | 13.43 | ton/yr |
| CO = | 11.19 | ton/yr |
| SO2 = | 8.32 | ton/yr |
| VOC = | 0.34 | ton/yr |
| $PM_{10}/PM_{2.5}$ = | 0.45 | ton/yr |

4/17/2012

**CO2 Vent Maximum Operations**

**Short-term Emission Rates**

| | | | |
|---|---|---|---|
| Total flow = | 761,400 | lb/hr | *Based on 380.7 stph CO2 to pipeline from |
| = | 17,584 | lbmol/hr | Plant Performance Study |
| H2S = | 10 | ppmv | |
| = | 6.0 | lb/hr | |
| COS = | 10 | ppmv | |
| | 10.6 | lb/hr | |
| CO = | 1000 | ppmv | (ranges from 500 to 1000 ppmv) |
| = | 492 | lb/hr | |
| VOC (MeOH) = | 40 | ppmv | |
| | 11 | lb/hr (as CH4) | |

**Annual Emissions**

| | | |
|---|---|---|
| Assume | 21 | days/yr CO2 venting at full rate |
| | 10 | ppmv COS, annual average concentration |
| H2S = | 1.5 | ton/yr (based on 10 ppmv) |
| COS = | 2.7 | ton/yr (as COS, based on 10 ppmv) |
| CO = | 124 | ton/yr (based on 1000 ppmv) |
| VOC = | 2.8 | ton/yr (as CH4, based on 40 ppmv) |

Note: These emissions represent the maximum emissions associated with Infrequent venting of product CO2.

**Emission factors**

| | lb/10^6 Btu, HHV | Basis |
|---|---|---|
| **Normal Operation (each flare) - pilots only, natural gas fuel** | | |
| SO2 | 0.00204 | 12.65 ppmv total sulfur in pipeline natural gas |
| NOx | 0.12 | Supplier data |
| CO | 0.08 | Supplier data |
| $PM_{10}/PM_{2.5}$ | 0.003 | Supplier data |
| VOC | 0.0013 | 99% VOC destruction for typical natural gas |
| **Gasifier Startup - waste gases or H2-rich gas to Gasification Flare** | | |
| SO2 | negligible | Startup - no sulfur in startup feed |
| NOx | 0.07 | Supplier data |
| CO (1) | 2 | Supplier data (98% destruction of CO in waste gas) |
| CO (2) | 0.37 | Supplier data |
| $PM_{10}/PM_{2.5}$ | negligible | Supplier data |
| VOC | negligible | no VOC in waste gas or H2-rich gas |

(1) Unshifted syngas
(2) Shifted syngas

**Short-term Emission Calculations**
Normal Operation - include pilots only, natural gas fuel
Maximum emissions include max of startup or shutdown plus pilot

Gasification Flare pilot fuel = 0.5 x 10^6 Btu/hr
SRU and Rectisol Flares pilot fuel = 0.3 x 10^6 Btu/hr, each

| | Pilot | Max hourly emissions | Max daily emissions |
|---|---|---|---|
| | lb/hr | lb/hr | lb/hr |
| **Gasification Flare** | | | |
| SO2 | 0.00102 | 6.0 | 0.2 |
| NOx | 0.06 | 351.2 | 35.7 |
| CO | 0.04 | 4772.0 | 283.0 |
| $PM_{10}/PM_{2.5}$ | 0.0015 | 8.8 | 0.4 |
| VOC | 0.0007 | 3.8 | 0.2 |
| **SRU Flare** | | | |
| SO2 | 0.0006 | 18.4 | 18.4 |
| NOx | 0.036 | 7.9 | 7.9 |
| CO | 0.0240 | 2.9 | 2.9 |
| $PM_{10}/PM_{2.5}$ | 0.0009 | 0.1 | 0.1 |
| VOC | 0.0004 | 0.05 | 0.05 |
| **Rectisol Flare** | | | |
| SO2 | 0.0006 | 15.0 | 15.0 |
| NOx | 0.036 | 51.6 | 51.6 |
| CO | 0.0240 | 34.4 | 34.4 |
| $PM_{10}/PM_{2.5}$ | 0.0009 | 1.3 | 1.3 |
| VOC | 0.0004 | 0.6 | 0.6 |

**Startup/Shutdown - Gasification Flare**
*Based on Startup/Shutdown Procedures provided by MHI for the PurGen One Project

| Startup | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Step | Duration (hrs) | Heat Input (mmbtu/hr) | | SO2 | Nox | CO | $PM_{10}/PM_{2.5}$ | VOC |
| 2. Flaring NG | 3 | 2,926 | lb/hr | 6.0 | 351.2 | 234.1 | 8.8 | 3.8 |
| | | | lb | 17.9 | 1053.5 | 702.3 | 26.3 | 11.4 |
| 3. Flaring Unshifted Syngas | 2 | 2,386 | lb/hr | 0.0 | 167.0 | 4772.0 | 0.0 | 0.0 |
| | | | lb | 0.0 | 334.0 | 9544.0 | 0.0 | 0.0 |
| 4. Flaring Shifted Syngas | 5 | 2,413 | lb/hr | 0.0 | 168.9 | 892.8 | 0.0 | 0.0 |
| | | | lb | 0.0 | 844.6 | 4464.1 | 0.0 | 0.0 |
| **Tons/Startup** | | | | **0.01** | **1.12** | **7.36** | **0.01** | **0.01** |

| Shutdown | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Step | hrs | mmbtu/hr | | SO2 | Nox | CO | $PM_{10}/PM_{2.5}$ | VOC |
| 1. Flaring Shifted Syngas | 4 | 2,413 | lb/hr | 0 | 169 | 893 | 0 | 0 |
| | | | lb | 0 | 676 | 3,571 | 0 | 0 |
| **Tons/Shutdown** | | | | **0.00** | **0.34** | **1.79** | **0.00** | **0.00** |

**Gasification Flare**
Pilot gas = 4380 x 10^6 Btu
2 startups/shutdowns per year

**Gasification Flare Annual Emissions**

| | ton/yr | | |
|---|---|---|---|
| | **S/U and S/D** | **Pilot** | **Total** |
| SO2 | 0.02 | 0.004 | 0.022 |
| NOx | 2.91 | 0.263 | 3.170 |
| CO | 18.28 | 0.175 | 18.457 |
| $PM_{10}/PM_{2.5}$ | 0.026 | 0.007 | 0.033 |
| VOC | 0.01 | 0.003 | 0.014 |

**Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS**

| lb/hr |
|---|
| 0.66 |

**Startup/Shutdown Operation - SRU Flare**

Acid gas vent to elevated flare prior to introducng to SRU
Acid gas = 4600 lb/hr SO2 = 72 lbmol/hr H2S
Assume 99.6% sulfur removal for caustic scrubber:
Scrubbed acid gas = 18.4 lb/hr SO2
plus approx 25,000 to 140,000 scf/hr of mostly CO2 and other inerts
Assume 36 x10^6 Btu/hr of natural gas assist fuel
added to scrubbed acid gas for flaring.
Approximate heating value of mixed gas to flare
= 36 x10^6 Btu /(140,000 + 36,000) scf
= 205 Btu/scf, adequate for combustion

**Estimated Startup SRU Flare Emissions - flaring scrubbed acid gas**

| | lb/hr |
|---|---|
| SO2 | 18.4 |
| NOx | 4.3 |
| CO | 2.9 |
| $PM_{10}/PM_{2.5}$ | 0.11 |
| VOC | 0.05 |

***99.6% effective caustic scrubber***

(Emissions for NOX, CO, PM10, and VOC based on factors for natural gas pilots above)

**SRU Flare**

SRU startup vent gas to flare 1) = 40 hr /yr*

Pilot gas = 2628 x 10^6 Btu

**SRU Flare Annual Emissions**

| | ton/yr | | |
|---|---|---|---|
| | S/U and S/D | Pilot | Total |
| SO2 | 0.368 | 0.003 | 0.371 |
| NOx | 0.086 | 0.16 | 0.24 |
| CO | 0.058 | 0.11 | 0.16 |
| $PM_{10}/PM_{2.5}$ | 0.002 | 0.004 | 0.006 |
| VOC | 0.001 | 0.002 | 0.003 |

**Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS**

| lb/hr |
|---|
| 0.02 |

**Startup Operation - Rectisol Flare**

CO2 gas vent to Rectisol Flare until within product specification

Vent gas flow = 4,542 lbmol/hr = 430 x 10^6 Btu/hr, HHV

Sulfur in vent gas = 50 ppmv,max

**Estimated Startup Rectisol Flare Emissions**

| | lb/hr |
|---|---|
| SO2 | 15 |
| NOx | 51.6 |
| CO | 34.4 |
| $PM_{10}/PM_{2.5}$ | 1.3 |
| VOC | 0.6 |

(Emissions for NOX, CO, PM10, and VOC based on factors for natural gas pilots above)

**Rectisol Flare**

Rectisol startup vent gas to flare = 40 hr /yr

Pilot gas = 2628 x 10^6 Btu

**Rectisol Flare Annual Emissions**

| | ton/yr | | |
|---|---|---|---|
| | S/U and S/D | Pilot | Total |
| SO2 | 0.30 | 0.003 | 0.303 |
| NOx | 1.03 | 0.2 | 1.190 |
| CO | 0.69 | 0.1 | 0.793 |
| $PM_{10}/PM_{2.5}$ | 0.03 | 0.004 | 0.030 |
| VOC | 0.01 | 0.002 | 0.013 |

**Annualized Startup/Shut down Emission rate for NO2 1-hr NAAQS**

| lb/hr |
|---|
| 0.24 |

## Flare Stack Parameters

*4/17/2012*

| Parameter | Rectisol Flare (during startup and shutdown) | Rectisol Flare (during normal pilot gas mode) | Rectisol Flare Annualized for NO2 1-hr NAAQS | Gasification Flare (during startup flare nitrogen) | Gasification Flare (during startup flare unshifted syngas gas) | Gasification Flare (during startup flare shifted syngas, sweet) | Gasification Flare (during normal pilot gas mode) | Gasification Flare annualized for NO2 1-hr NAAQS | SRU Flare (during Gasifier Startup and Shutdown) | SRU Flare (during normal pilot gas mode) | SRU Flare Annualized for NO2 1-hr NAAQS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat release rate for flare+pilot, ($10^6$ Btu/hr HHV) | 430 | 0.3 | 2.263 | 2,926 | 2,386 | 2,413 | 0.5 | 4.526 | 36 | 0.3 | 0.464 |
| H = Total Heat release rate (cal/s) | 3.01E+07 | 2.10E+04 | 1.58E+05 | 2.05E+08 | 1.67E+08 | 1.69E+08 | 3.50E+04 | 3.17E+05 | 2.52E+06 | 2.10E+04 | 3.25E+04 |
| Fb = Buoyancy flux | 5.00E+02 | 3.49E-01 | 2.63E+00 | 3.40E+03 | 2.77E+03 | 2.80E+03 | 5.81E-01 | 5.26E+00 | 4.18E+01 | 3.49E-01 | 5.40E-01 |
| $Q_H$ = sensible heat release rate | 1.35E+07 | 9.45E+03 | 7.13E+04 | 9.22E+07 | 7.52E+07 | 7.60E+07 | 1.57E+04 | 1.43E+05 | 1.13E+06 | 9.45E+03 | 1.46E+04 |
| Actual Stack height (m) | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 |
| GEP stack height for modeling (m) | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| AERMOD Input parameters | | | | | | | | | | | |
| He = Effective stack height (m) as calculated in SCREEN3 | 82.13 | 65.53 | 66.39 | 107.84 | 103.85 | 104.06 | 65.68 | 66.94 | 70.23 | 65.53 | 65.65 |
| T = Stack temperature (K) | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |
| v = Exit velocity (m/s) | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| d = effective stack diameter (m) | 3.636 | 0.096 | 0.264 | 9.486 | 8.565 | 8.614 | 0.124 | 0.373 | 1.052 | 0.096 | 0.119 |

Flare stack parameters are based on calculated using the SCREEN3 technique

Fb = Buoyancy flux = 1.66 x 10-5 x H

QH = sensible heat release rate = 0.45 x H

He = Effective stack height (m) = Hs + 4.56E-03 * H^0.478

BTU/hr to cal/sec 0.06999882

4/17/2012

| Cooling Tower Operating Data and Emission Calculation | | | | |
|---|---|---|---|---|
| **Parameter** | **Process** | **Power Block** | **ASU** | **Basis** |
| Cooling water (CW) circulation rate, gpm | 162,582 | 95,500 | 44,876 | Typical plant performance |
| CW circulation rate, million lb/hr | 81 | 48 | 22 | |
| CW dissolved solids, ppmw | 9,000 | 9,000 | 2,000 | (See note) |
| Drift, fraction of circulating CW | 0.0005% | 0.0005% | 0.0005% | Expected BACT |
| PM10 emission rate, lb/hr | 3.7 | 2.1 | 0.2 | Calculated |
| PM10 emission rate, ton/yr | 15.2 | 9.3 | 0.9 | Calculated |
| PM2.5 emission rate, lb/hr | 2.2 | 1.3 | 0.1 | PM2.5 portion is equal to 60% of PM10 |
| PM2.5 emission rate, ton/yr | 9.1 | 5.6 | 0.6 | PM2.5 portion is equal to 60% of PM10 |
| Annual operation (hours/yr) | 8314 | 8668 | 8314 | |
| Cells per cooling tower | 13 | 12 | 4 | |

*Notes:* Basis: Supplier data
Assumed maximum TDS in circulating cooling water, normally TDS will be less.
Each tower assumed to operate at full capacity, when operating.
Cooling water circulation rates and dissolved solids concentrations may vary, but in combination will not exceed the stated particulate emission rates.
Portion of PM10 that is PM2.5 60%

4/17/2012

**Emergency Generator - Expected Emergency Operation and Maintenance**

| | | |
|---|---|---|
| **Total Hours of Operation** | 50 | hr/yr |
| **Generator Specification** | 2,922 | Bhp |

**Generator Pollutant Emission Factors (per generator)**

| | |
|---|---|
| NOx (g/Bhp/hr) | 0.50 |
| CO (g/Bhp/hr) | 2.60 |
| VOC (g/Bhp/hr) | 0.30 |
| $SO_2$ (g/Bhp/hr) | N/A |
| $PM_{10} = PM_{2.5}$ (g/Bhp/hr) | 0.07 |

Source: CARB Tier 4 Interim Standard

**Generator Pollutant Emission Rates (per generator)**

| | **Generator Emissions** | | | |
|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **lb/day** | **lb/yr** | **ton/yr** |
| NOx | 3.22 | 3.22 | 161.04 | 0.08 |
| CO | 16.75 | 16.75 | 837.43 | 0.42 |
| VOC | 1.93 | 1.93 | 96.63 | 0.05 |
| $SO_2$ | 0.03 | 0.03 | 1.40 | 0.00 |
| $PM_{10} = PM_{2.5}$ | 0.45 | 0.45 | 22.55 | 0.01 |

| | | |
|---|---|---|
| Fuel sulfur content = | 15 | ppmw |
| $SO_2$ emissions = | 0.20 | lb $SO_2$/1000 gal |
| Fuel flow | 140.00 | gal/hr |

Pounds per day assumes 1 hour of operation for maintenance and testing per engine.

***Please note that there are two generators; all emissions are shown for individual generators.***

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**Modeling Worst-Case 1 hr Emissions (per generator)** / **Annualized lb/hr for NO2 1-hr NAAQS**

| | | |
|---|---|---|
| NOx (g/sec) | 0.4 | 0.0184 |
| CO (g/sec) | 2.1 | |
| $SO_2$ (g/sec) | 0.004 | |

Only NOx, CO, and $SO_2$ are considered for an average 1-hour Ambient Air Quality Standard.

**Parameters**

| | |
|---|---|
| Days per year: | 365 |
| Hours per day: | 24 |
| Minutes per hour: | 60 |
| Seconds per minute: | 60 |

**Modeling Worst-Case 3 hr Emissions (per generator)**

| | |
|---|---|
| $SO_2$ (lb/3-hr) | 0.03 |
| $SO_2$ (g/sec) | 0.001 |

Only $SO_2$ is considered for an average 3-hour Ambient Air Quality Standard.
Pounds per 3-hr assumes two (2) hours of operation.

**Modeling Worst-Case 8 hr Emissions (per generator)**

| | |
|---|---|
| CO (lb/8-hr) | 16.75 |
| CO (g/sec) | 0.26 |

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Pounds per 8-hr assumes two (2) hours of operation.

**Modeling Worst-Case 24 Hour Emissions (per generator)**

| | |
|---|---|
| $SO_2$ (lb/24-hr) | 0.03 |
| $SO_2$ (g/sec) | 0.0001 |
| $PM_{10} = PM_{2.5}$ (lb/24-hr) | 0.45 |
| $PM_{10} = PM_{2.5}$ (g/sec) | 0.002 |

Only $SO_2$ and PM are considered for an average 24-hour Ambient Air Quality Standard.
Pounds per 24-hr assumes two (2) hours of operation.

**Modeling Annual Average Emissions (per generator)** / **Annual Emissions (tons/yr)**

| | | per generator | both generators |
|---|---|---|---|
| NOx (g/sec) | 0.002 | 0.081 | 0.161 |
| CO (g/sec) | 0.012 | 0.419 | 0.837 |
| VOC (g/sec) | 0.001 | 0.048 | 0.097 |
| $SO_2$ (g/sec) | 0.00002 | 0.001 | 0.001 |
| $PM_{10} = PM_{2.5}$ (g/sec) | 0.0003 | 0.011 | 0.023 |

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### Fire Water Pump - Expected Emergency Operation and Maintenance

| | | |
|---|---|---|
| **Total Hours of Operation** | 100 | hr/yr |
| **Fire Water Pump Specification** | 556 | Bhp |

### Fire Water Pump Pollutant Emission Factors

| | |
|---|---|
| NOx (g/Bhp/hr) | 1.50 |
| CO (g/Bhp/hr) | 2.60 |
| VOC (g/Bhp/hr) | 0.14 |
| $SO_2$ (g/Bhp/hr) | N/A |
| $PM_{10} = PM_{2.5}$ (g/Bhp/hr) | 0.015 |

Source: CARB Tier 4 Interim Standard

### Fire Water Pump Pollutant Emission Rates

| | Fire Water Pump Emissions | | | |
|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **lb/day** | **lb/yr** | **ton/yr** |
| NOx | 1.84 | 3.68 | 183.86 | 0.1 |
| CO | 3.19 | 6.37 | 318.69 | 0.2 |
| VOC | 0.17 | 0.34 | 17.16 | 0.01 |
| $SO_2$ | 0.01 | 0.01 | 0.56 | 0.0003 |
| $PM_{10} = PM_{2.5}$ | 0.02 | 0.04 | 1.84 | 0.00 |

| | | |
|---|---|---|
| Fuel sulfur content = | 15 | ppmw |
| $SO_2$ emissions = | 0.20 | lb $SO_2$/1000 gal |
| Fuel flow | 28.00 | gal/hr |

Pounds per day assumes two (2) hours of operation for maintenance and testing.

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### Modeling Worst-Case 1 hr Emissions

| | | Annualized lb/hr for NO2 1-hr NAAQS |
|---|---|---|
| NOx (g/sec) | 0.2 | 0.02 |
| CO (g/sec) | 0.4 | |
| $SO_2$ (g/sec) | 0.0007 | |

Only NOx, CO, and $SO_2$ are considered for an average 1-hour Ambient Air Quality Standard

### Parameters

| | |
|---|---|
| Days per year: | 365 |
| Hours per day: | 24 |
| Minutes per hour: | 60 |
| Seconds per minute: | 60 |

### Modeling Worst-Case 3 hr Emissions

| | |
|---|---|
| $SO_2$ (lb/3-hr) | 0.01 |
| $SO_2$ (g/sec) | 0.0005 |

Only $SO_2$ is considered for an average 3-hour Ambient Air Quality Standard.
Pounds per 3-hr assumes two (2) hours of operation.

### Modeling Worst-Case 8 hr Emissions

| | |
|---|---|
| CO (lb/8-hr) | 6.37 |
| CO (g/sec) | 0.1 |

Only CO is considered for an average 8-hour Ambient Air Quality Standard.
Pounds per 8-hr assumes two (2) hours of operation.

### Modeling Worst-Case 24 Hour Emissions

| | |
|---|---|
| $SO_2$ (lb/24-hr) | 0.01 |
| $SO_2$ (g/sec) | 0.0001 |
| $PM_{10} = PM_{2.5}$ (lb/24-hr) | 0.04 |
| $PM_{10} = PM_{2.5}$ (g/sec) | 0.0002 |

Only $SO_2$ and PM are considered for an average 24-hour Ambient Air Quality Standard.
Pounds per 24-hr assumes two (2) hours of operation.

### Modeling Annual Average Emissions

| | | tons/yr |
|---|---|---|
| NOx (g/sec) | 0.003 | 0.092 |
| CO (g/sec) | 0.005 | 0.159 |
| VOC (g/sec) | 0.0002 | 0.009 |
| $SO_2$ (g/sec) | 0.00001 | 0.000 |
| $PM_{10} = PM_{2.5}$ (g/sec) | 0.00003 | 0.001 |

## Ammonia Synthesis Plant Startup Heater

| | | |
|---|---|---|
| Maximum heat release | 55 | 10^6 Btu/hr, HHV |
| Maximum annual usage: | 7,700 | 10^6 Btu/yr, HHV |
| (equivalent to | 140 | hours @ full capacity) |

**Emission factors**

| | lb/10^6 Btu, HHV | Basis |
|---|---|---|
| SO2 | 0.00204 | 12.65 ppmv total sulfur in pipeline natural gas (max short-term) |
| NOx | 0.011 | Low NOx burner, 9 ppmvd (3% O2) |
| CO | 0.037 | 50 ppmvd (3% O2) |
| $PM_{10}/PM_{2.5}$ | 0.005 | Similar equipment from previous project |
| VOC | 0.004 | Similar equipment from previous project |

| | Max short-term lb/hr | Annual average ton/yr |
|---|---|---|
| SO2 | 0.1 | 0.0079 |
| NOx | 0.6 | 0.0420 |
| CO | 2.0 | 0.1425 |
| $PM_{10}/PM_{2.5}$ | 0.3 | 0.0193 |
| VOC | 0.2 | 0.0154 |

Used only for Ammonia Plant Startup only.
Natural gas fuel

**Annualized Startup Emission rate for NO2 1-hr NAAQS**

| lb/hr |
|---|
| 0.010 |

## Urea HP & LP Absorber Emission Calculation

| Reference Plant | | | HECA | | |
|---|---|---|---|---|---|
| Plant Capacity = | 3,360 | tpd (metric) | Plant Capacity = | 1,701 | stpd |
| Urea HP Absorber NH3 = | 11 | kg/hr | Urea HP Absorber NH3 = | 11.1 | lb/hr |
| Urea LP Absorber NH3 = | 2 | kg/hr | Urea LP Absorber NH3 = | 2.0 | lb/hr |

Reference plant information is from technical proposal provided by UreaCasale for the SCS PurGen One project.

## Urea Pastillation Emission Calculation

| Reference Plant | | | HECA | | |
|---|---|---|---|---|---|
| Plant Max Capacity = | 3,855 | stpd | Plant Capacity = | 1,701 | stpd |
| Total Air Flow = | 21,000 | $m^3$/hr | NH3 Emission = | 1.02 | lb/hr |
| Ammonia Concentration = | 50 | mg/$m^3$ | Urea Dust Emission = | 0.05 | lb/hr |
| Urea Dust = | 0.001 | gr/dscf | Annual operating hours | 8052 | hours/year |
| | | | PM Annual Emissions = | 0.20 | tons/yr |

Reference plant information provided by Sandvik Fellbach for the SCS PurGen One project.
All PM emissions are PM2.5 or smaller

## Nitric Acid Plant Emission Calculation

**HECA**

| | | |
|---|---|---|
| Nitric Acid Production = | 501 | STPD |
| NOx Emissions Factor* = | 0.20 | lb/T |
| NOx Emissions = | 4.18 | lb/hr |
| NH3 Emissions = | 0.5 | lb/hr |
| Annual operating hours | 8052 | hours/year |
| NOx Annual Emissions = | 16.8 | tons/yr |

*Emission factor based on use of the Udhe EnviNOx system. Approx 15 ppmv NOx in vent gas
50% NO2/NOx in-stack ratio used in NAAQS modeling

## Ammonium Nitrate Plant Emission Calculation

**HECA**

| | | |
|---|---|---|
| Ammonium Nitrate Production = | 636 | STPD |
| PM Emissions = | 0.20 | lb/hr |
| Annual operating hours | 8000 | hours/year |
| PM Annual Emissions = | 0.80 | tons/yr |

Vendor provided emission rate
All PM emissions are PM2.5 or smaller

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| Material Handling Emissions | | | | | | | Stack Parameters for Modeling | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Release Point** | **Operating Capacity** | | **Flow** | **Grain Loading** | **Emissions** | | **Stack Diameter** | **Stack Height** | **Stack velocity** | **Stack velocity** |
| **Coal/Coke Storage and Handling** | hr/day | day/week | ACFM | gr/dscf | Total PM (lb/hr) | Total PM (tons/yr) | ft | ft | (ft/sec) | (m/s) |
| 17 Coal Rail Unloading Station | 8 | 5 | 20,000 | 0.001 | 0.17 | 0.18 | 3 | 30 | 47.2 | 14.4 |
| 18 Coal Transfer Tower | 12 | 7 | 1,500 | 0.001 | 0.01 | 0.03 | 0.83 | 100 | 46.2 | 14.1 |
| **20** Coal/Coke Truck Unloading Station | 12 | 5 | 80,000 | 0.001 | 0.69 | 1.07 | 6 | 60 | 47.2 | 14.4 |
| 22 Coal/Coke Transfer Tower B | 12 | 5 | 1,500 | 0.001 | 0.01 | 0.02 | 0.83 | 100 | 46.2 | 14.1 |
| 19 Coal/Coke Crusher Building | 12 | 7 | 1,500 | 0.001 | 0.01 | 0.03 | 0.83 | 100 | 46.2 | 14.1 |
| **Urea Storage and Handling** | | | | | | | | | | |
| 30 Urea Bucket Elevator to Conveyor | 24 | 7 | 1,500 | 0.001 | 0.01 | 0.06 | 0.83 | 50 | 46.2 | 14.1 |
| 31 Urea Transfer Tower 1 | 24 | 7 | 1500 | 0.001 | 0.01 | 0.06 | 0.83 | 100 | 46.2 | 14.1 |
| 32 Urea Transfer Tower 2 | 24 | 1.75 | 1500 | 0.001 | 0.01 | 0.01 | 0.83 | 100 | 46.2 | 14.1 |
| 33 Urea Transfer Tower 3 | 24 | 3.5 | 1500 | 0.001 | 0.01 | 0.03 | 0.83 | 100 | 46.2 | 14.1 |
| 34 Urea Transfer Tower 4 | 24 | 1.75 | 1500 | 0.001 | 0.01 | 0.01 | 0.83 | 100 | 46.2 | 14.1 |
| 35 Urea Transfer Tower 5 | 8 | 5 | 1500 | 0.001 | 0.01 | 0.01 | 0.83 | 100 | 46.2 | 14.1 |
| 23 Urea Loading Bldg Baghouse 1 | 8 | 5 | 20,000 | 0.001 | 0.17 | 0.18 | 3 | 30 | 47.2 | 14.4 |
| 24 Urea Loading Bldg Baghouse 2 | 8 | 5 | 10,000 | 0.001 | 0.09 | 0.09 | 2 | 30 | 53.1 | 16.2 |
| **Gasification Solids Storage and Handling** | | | | | | | | | | |
| 25 Gasification Solids Bunker & Pad | 24 | 7 | - | - | 0.02 | 0.09 | NA | | | |
| 28 Gasification Solids Transfer Tower | 8 | 3 | 3,000 | 0.001 | 0.03 | 0.02 | 1.17 | 30 | 46.5 | 14.2 |
| 29 Gasification Solids Load-Out System | 8 | 3 | 10,000 | 0.001 | 0.09 | 0.05 | 2 | 30 | 53.1 | 16.2 |
| | | | | Total = | **1.36** | **1.93** | | | | |

All PM emissions are PM2.5 or smaller

| Source | HRSG Stack[2] ON-Peak | HRSG Stack[2] OFF-Peak | Gasification Coal Dryer Stack[3] | Urea Plant Absorbers MP | Urea Plant Absorbers LP | Urea Pastillation Stack | Nitric Acid Plant Stack | Gasification Flare |
|---|---|---|---|---|---|---|---|---|
| Stack height, ft above grade[1] | 213 | 213 | 305 | 130 | 50 | 50 | 145 | 250 |
| Stack diameter, ft | 23 | 23 | 16 | 1 | 1 | 1.5 | 8 | 9.8 |
| Stack outlet temp, deg F | 200 | 200 | 200 | 122 | 119 | ambient | 239 | (NA) |
| Stack exit flow, act ft3/sec | 22,357 | 16,953 | 3,852 | 19 | 19 | 111 | 860 | varies per scenario |
| Stack exit velocity (ft/sec) | 53.81 | 40.80 | 19.16 | 24.19 | 24.19 | 62.81 | 17.11 | |
| Stack exit velocity (m/sec) | 16.40 | 12.44 | 5.84 | 7.37 | 7.37 | 19.15 | 5.21 | |

| Source | SRU Flare | Rectisol Flare | Cooling Towers (per cell)[4] | Tail Gas Oxidizer | Fire Pump Engine | Diesel Generator (ea.) | CO2 Vent | Aux Boiler | Ammonia Plant SU Heater | Ammonium Nitrate Vent |
|---|---|---|---|---|---|---|---|---|---|---|
| Stack height, ft above grade[1] | 250 | 250 | 55 | 165 | 20 | 20 | 260 | 80 | 80 | 40 |
| Stack diameter, ft | 2 | 1.3 | 30 | 2.5 | 0.7 | 1.2 | 3.5 | 4.5 | 3.5 | 0.17 |
| Stack outlet temp, deg F | (NA) | (NA) | 75 | 1200 | 850 | 760 | 65 | 300 | 300 | 100 |
| Stack exit flow, act ft3/sec | varies per scenario | varies per scenario | 18,500 | 250 | 60 | 250 | 1,765 | 480 | 180 | 0.3 |
| Stack exit velocity (ft/sec) | | | 26.17 | 50.93 | 155.91 | 221.05 | 183.45 | 30.18 | 18.71 | 13.75 |
| Stack exit velocity (m/sec) | | | 7.98 | 15.52 | 47.52 | 67.38 | 55.92 | 9.20 | 5.70 | 4.19 |

Notes:

(1) Actual stack hieght for flares. Effective stack height for modeling was calculated based on GEP height of 65 meters. See Flare Stack Parameters tab in this workbook.

(2) Stack outlet temperature shown for HRSG is the estimated stack temperature after power cycle optimization. Case 1 On-Peak Power exit flow rate, Case 2 Off-Peak Power exit flow rate

(3) Flow rate shown in table for coal dryer is based on full load syn gas combustion for Case 4 (relatively constant for varying power plant loads and ambient temperatures).

(4) Nine cells estimated for power block cooling tower; 13 cells estimated for process cooling tower, and four cells estimated for the ASU cooling tower.

(5) Flare gas heat release, 10^6 Btu/hr, HHV; first value is normal pilot gas, second value is the maximum startup heat release

| | Process Area | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | **Methanol** | **Syn Gas** | **Shifted Syn Gas** | **Propylene** | **Sour Water** | **$H_2S$ Laden Methanol** | **$CO_2$ Laden Methanol** | **Acid Gas** | **Ammonia-Laden Gas** | **Sulfur** | **TGTU Process Gas** | **Total** |
| **Compound** | **Annual Fugitive Emissions with LDAR Application (ton/yr)** | | | | | | | | | | | |
| $CO_2$ | | 0.74 | 20.08 | | 0.69 | 1.82 | 0.49 | 0.81 | 0.84 | | 5.72 | 31.19 |
| $CH_4$ | | 0.05 | 0.14 | | | 0.00 | 0.00 | 0.00 | 0.00 | | | 0.19 |
| CO | | 4.16 | 0.42 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.03 | 4.62 |
| $H_2S$ | | 0.06 | 0.20 | | 0.05 | 0.07 | 0.00 | 0.53 | 0.07 | 0.00 | 0.16 | 1.14 |
| $NH_3$ | | 0.00 | | | 0.07 | | | | 0.09 | | | 0.16 |
| COS | | 0.02 | | | | 0.00 | | 0.01 | 0.00 | | 0.00 | 0.03 |
| $CH_3OH$ | 4.02 | | | | | 2.18 | 0.88 | 0.00 | | | | 7.09 |
| $C_3H_6$ | | | | 6.33 | | | | | | | | 6.33 |
| HCN | | | | | | | | | 0.00 | | | 0.00 |
| **Total VOC** | **4.02** | **0.02** | **0.00** | **6.33** | **0.00** | **2.18** | **0.88** | **0.01** | **0.00** | **0.00** | **0.00** | **13.45** |
| Total percentage of VOC content of gas in each process area | 100.00% | 0.15% | 0.00% | 100.00% | 0.00% | 53.51% | 64.10% | 0.54% | 0.07% | 0.00% | 0.03% | |

Note: The following compounds are included as VOCs, although not all compounds are found in the gas in each process area.
$CH_3OH$, $C_3H_6$, COS, and HCN

**Summary by Volume Source for Modeling - Emissions are divided by number of Volume Sources**

"GASIFICATION" (Area #2)

| | lb/hr/volume | lb/yr/volume |
|---|---|---|
| CO | 0.316 | 2,772.38 |
| $H_2S$ | 4.19E-03 | 36.69 |
| $NH_3$ | 9.74E-06 | 8.53E-02 |
| $CH_3OH$ | | |
| $C_3H_6$ | | |
| HCN | | |

3 number of Volume Sources
28 horizontal dimension (m)
46.48 release ht (m)
13.02 horizontal dimension (m)
43.24 vertical dimension (m)

"SHIFT" (Area #4, 6)

| | lb/hr/volume | lb/yr/volume |
|---|---|---|
| CO | 4.84E-02 | 424.19 |
| $H_2S$ | 2.81E-02 | 245.74 |
| $NH_3$ | 7.83E-03 | 68.56 |
| $CH_3OH$ | | |
| $C_3H_6$ | | |
| HCN | | |

2 number of Volume Sources
35 horizontal dimension (m)
6.10 release ht (m)
16.28 horizontal dimension (m)
5.67 vertical dimension (m)

"AGR" (Area #1, #5, #7, #8, #9)

| | lb/hr/volume | lb/yr/volume |
|---|---|---|
| CO | 6.32E-04 | 5.54 |
| $H_2S$ | 1.37E-01 | 1195.86 |
| $NH_3$ | | |
| $CH_3OH$ | 1.62E+00 | 14172.79 |
| $C_3H_6$ | 1.44E+00 | 12657.98 |
| HCN | | |

1 number of Volume Sources
48 horizontal dimension (m)
6.10 release ht (m)
22.33 horizontal dimension (m)
5.67 vertical dimension (m)

"Sour Water Stripper" (Area #10)

| | lb/hr/volume | lb/yr/volume |
|---|---|---|
| CO | 1.02E-03 | 8.94 |
| $H_2S$ | 1.68E-02 | 146.89 |
| $NH_3$ | 2.06E-02 | 180.69 |
| $CH_3OH$ | | |
| $C_3H_6$ | | |
| HCN | 1.31E-04 | 1.15 |

1 number of Volume Sources
16 horizontal dimension (m)
6.10 release ht (m)
7.44 horizontal dimension (m)
5.67 vertical dimension (m)

"SRU" (Area #11, #12)

| | lb/hr/volume | lb/yr/volume |
|---|---|---|
| CO | 3.08E-03 | 27.01 |
| $H_2S$ | 1.89E-02 | 165.37 |
| $NH_3$ | | |
| $CH_3OH$ | | |
| $C_3H_6$ | | |
| HCN | | |

2 number of Volume Sources
16 horizontal dimension (m)
6.10 release ht (m)
7.44 horizontal dimension (m)
5.67 vertical dimension (m)

Note: Selective LDAR program was applied to Areas # 1, #5, #7, #8, #9, #10 due to high uncontrolled emissions for the VOCs (methanol and propylene) and hydrogen sulfide

## Summary of Transportation Vehicles and Routes

4/17/2012

| Commodity Handled | Petcoke | Coal | Liquid Sulfur | Gasification | Ammonia | Urea | UAN | Equipment | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|
| **Expected plant operation** | | | | | | | | | |
| Expected plant operation is 8000 hours / year | | | | | | | | | |
| The plant will operate 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day |
| The plant will operate 333 days / year | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr |
| Shipment by trucks | 100 % | 0 % | 75 % | 25 % | 75 % | 25 % | 50 % | 100 % | 100 % |
| Shipment by train | 0 % | 100 % | 25 % | 75 % | 25 % | 75 % | 50 % | 0 % | 0 % |
| **Production rate** | | | | | | | | | |
| Required Normal Flow / day | 1,140 tons / day | 4,580 tons / day | 100 tons / day | 839 tons / day | 500 tons / day | 833 tons / day | 1,392 tons / day | | |
| Required Normal Flow / year | 380,000 tons / yr | 1,525,000 tons / yr | 33,000 tons / yr | 280,000 tons / yr | 167,000 tons / yr | 280,000 tons / yr | 464,000 tons / yr | | |
| Required Maximum Flow day | 1,368 tons / day (3) | 6,107 tons / day (4) | 200 tons / day (5) | 1,678 tons / day (6) | 1,000 tons / day (6) | 1,666 tons / day (6) | 2,784 tons / day (6) | | |
| **Truck Shipments** | | | | | | | | | |
| Truck Capacity | 25 tons / truck | | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck |
| Required trucks loads for normal operation / day | 46 trucks / day | | 4 trucks / day | 8 trucks / day | 15 trucks / day | 8 trucks / day | 28 trucks / day | 2 trucks / day | 3 trucks / day |
| Required trucks loads for normal operation / yr | 15,200 truck / yr | | 990 truck / yr | 2,800 truck / yr | 5,010 truck / yr | 2,800 truck / yr | 9,280 truck / yr | | |
| Required trucks loads for maximum operation /day | 55 trucks / day | | 8 trucks / day | 17 trucks / day | 30 trucks / day | 17 trucks / day | 56 trucks / day | | |
| **Train Shipments** | | | | | | | | | |
| Railcar Capacity | | 117 tons / car | 100 tons / car | 100 tons / car | 117 tons / car | 117 tons / car | 117 tons / car | | |
| Assume a train has 13,000 ton capacity | | | | | | | | | |
| Required railcars for normal operation / day | | 39 cars / day | 0.25 cars / day | 6 cars / day | 1 cars / day | 5 cars / day | 6 cars / day | | |
| Required railcar loads for normal operation / yr | | 13,034 cars / yr | 83 cars / yr | 2,800 cars / yr | 357 cars / yr | 1,795 cars / yr | 1,983 cars / yr | | |
| Required railcars for maximum operation / day | | 200 cars / day | 1 cars / day | 16 cars / day | 2 cars / day | 11 cars / day | 12 cars / day | | |
| **Basis** | - 91% availability<br>- 25% petcoke (heat input)<br>- 25 ton/truck<br>- 7 days/week receiving<br>- 25% excess truck | - 91% availability<br>- 75% coal (heat input) per<br>- 117 tons/car<br>- 100% coal for maximum<br>- Rack sized to handle two | - 91% availability<br>- High sulfur case - 100<br>- 25 ton/truck<br>- Weekdays only<br>- Can only move up to 25% of | - 91% availability<br>- 75% coal max annual<br>- 100% capable by rail<br>- 25% capable by truck<br>- Maximun is double the daily | - 91% availability<br>- 500 t/d NH3 sales<br>- 75% by truck<br>- Ability to ship 7500 tons over | - 91% availability<br>- 75% by rail<br>-empty 45 day storage in 10 d<br>' | - 91% availability<br>- 75% by rail<br>-empty 45 day storage in 10 d | ' | |
| **Traffic route** | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route |
| Destination/Origin | Carson Refinery | None | California Sulfur | Various | Various | Various | Various | Various | Various |
| Address | 1801 E Sepulveda, Carson | | 2509 E Grant Street, Wilmington | | | | | | |
| Distance | 140 Miles | | 142 Miles | 80 Mile radius | 40 mile radius | 40 mile radius | 40 mile ratius | 40 mile ratius | 40 mile ratius |
| Route | Alameda<br>405 Fwy<br>5 Fwy<br>Stockdale hwy<br>Morris Road<br>Station Road<br><br>Station Road | | Grant<br>Henry Ford<br>Alameda<br>405 Fwy<br>5 Fwy<br>Stockdale hwy<br>Morris Road<br>Station Road | 40 mile radius<br>Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | 5 fwy<br>Stockdale Hwy<br>Dairy Road | 5 fwy<br>Stockdale Hwy<br>Dairy Road |
| | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route |
| Destination/Origin | None | Elk Ranch New Mexico | In SJVAPCD | CEMEX, Victorville | Calamco | Oregon/Washington | Calamco | None | None |
| Address | | | | | Port Rd G15, Stockton, CA | | Port Rd G15, Stockton, CA | | |
| Distance | | 794 miles | | 198 miles | 264 miles | 628 Miles | 264 miles | | |
| Route | | Kern County: 132.2 miles (County Line near Boron, CA to north prope<br>Mine to Boron, CA: 662 miles<br>Total Distance: 794.2 miles | | SJVR/BNSF | SJVR/UPRR | SJVR/UPRR | | | |

**Notes**

1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation.
3) The maximum flow rate of coke is ratioed up from the normal flow rate at 25% to 30% of feed
4) The maximum flow rate of coal is ratioed up from the normal flow rate at 75% to 100% of feed
5) The maximum flow rate of sulfur is 2 times the normal production
6) The maximum flow rate of these commodities is 2 times the normal production
7) The sources of flow data used in the Production Rate calculation were based on the flow rates provided in "Conference Note: Rail and Truck Traffic - Planning Session" and the "FertilizerProductMovement Update", 01-25-12.

4/17/2012

**Calculations for Trucks Operation Modeling**

| Data Supplied By Client | | | | | |
|---|---|---|---|---|---|
| Parameter | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
| | Running Emissions | Idling Emissions | Running Emissions | Idling Emissions | Running Emissions |
| Distance Traveled (mi)* | 0.96 | | 2.49 | | 2.20 |
| Per Truck Idle Time (hr) | | 0.083 | | 0.083 | |
| **Maximum number of trucks or loads:** | | | | | |
| 1-hr | 6 | 6 | 13 | 13 | 5 |
| 3-hr | 17 | 17 | 39 | 39 | 5 |
| 8-hr | 44 | 44 | 104 | 104 | 5 |
| 24-hr | 55 | 55 | 130 | 130 | 5 |
| Annual average trucks or loads | 15,200 | 15,200 | 20,880 | 20,880 | 1,818 |

**EMFAC2007 Emission Factors + Fugitive Dust (g/mi or g/idle-hour) For Truck Model year 2010**

| | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions (g/mile/trk) | Idling Emissions (g/idle-hour/trk) | Running Emissions (g/mile/trk) | Idling Emissions (g/idle-hour/trk) | Running Emissions (g/mile/trk) |
| CO | 3.03 | 43.69 | 3.03 | 43.69 | 3.03 |
| NOx | 5.43 | 122.65 | 5.43 | 122.65 | 5.43 |
| ROG | 1.39 | 7.74 | 1.39 | 7.74 | 1.39 |
| SOx | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 |
| PM10 * | 0.92 | 0.11 | 0.92 | 0.11 | 0.92 |
| PM2.5 * | 0.29 | 0.10 | 0.29 | 0.10 | 0.29 |

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 10 mph.

**1-hr Emission Rates for AERMOD (g/s) all trucks**

| | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 4.424E-03 | 5.562E-03 | 2.726E-02 | 1.319E-02 | 1.010E-02 |
| NOx | 7.929E-03 | 1.561E-02 | 4.886E-02 | 3.702E-02 | 1.810E-02 |
| ROG | 2.028E-03 | 9.859E-04 | 1.250E-02 | 2.337E-03 | 4.629E-03 |
| SOx | 4.383E-05 | 7.894E-06 | 2.701E-04 | 1.871E-05 | 1.000E-04 |
| PM10 | 1.340E-03 | 1.451E-05 | 8.255E-03 | 3.441E-05 | 3.058E-03 |
| PM2.5 | 4.273E-04 | 1.324E-05 | 2.633E-03 | 3.139E-05 | 9.754E-04 |

**3-hr Emission Rates for AERMOD (g/s) all trucks**

| | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 4.424E-03 | 5.562E-03 | 2.726E-02 | 1.319E-02 | 1.010E-02 |
| NOx | 7.929E-03 | 1.561E-02 | 4.886E-02 | 3.702E-02 | 1.810E-02 |
| ROG | 2.028E-03 | 9.859E-04 | 1.250E-02 | 2.337E-03 | 4.629E-03 |
| SOx | 4.383E-05 | 7.894E-06 | 2.701E-04 | 1.871E-05 | 1.000E-04 |
| PM10 | 1.340E-03 | 1.451E-05 | 8.255E-03 | 3.441E-05 | 3.058E-03 |
| PM2.5 | 4.273E-04 | 1.324E-05 | 2.633E-03 | 3.139E-05 | 9.754E-04 |

**8-hour Emission Rates for AERMOD (g/s) all trucks**

| | Coke and Coal Trucks (@ 10 mph) | | Product Trucks (@ 10 mph) | | Miscellaneous Trucks @ 10 mph |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 4.424E-03 | 5.562E-03 | 2.726E-02 | 1.319E-02 | 1.010E-02 |
| NOx | 7.929E-03 | 1.561E-02 | 4.886E-02 | 3.702E-02 | 1.810E-02 |
| ROG | 2.028E-03 | 9.859E-04 | 1.250E-02 | 2.337E-03 | 4.629E-03 |
| SOx | 4.383E-05 | 7.894E-06 | 2.701E-04 | 1.871E-05 | 1.000E-04 |
| PM10 | 1.340E-03 | 1.451E-05 | 8.255E-03 | 3.441E-05 | 3.058E-03 |
| PM2.5 | 4.273E-04 | 1.324E-05 | 2.633E-03 | 3.139E-05 | 9.754E-04 |

4/17/2012

**24-hour Emission Rates for AERMOD (g/s) all trucks**

| | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| **Pollutant** | **Running Emissions** | **Idling Emissions (at each Idle Point)** | **Running Emissions** | **Idling Emissions (at each Idle Point)** | **Running Emissions** |
| CO | 1.843E-03 | 2.318E-03 | 1.136E-02 | 5.495E-03 | 1.010E-02 |
| NOx | 3.304E-03 | 6.506E-03 | 2.036E-02 | 1.542E-02 | 1.810E-02 |
| ROG | 8.449E-04 | 4.108E-04 | 5.207E-03 | 0.000E+00 | 4.629E-03 |
| SOx | 1.826E-05 | 3.289E-06 | 1.125E-04 | 7.798E-06 | 1.000E-04 |
| PM10 | 5.582E-04 | 6.047E-06 | 3.440E-03 | 1.434E-05 | 3.058E-03 |
| PM2.5 | 1.781E-04 | 5.517E-06 | 1.097E-03 | 1.308E-05 | 9.754E-04 |

**Annual Emission Rates for AERMOD (g/s) all trucks**

| | Petcoke Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| **Pollutant** | **Running Emissions** | **Idling Emissions (at each Idle Point)** | **Running Emissions** | **Idling Emissions (at each Idle Point)** | **Running Emissions** |
| CO | 1.396E-03 | 1.755E-03 | 4.983E-03 | 2.411E-03 | 3.839E-04 |
| NOx | 2.501E-03 | 4.926E-03 | 8.931E-03 | 6.767E-03 | 6.880E-04 |
| ROG | 6.398E-04 | 3.110E-04 | 2.284E-03 | 4.273E-04 | 1.760E-04 |
| SOx | 1.383E-05 | 2.490E-06 | 4.937E-05 | 3.421E-06 | 3.803E-06 |
| PM10 | 4.226E-04 | 4.579E-06 | 1.509E-03 | 6.290E-06 | 1.162E-04 |
| PM2.5 | 1.348E-04 | 4.177E-06 | 4.813E-04 | 5.738E-06 | 3.708E-05 |

Volume, Line Sources

| | | | |
|---|---|---|---|
| Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide | | | |
| 2.3.2 Oyo=12W/2.15 | | | |
| Truck Traveling vol src | | Truck Idling pt src | |
| 6 | ft Release height | 12.6 | ft Release height |
| 12 | ft Width | 0.1 | m diam |
| 66.98 | ft init horz dim Syo | 51.71 | m/s vel |
| 5.58 | ft init vert dim Szo | 366 | K Temp |
| | | 199.134 | F Temp |

Volume, Stand Alone

| | |
|---|---|
| Guidance for Air Dispersion Modeling, SJVAPCD, 2007 | |
| 2.3.2 + modelers judgement + ISC guidance | |
| Truck Traveling vol src | |
| 6 | ft Release height |
| 12 | ft Width |
| 2.79 | ft init horz dim Syo |
| 5.58 | ft init vert dim Szo |
| | |

## Summary of On-Site Operations Truck Emissions — Emissions Summary

4/17/2012

| Transportation Information | | Notes |
|---|---|---|
| - Onsite Vehicle = | 20 trucks | - Information Provided By Applicant |
| - Vehicle year= | 2010 | - Information Provided By Applicant |
| - Maximum annual mileage = | 10,000 miles/truck-year | - All routine vehicular traffic is anticipated to travel exclusively on paved roads |
| | | - Assumed 15 mph average speed within HECA facility |

**Calculations for Trucks Operation Modeling per Truck**

| | Onsite O&M Trucks |
|---|---|
| **Mileage** | |
| 1-hr | 1 |
| 3-hr | 3 |
| 8-hr | 9 |
| 24-hr | 27 |
| Annual average trucks or loads | 10000 |

**EMFAC2007 Emission Factors (g/mi) For Truck Model year 2010**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 0.229 | 0.920 |
| NOx | 0.064 | 0.672 |
| ROG | 0.014 | 0.085 |
| SOx | 0.011 | 0.005 |
| PM10 * | 0.167 | 0.176 |
| PM2.5 * | 0.054 | 0.062 |

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
EMFAC emissions are for fleet year 2010 travelling at 15 mph.

**1-hr Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**3-hr Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**8-hour Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**24-hour Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**Annual Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| **Pollutant** | **Gas LHDT1** | **Diesel LHDT2** |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

## Fugitive Dust on Paved Road

4/17/2012

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [ k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

| | k |
|---|---|
| | **g/VMT** |
| **PM2.5** | 0.25 |
| **PM10** | 1.00 |

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

**Large Trucks**

| | | | | Empty truck | full truck | Load Capacity |
|---|---|---|---|---|---|---|
| W= | 17.5 | tons, average | | 5 | 30 | 25 tons |
| sL= | 0.031 | g/m2 | Default value from URBEMIS 9.2 for Kern County | | | |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | | | | |

E=

0.19149 g/VMT PM2.5 large delivery trucks
0.76594 g/VMT PM10 large delivery trucks

**Operation and Maintenance Vehicles**

| | | | |
|---|---|---|---|
| W= | 3 | tons | |
| sL= | 0.031 | g/m2 | Default value from URBEMIS 9.2 for Kern County |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | |

E=

0.03169 g/VMT PM2.5 large delivery trucks
0.12675 g/VMT PM10 large delivery trucks
#vol sources= 10

## Fugitive Dust on Paved Road

4/17/2012

**Fertilizer Product + Sulfur Product trucks + Gas Solids trucks + Misc trucks**

102 max trucks/day for Ammonia + Urea + UAN    24 hrs/day
8 max trucks/day for Sulfur
17 max trucks/day gas solids
3 miscellaneous truck along this path
**130** Total product trucks max/day

4000 meters, approximate length of road for product trucks: eastern fenceline to southern fenceline to middle loop and back out the opposite way
2.49 miles

| | | |
|---|---|---|
| 0.47593 grams PM2.5/truck/day | 62.059 g PM2.5/day for all product trucks | 2.5858 g PM2.5/hr |
| 1.90373 grams PM10/truck/day | 248.237 g PM10/day for all product trucks | 10.3432 g PM10/hr |

# volume source in model
73    3.5422E-02 g PM2.5/hr/volume source
    1.4169E-01 g PM10/hr/volume source

**Coke feedstock trucks (no coal by truck)**

**55** max feedstock trucks/day

1539 meters, approximate length of road loop to truck feedstock unloading facility on east side
0.96 miles

| | | |
|---|---|---|
| 0.18312 grams PM2.5/truck/day | 10.071 g PM2.5/day for all product trucks | 0.4196 g PM2.5/hr |
| 0.73246 grams PM10/truck/day | 40.285 g PM10/day for all product trucks | 1.6786 g PM10/hr |

# volume source in model
34    1.2342E-02 g PM2.5/hr/volume source
    4.9369E-02 g PM10/hr/volume source

**Miscellaneous Delivery Trucks**

**5** max trucks/day

3540 meters, approximate length of road from end of product truck south road, along southern fenceline, north toward main site, to parking lot and back
2.20 miles

| | | |
|---|---|---|
| 0.421 grams PM2.5/truck/day | 2.299 g PM2.5/day for all product trucks | 0.0958 g PM2.5/hr |
| 1.685 grams PM10/truck/day | 9.196 g PM10/day for all product trucks | 0.3832 g PM10/hr |

# volume source in model
5    1.9158E-02 g PM2.5/hr/volume source
    7.6631E-02 g PM10/hr/volume source

**Assumed Number of Unit Trains (incoming/outgoing)**

| Averaging Period | Coal Unit Trains (incoming) | Unit Trains of Product (outgoing) | Maximum Total Trains per period |
|---|---|---|---|
| 1-hr | 1 | 1 | 1 |
| 3-hr | 1 | 1 | 2 |
| 8-hr | 2 | 1 | 3 |
| 24-hr | 2 | 1 | 3 |
| Annual average unit trains | 109 | 153 | 262 |
| # Cars Per train | 120 | 46 | |
| maximum # Cars Per day | 200-240 | 42-46 | |

| | Switching Enigne/ Rail car movers | Line-Haul Engine for Coal Train | Line-Haul Engine for Product Trains |
|---|---|---|---|
| Engine Power Rating (hp) | | 4400 | 3000 |
| Notch Operation | | 1 | 1 |
| Notch percentage of hp | | 5.0% | 5.0% |
| Avg Notch horsepower | 260 | 220 | 150 |
| # of engines per train | 1 | 2 | 2 |
| hours to unload/load each train | | 2 | 1 |
| max operating hours (hrs/day) | 8 | | |
| max operating hours (hrs/year) | 1248 | | |

The majority of the time the line-haul engine will operate in Notch 1 or idling, therefore emissions were conservatively estimated for Notch 1 horsepower.

Notch percentage presented in PORT OF LONG BEACH AIR EMISSIONS INVENTORY for 2007 (POLB, Jan 2009) derived from EPA data.

For each coal train it takes 2 hours to complete the onsite loop to unload

For each product train it takes 1 hour to load

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| Switching Engine Emission Factors | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| Tier 3 Emission Factor (g/bhp-hr) | 2.4 | 5.0 | 0.10 | 0.097 | 0.124 | 0.63 |
| Emissions (lbs/hr /engine) | 1.37 | 2.86 | 0.06 | 0.06 | 0.07 | 0.36 |
| **Line-Haul Emission Factors** | | | | | | |
| Tier 3 Emission Factor (g/bhp-hr) | 1.50 | 5.50 | 0.10 | 0.10 | 0.09 | 0.32 |
| Coal Train Emissions (lbs/hr /engine) | 0.73 | 2.67 | 0.05 | 0.05 | 0.04 | 0.15 |
| Product Train Emissions (lbs/hr /engine) | 0.50 | 1.82 | 0.03 | 0.03 | 0.03 | 0.10 |

**1-hr Emission Rates**

| | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| | **1-hr Emission Rates (lb/hr) all trains** | | | | | |
| Switching engines | 1.37 | 2.86 | 0.06 | 0.06 | 0.07 | 0.36 |
| Line-haul coal engines | 1.45 | 5.33 | 0.10 | 0.09 | 0.09 | 0.31 |
| | **1-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources** | | | | | |
| All On-site Trains | 2.7E-02 | 7.9E-02 | 1.5E-03 | 1.4E-03 | 1.5E-03 | 6.4E-03 |

During a given hour either the line-haul engines for the coal train or product train operate, not both, thus emissions from the larger coal trains are only included in the peak hour emissions.

**3-hr Emission Rates**

| | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| | **3-hr Emission Rates (lb/period) all trains** | | | | | |
| Switching engines | 4.12 | 8.59 | 0.17 | 0.17 | 0.21 | 1.09 |
| Line-haul coal engines | 2.91 | 10.66 | 0.19 | 0.19 | 0.18 | 0.61 |
| Line-haul product engines | 0.99 | 3.63 | 0.07 | 0.06 | 0.06 | 0.21 |
| | **3-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources** | | | | | |
| All On-site Trains | 2.6E-02 | 7.3E-02 | 1.4E-03 | 1.3E-03 | 1.4E-03 | 6.1E-03 |

In the maximum operations 3 hour period, the switching engine operates up to 3 hours, 1 coal train unloads in 2 hours and 1 product train loads in 1 hour.

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**8-hour Emission Rates**

| | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| | 8-hr Emission Rates (lb/period) all trains | | | | | |
| Switching engines | 11.00 | 22.91 | 0.46 | 0.44 | 0.57 | 2.89 |
| Line-haul coal engines | 5.81 | 21.32 | 0.39 | 0.38 | 0.35 | 1.22 |
| Line-haul product engines | 0.99 | 3.63 | 0.07 | 0.06 | 0.06 | 0.21 |
| | 8-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources | | | | | |
| All On-site Trains | 2.1E-02 | 5.8E-02 | 1.1E-03 | 1.1E-03 | 1.2E-03 | 5.2E-03 |

In the maximum operations 8 hour period, the switching engine operates up to 8 hours, 2 coal train unloads in 2 hours each and 1 product train loads in 1 hour.

**24-hour Emission Rates**

| | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| | 24-hr Emission Rates (lb/period) all trains | | | | | |
| Switching engines | 11.00 | 22.91 | 0.46 | 0.44 | 0.57 | 2.89 |
| Line-haul coal engines | 5.81 | 21.32 | 0.39 | 0.38 | 0.35 | 1.22 |
| Line-haul product engines | 0.99 | 3.63 | 0.07 | 0.06 | 0.06 | 0.21 |
| | 24-hr Emission Rates for AERMOD (lb/hr) all trains divided by number of volume sources | | | | | |
| All On-site Trains | 7.1E-03 | 1.9E-02 | 3.7E-04 | 3.5E-04 | 3.9E-04 | 1.7E-03 |

In the maximum operations 24 hour period, the switching engine operates up to 8 hours, 2 coal train unloads in 2 hours each and 1 product train loads in 1 hour.

**Annual Emission Rates**

| | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|
| | Annual Emission Rates (tons/period) all trains | | | | | |
| Switching engines | 0.86 | 1.79 | 0.04 | 0.03 | 0.04 | 0.23 |
| Line-haul coal engines | 0.16 | 0.58 | 0.01 | 0.01 | 0.01 | 0.03 |
| Line-haul product engines | 0.08 | 0.28 | 0.01 | 0.00 | 0.00 | 0.02 |
| | Annual Emission Rates for AERMOD (tons/yr) all trains divided by number of volume sources | | | | | |
| All On-site Trains | 1.0E-02 | 2.5E-02 | 4.9E-04 | 4.8E-04 | 5.6E-04 | 2.6E-03 |

AERMOD source parameters
Volume sources spaces every 20 widths

| | | |
|---|---|---|
| Width | | 10 ft |
| Release Height | | 15 ft |
| Sigma Y | | 93 ft |
| Sigma Z | | 14 ft |
| # of volumes | 104 | |

Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide

4/17/2012

**Emission Factors**

**40 CFR Part 1033**

**Table 2 of 1033.101 Switch Locomotive Emission Standards**

| | | Standards (g/bhp-hr) | | | |
|---|---|---|---|---|---|
| **Year of original manufacture** | **Tier of standards** | **CO** | **NOx** | **PM** | **HC** |
| 1973-2001 | Tier 0 | 8.0 | 11.8 | 0.26 | 2.1 |
| 2002-2004 | Tier 1 | 2.5 | 11 | 0.26 | 1.2 |
| 2004-2010 | Tier 2 | 2.4 | 8.1 | 0.13 | 0.60 |
| 2011-2014 | Tier 3 | 2.4 | 5.0 | 0.10 | 0.60 |
| 2015 or later | Tier 4 | 2.4 | 1.3 | 0.03 | 0.14 |

**Table 1 to §1033.101—Line-Haul Locomotive Emission Standards**

| | | Standards (g/bhp-hr) | | | |
|---|---|---|---|---|---|
| **Year of original manufacture** | **Tier of standards** | **CO** | **$NO_X$** | **PM** | **HC** |
| 1973–1992 | Tier 0 | 5 | 8 | 0.22 | 1 |
| 1993–2004 | Tier 1 | 2.2 | 7.4 | 0.22 | 0.55 |
| 2005–2011 | Tier 2 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2012–2014 | Tier 3 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2015 or later | Tier 4 | 1.5 | 1.3 | 0.03 | 0.14 |

Reference: 40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards

| **Emission Factors For all Locomotives** | | | |
|---|---|---|---|
| **SOx** | **$CO_2$** | **$CH_4$** | **$N_2O$** |
| g/gal | g/gal | g/gal | g/gal |
| 1.88 | 10217 | 0.80 | 0.26 |

| Locomotive Application | Conversion Factor (bhp-hr/gal) |
|---|---|
| Large Line-haul & Passenger | 20.8 |
| Small Line-haul | 18.2 |
| Switching | 15.2 |

Notes:

New line-haul engines will be AC locomotives such as the GE Evolution Series, that meet Tier 3 emissions

New switching engines will meet Tier 3 emissions, they may be the Titan Trackmobile railcar movers or similar

EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).

Based on 300 ppm sulfur diesel fuel.

$CH_4$ and $N_2O$ factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for

VOC emissions can be assumed to be equal to 1.053 times the HC emissions

$PM_{2.5}$ Fraction of $PM_{10}$, = 0.97

# Appendix E-4

# Response to PM2.5 Cooling Tower Data Requests from CEC and USEPA

# APPLICANT RESPONSES TO

# CALIFORNIA ENERGY COMMISSION AND ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE

# PRELIMINARY DETERMINATION OF COMPLIANCE FOR THE HYDROGEN ENERGY CALIFORNIA (HECA) PROJECT (08-AFC-8)

*Prepared for:*

**San Joaquin Valley Air Pollution Control District**
**Project Number S-1093741**
**Kern County, CA**

*Prepared on behalf of:*

**Hydrogen Energy California LLC**

September 14, 2010

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## TABLE OF CONTENTS

**APPLICANT RESPONSES TO CEC AND EPA COMMENTS ON THE JUNE 21, 2010 SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT PRELIMINARY DETERMINATION OF COMPLIANCE**



**ATTACHMENTS**

## LIST OF ACRONYMS AND ABBREVIATIONS USED IN RESPONSES

| | |
|---|---|
| ATC | Authority to Construct |
| BACT | Best Available Control Technology |
| BTU | British Thermal Unit |
| CARB | California Air Resources Board |
| CEC | California Energy Commission |
| CEIDARS | California Emission Inventory Data and Reporting System |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| CTG | combustion-turbine generator |
| GE | General Electric |
| GEP | Good Engineering Practice |
| HECA LLC | Hydrogen Energy California LLC |
| HECA | Hydrogen Energy California |
| HRSG | heat-recovery steam generator |
| IGCC | integrated gasification combined-cycle |
| lb/hr | pounds per hour |
| m | meters |
| $NO_x$ | nitrogen oxides |
| PDOC | Preliminary Determination of Compliance |
| PM | particulate matter |
| $PM_{10}$ | particulate matter less than or equal to 10 microns in diameter |
| $PM_{2.5}$ | particulate matter less than or equal to 2.5 microns in diameter |
| SCAQMD | South Coast Air Quality Management District |
| SCR | selective catalytic reduction |
| SJVAPCD | San Joaquin Valley Air Pollution Control District |
| EPA | Environmental Protection Agency |
| VOC | volatile organic compound |

# INTRODUCTION

The Hydrogen Energy California (HECA) Project will produce low-carbon baseload electricity by capturing carbon dioxide ($CO_2$) and transporting it for enhanced oil recovery (EOR) and sequestration. The Project will gasify petroleum coke (petcoke) (or blends of petcoke and coal, as needed) to produce raw syngas and ultimately hydrogen to fuel a combustion turbine operating in combined cycle mode. The net electrical generation output from the Project will provide California with approximately 250 MW of low-carbon baseload power to the grid. The Gasification Block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for $CO_2$ EOR and sequestration. The Project will have significantly lower criteria pollutant emissions than a similarly sized petcoke-fired, coal-fired or integrated gasification combined-cycle (IGCC) power plant. To minimize air emissions, state-of-the art emission control technologies will be implemented for the HECA Project.

On June 26, 2009, HECA LLC (or the Applicant) submitted an application for an Authority to Construct (ATC) permit to San Joaquin Valley Air Pollution Control District (SJVAPCD). This application was deemed complete by SJVAPCD on August 3, 2009, and was assigned SJVAPCD Project Number S-1093741.

On June 21, 2010, SJVAPCD issued a Preliminary Determination of Compliance (PDOC) for public review and comment. The California Energy Commission (CEC) issued comments on the PDOC on August 3, 2010. Environmental Protection Agency (EPA) Region IX issued comments on the PDOC on August 16, 2010.

This document presents the Applicant's responses to the CEC's and EPA's comments on the PDOC.

## RESPONSES TO CEC COMMENTS

### CEC COMMENT

***1. <u>Stack Heights and Good Engineering Practice:</u> The PDOC specifically notes the stack height for the CO2 Vent exceeds the de-minimis good engineering practice (GEP) height of 65 meters, but does not indicate either in the engineering evaluation discussion on page 20 or in the Air Quality Impact Analysis (AQIA) (Appendix H) whether and how this stack or all of the other proposed stacks that are above the de-minimis height meet GEP regulation requirements. This question about compliance with GEP stack height concerns all of the following:***

| *Emissions Stack* | *Height (meters)* |
|---|---|
| *CO2 Vent* | *79.2* |
| *SRU Flare* | *76.2* |
| *Gasification Flare* | *76.2* |
| *Rectisol Flare* | *76.2* |

***Staff believes that a brief note regarding compliance with GEP stack height should be added to the FDOC to complete the discussion regarding these sources/stacks.***

### RESPONSE

Good engineering practice (GEP) is defined as the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes that may be created by the source itself, nearby structures, or nearby terrain obstacles.[1]

The Building Profile Input Program Plume Rise Model Enhancements building downwash model was run to determine the GEP height for each stack. The output of this model shows that the GEP for the three flares and the carbon dioxide ($CO_2$) vent is 152.4 meters (m). This file was provided to SJVAPCD with the other air quality modeling files.

GEP is calculated based on the following equation

$$H_g = H + 1.5 * L$$

Where: $H_g$ = GEP stack height (m)

H = height of the nearby structure (m)
L = lesser dimension of the height or projected width of the nearby structure (m)

The largest nearby structure is the gasifier building, which is 60.96 m high and 70.9 m long. Therefore, L = 60.96 m, H = 60.96 m, and $H_g$ = 152.4 m.

The gasifier building is within five times L (3,048 m) from the three flares and the $CO_2$ vent; therefore, GEP for these stacks is calculated based on the gasifier building dimensions. The heights of the three flares and the $CO_2$ vent are thus well below the GEP height of 152.4 m.

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1 Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), EPA-450/4-80-023R, June 1985.

## CEC COMMENT

***2. <u>Combined Cycle Combustion Turbine Generator (S-7616-9) Particulate Emissions:</u> The particulate matter (PM10/PM2.5) emission levels requested by the applicant for this emission unit are well above similar gas turbine emission rate limits considering fuel firing heat input levels. The applicant has not provided compelling technical rationale to explain why this gas turbine would need a particulate matter (PM) emission rate that is so much higher than other similar gas turbines, and staff believes that the other recently permitted turbine projects have established a reasonable Best Available Control Technology (BACT) emissions level, which based on staff's review of available source test data generally provides a 50 percent safety factor (i.e., actual emissions are generally no more than half the allowable emissions, which for example would mean that the expected actual PM emissions for the Carlsbad project turbines would be somewhere between 4 to 5 lbs/hour, or about half of the allowable 9.5 lbs/hour). A comparison of the estimated HECA-proposed PM emissions compared to similar, recently approved and on-going projects are as follows:***

| ***Project*** | ***Gas Turbine*** | ***Lb/hr*** | ***Lb/ MMBtu*** | ***Lb/MW gross*** |
|---|---|---|---|---|
| *HECA – $H_2$ Fuel* | *GE 7FB* | *18 (19.8)* | *0.0084 (0.0079)* | *(0.051) (0.051)* |
| *HECA – Natural Gas* | *GE 7FB* | *18 (19.8)* | *0.0090 (0.0078)* | *0.066 (0.060)* |
| ***Allowable Emissions on Natural Gas:*** | | | | |
| *Avenal* | *GE 7FA* | *8.91 (11.78)* | *0.0050 (0.0052)* | *0.034 (0.039)* |
| *Inland Empire* | *GE 107H* | *10* | *0.0040* | *0.026* |
| *Carlsbad* | *Siemens SGT6-PAC5000F* | *9.5* | *0.0046* | *0.034* |
| *Value in "()" is duct firing value for projects with duct burners.* | | | | |

***Staff believes that the District should consider reducing the Particulate Matter (PM10/PM2.5) emission rate down to no more than 15 lbs/hour without duct firing and 16.8 lbs/hour with duct firing as BACT emission rates. These rates should provide an adequate safety margin compared to expected actual emissions and would also serve to reduce the total permitted annual PM2.5 emission rate to a level where the PM2.5 fraction of the cooling tower emissions are no longer an issue in regards to the potential for the site to exceed 100 tons per year of PM2.5 emissions, which would trigger the need for the project to obtain federal PM2.5 offsets.***

## RESPONSE

The Applicant is requesting additional time to address this comment.

## CEC COMMENT

***3. <u>Cooling Tower PM2.5 Fraction Assumption:</u> Staff believes that the rationale used by the applicant for the ratio of particulate matter less than 2.5 microns (PM2.5) to particulate matter less than 10 microns (PM10) of 0.6:1 for the cooling tower emissions is flawed. The rationale provided by the applicant notes that this ratio is cited in the South Coast Air Quality Management District's (SCAQMD's) particulate size fraction in the California Emission Inventory Development and Reporting System (CEIDARS) table from the SCAQMD CEQA website. However, the CEIDARS particulate size fraction data was originally produced by the California Air Resource Board (ARB) and review of the original CEIDARS particulate size fraction table from ARB shows that there is no cooling tower category and that the "other" category values have been used by SCAQMD in lieu of other available data for cooling towers in their version of the CEIDARS table. This shows that this particulate size fraction data is not specific to cooling towers and is not technically supportable. Staff is willing to accept a defendable cooling tower particulate size fraction reference; however, to date staff is not aware of such a defendable reference. Staff believes that the District should investigate this further and if possible provide a more technically defensible particulate size fraction reference and revise the cooling tower particulate matter (PM10 and PM2.5) emissions appropriately. If no specific particulate size fraction data reference for cooling towers is available, the District should assume 100 percent of the PM10 is PM2.5.***

## RESPONSE

The cooling tower total PM emissions are based on the maximum expected total dissolved solids in the cooling water, annual circulating water rate, and the use of a high-efficiency drift eliminator. The Applicant conservatively estimated that total PM emitted from the cooling tower will be equal to $PM_{10}$ in diameter, and the quantity of PM emissions that are equal to $PM_{2.5}$ will be 60 percent of the $PM_{10}$ emissions (a fraction or ratio of 0.6). This ratio used by the Applicant is based on the several justifications described below.

1. The "South Coast Air Quality Management District (SCAQMD) – Final Methodology to Calculate $PM_{2.5}$ and $PM_{2.5}$ Significance Thresholds, Appendix A – Updated California Emission Inventory Data and Reporting System (CEIDARS) Table with $PM_{2.5}$ Fractions[2]" provides the cooling tower ratios of 0.7 for the $PM_{10}$ fraction of total PM, 0.6 for the $PM_{2.5}$ fraction of $PM_{10}$, and 0.42 for the $PM_{2.5}$ fraction of total PM. The Applicant consulted with SCAQMD staff and confirmed these PM size fractions were derived from PM profiles in the CEIDARS developed by the California Air Resources Board (CARB). The Applicant also confirmed that SCAQMD examined carefully, approved, and officially adopted this document in October 2006. Since then, SCAQMD has required all California Environmental Quality Act/National Environmental Policy Act projects to use this methodology and its PM size fractions to estimate their PM, $PM_{10}$, and $PM_{2.5}$ emissions from cooling towers. Therefore, the use of the 0.6 ratio of $PM_{2.5}$ to $PM_{10}$ provided by this SCAQMD document is valid for estimating the HECA Project cooling tower $PM_{2.5}$ emissions, although the $PM_{2.5}$ emissions will be

2 Final Methodology to Calculate $PM_{2.5}$ and $PM_{2.5}$ Significance Thresholds (October 2006) from http://www.aqmd.gov/ceqa/handbook/PM2_5/finalmeth.doc; and its Appendix A – Updated CEIDARS Table with $PM_{2.5}$ Fractions from http://www.aqmd.gov/ceqa/handbook/PM2_5/finalAppA.doc.

overestimated due to the assumption that all PM emissions are comprised of $PM_{10}$.

2. The Applicant conducted a query for cooling towers in California on the CEIDARS[3]. The query results show that all of the cooling towers from different source categories in California in 1995, 2000, 2005, and 2008 have an average $PM_{2.5}$-to-$PM_{10}$ ratio of 0.636, and an average $PM_{2.5}$–to-PM ratio of 0.441 (see Attachment CEC-3-1). In addition, the Applicant, with assistance from CARB emission inventory staff (Gabe Ruiz and Darryl Look), gathered all the California power plant cooling tower emissions from CEIDARS (see Attachment CEC-3-2). Because only PM emissions were measured, $PM_{2.5}$ emissions are estimated from PM emissions. Attachment CEC-3-2 and Applicant discussions with CARB staff confirmed that the 0.7/0.6/0.42 $PM/PM_{10}/PM_{2.5}$ ratios were applied to most of the power plant cooling tower emission estimates. The average $PM_{2.5}$ fraction of $PM_{10}$ is 0.633, and the average $PM_{2.5}$ fraction of PM is 0.478 for all power plant cooling towers in California. The $PM_{2.5}$ fractions of $PM_{10}$ from the CEIDARS database for cooling towers from power plant cooling towers and from different source categories are very similar to the fraction the Applicant used in its cooling tower $PM_{2.5}$ emissions estimations. Therefore, in calculating the cooling tower PM emissions, the Applicant has accurately presented the $PM_{2.5}$ portion of $PM_{10}$ emissions, and furthermore, by assuming 100 percent of the total PM emissions to be $PM_{10}$, the Applicant has significantly overestimated the $PM_{2.5}$ emissions.

3. The assumption that 100 percent of the PM emitted from a cooling tower is smaller than 2.5 microns is too conservative from a technical perspective. The drift droplets generally contain the chemical impurities (or minerals) in the water circulating through the tower, and these impurities can be converted to airborne emissions. There are currently few papers about $PM_{10}/PM_{2.5}$ emission factors for mechanical draft cooling tower processes. One good reference[4] from Joel Reisman and Gorden Frisbie confirms the point that only a small amount of the circulating water may be entrained in the air stream, and it appears that most of the particles emitted from the cooling tower are larger than $PM_{10}$. According to the conclusion of this paper, 85 percent of the mass that is emitted is larger than 10 microns, and only 15 percent is less than 10 microns. The Applicant also consulted with EPA Staff (J. David Mobley, Deputy Director, Atmospheric Modeling and Analysis Division, National Exposure Research Laboratory; Lee Beck, Senior Project Engineer, Emissions Characterization & Prevention Branch, Air Pollution Prevention and Control Division), and the staff agree with the methodology and conclusion of this paper.

4. It should be reiterated that the $PM_{10}$ emissions from the cooling towers at HECA were estimated using U.S. EPA's AP-42 guidance[5] that conservatively assumes that all dissolved solids in the circulating water will be converted to airborne $PM_{10}$. The AP-42 document states " a *conservatively high* $PM_{10}$ emission factor can be obtained by (a) multiplying the total liquid drift factor by the total dissolved solids (TDS) fraction in the circulating water and (b) assuming that, once the water

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[3] CARB Emission Inventory Database (California Emission Inventory Development and Reporting System, CEIDARS) from http://www.arb.ca.gov/app/emsinv/emssumcat.php.
[4] Reisman, J. and Frisbie, G. (2002), Calculating realistic $PM_{10}$ emissions from cooling towers. Environmental Progress, 21: 127–130. doi: 10.1002/ep.670210216.
[5] AP-42, CH 13.4: Wet Cooling Towers: (http://www.EPA.gov/ttnchie1/ap42/ch13/final/c13s04.pdf).

evaporates, all remaining solid particles are within the $PM_{10}$ size range." This U.S. EPA guidance clearly describes that cooling tower emissions of $PM_{10}$, and thus $PM_{2.5}$, that are calculated with this technique are overestimated.

5. Data from the 2006 Micheletti study, "Atmospheric Emissions from Evaporative Cooling Towers"[6], confirm that the assumption that of all the particulate emissions are $PM_{10}$ is an exaggeration. Mr. Micheletti calculated $PM_{10}$ and $PM_{2.5}$ emission factors that are at least an order of magnitude less than the small particulate emissions that would be calculated using the U.S. EPA's conservatively high method. Even when Mr. Micheletti adjusted the U.S. EPA particulate emission factor for changes in drift rate and recirculating water TDS concentration, he calculated $PM_{10}$ and $PM_{2.5}$ emission factors that are noticeably lower (see Attachment CEC-3-3). He determined that the fatal flaw in the U.S. EPA's method is the assumption that all of the total dissolved solids in the drift become $PM_{10}$ or $PM_{2.5}$.

6. The CEC commissioned a study[7] of environmental effect from saltwater cooling towers. Although the focus of this study was the effects from saltwater cooling towers, some of the data are derived from non-saltwater cooling towers. The CEC study references the Micheletti study and agrees with the conclusion that "only a small fraction (less than 15%) of the residual particles will have an aerodynamic diameter of less than 10 microns", although they warn there may be uncertainties in the calculations. This study shows that the CEC believes that significantly less than 100% of the particulate matter emitted from cooling towers is $PM_{10}$ and $PM_{2.5}$.

Compliance with the PM emissions from the cooling tower will be demonstrated through PDOC Conditions 14 and 15.

Based on the data presented above, in the ATC application, in the response to CEC Data Request 18, and presented by SJVAPCD in the PDOC, the Applicant conservatively assumed all PM emissions were 10 microns or smaller and 60 percent of those emissions were 2.5 microns or smaller. In addition, the Applicant overestimated the $PM_{10}$ emissions by assuming that all PM is 10 microns or smaller. The Applicant believes the evaluation of the $PM_{2.5}$ emissions from the cooling tower presented in the PDOC is valid, and no change to the PDOC is warranted for the cooling tower $PM_{2.5}$ emissions.

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[6] Micheletti, W.C., 2006. "Atmospheric Emissions from Evaporative Cooling Towers." CTI Journal. Vol. 27, No. 1.
[7] CEC, Performance, Cost, And Environmental Effects Of Saltwater Cooling Towers, January 2010, CEC-500-2008-043.

**ATTACHMENT CEC-3-1**

# ATTACHMENT CEC-3-1
# CEIDARS DATABASE QUERY for COOLING TOWERS

| DATA_SO | YEAR | AREA | SEASON | EMISSION_TYPE | SRC_TYPE | EIC | EICSUMN | EICSOUN | EICMATN | EICSUBN | TOG | ROG | COT | NOX | SOX | PM | PM10 | PM2_5 | PM2.5 Fraction of Total PM | PM10 Fraction of Total PM | PM2.5 Fraction of PM10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | SCAQMD CIEDARS data base summary | | | **0.420** | **0.700** | **0.600** |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 430-338-0 | MINERAL PROCESSES | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0002 | 0.0001 | 0.0001 | 0.500 | 0.500 | 1.000 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 420-338-0 | FOOD AND AGRICULTURE | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.1638 | 0.1146 | 0.0689 | 0.421 | 0.700 | 0.601 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 410-338-0 | CHEMICAL | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0.0138 | 0.0096 | 0 | 0 | 0 | 0.1142 | 0.08 | 0.0479 | 0.419 | 0.701 | 0.599 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 320-338-0 | PETROLEUM REFINING | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 2.1388 | 2.0747 | 0 | 0 | 0 | 2.2645 | 1.4118 | 1.2111 | 0.535 | 0.623 | 0.858 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 499-338-0 | OTHER (INDUSTRIAL PROCESSES) | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0.0194 | 0.0136 | 0 | 0 | 0 | 0.9743 | 0.6836 | 0.4095 | 0.420 | 0.702 | 0.599 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 470-338-0 | ELECTRONICS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0201 | 0.0142 | 0.0084 | 0.418 | 0.706 | 0.592 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 460-338-0 | GLASS AND RELATED PRODUCTS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0336 | 0.0235 | 0.0141 | 0.420 | 0.699 | 0.600 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 450-338-0 | WOOD AND PAPER | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0034 | 0.0025 | 0.0014 | 0.412 | 0.735 | 0.560 |
| 2009_Alma | 2008 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 440-338-0 | METAL PROCESSES | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.1705 | 0.1194 | 0.0716 | 0.420 | 0.700 | 0.600 |
| | | | | | | | | | | | | | | | | | | | **0.440** | **0.674** | **0.668** |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 499-338-0 | OTHER (INDUSTRIAL PROCESSES) | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0.0136 | 0.0096 | 0 | 0 | 0 | 0.1477 | 0.1046 | 0.0621 | 0.420 | 0.708 | 0.594 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 470-338-0 | ELECTRONICS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.009 | 0.0063 | 0.0037 | 0.411 | 0.700 | 0.587 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 420-338-0 | FOOD AND AGRICULTURE | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0094 | 0.0066 | 0.004 | 0.426 | 0.702 | 0.606 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 320-338-0 | PETROLEUM REFINING | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 2.658 | 2.617 | 0 | 0 | 0 | 0.3166 | 0.1931 | 0.1757 | 0.555 | 0.610 | 0.910 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 410-338-0 | CHEMICAL | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0.0042 | 0.0029 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 310-338-0 | OIL AND GAS PRODUCTION | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0072 | 0.0044 | 0.004 | 0.556 | 0.611 | 0.909 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 440-338-0 | METAL PROCESSES | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0003 | 0.0002 | 0.0001 | 0.333 | 0.667 | 0.500 |
| 2009_Alma | 2005 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 450-338-0 | WOOD AND PAPER | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0071 | 0.005 | 0.003 | 0.423 | 0.704 | 0.600 |
| | | | | | | | | | | | | | | | | | | | **0.446** | **0.672** | **0.672** |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 410-338-0 | CHEMICAL | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0.0036 | 0.0025 | 0 | 0 | 0 | 0.1997 | 0.1605 | 0.0839 | 0.420 | 0.804 | 0.523 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 330-338-0 | PETROLEUM MARKETING | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0046 | 0.0032 | 0.0019 | 0.413 | 0.696 | 0.594 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 499-338-0 | OTHER (INDUSTRIAL PROCESSES) | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0702 | 0.0557 | 0.0303 | 0.432 | 0.793 | 0.544 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 420-338-0 | FOOD AND AGRICULTURE | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0063 | 0.0059 | 0.0026 | 0.413 | 0.937 | 0.441 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 470-338-0 | ELECTRONICS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.005 | 0.0035 | 0.0021 | 0.420 | 0.700 | 0.600 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 460-338-0 | GLASS AND RELATED PRODUCTS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0012 | 0.0008 | 0.0005 | 0.417 | 0.667 | 0.625 |
| 2009_Alma | 2000 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 320-338-0 | PETROLEUM REFINING | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 2.1455 | 2.0528 | 0 | 0 | 0 | 0.0934 | 0.057 | 0.0518 | 0.555 | 0.610 | 0.909 |
| | | | | | | | | | | | | | | | | | | | **0.438** | **0.744** | **0.605** |
| 2009_Alma | 1995 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 320-338-0 | PETROLEUM REFINING | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 2.012 | 2.012 | 0 | 0 | 0 | 0.0008 | 0.0005 | 0.0004 | 0.500 | 0.625 | 0.800 |
| 2009_Alma | 1995 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 410-338-0 | CHEMICAL | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.2863 | 0.2475 | 0.1202 | 0.420 | 0.864 | 0.486 |
| 2009_Alma | 1995 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 420-338-0 | FOOD AND AGRICULTURE | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0047 | 0.0033 | 0.002 | 0.426 | 0.702 | 0.606 |
| 2009_Alma | 1995 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 499-338-0 | OTHER (INDUSTRIAL PROCESSES) | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0573 | 0.0437 | 0.0241 | 0.421 | 0.763 | 0.551 |
| 2009_Alma | 1995 | Statewide | Annual Ave | Grown and Controlled | STATIONAR` | 460-338-0 | GLASS AND RELATED PRODUCTS | COOLING TOWERS | HYDROCARBON COI | SUB-CATEGORY UN | 0 | 0 | 0 | 0 | 0 | 0.0033 | 0.0033 | 0.0014 | 0.424 | 1.000 | 0.424 |
| | | | | | | | | | | | | | | | | | | | **0.438** | **0.791** | **0.573** |
| | | | | | | | OTHER (INDUSTRIAL PROCESSES) | | | | | | | | | | | average | 0.423 | 0.741 | 0.572 |
| | | | | | | | | | | | | | | | | | | average all | 0.441 | 0.712 | 0.636 |

Source
http://www.arb.ca.gov/app/emsinv/emssumcat.php

**ATTACHMENT CEC-3-2**

# ATTACHMENT CEC-3-2
# CEIDARS DATABASE QUERY for POWER PLANT COOLING TOWER EMISSIONS

Cooling Tower PM, PM10, PM2_5 Emissions in tons per year selected by SCC= 38500101

| CO | AB | DIS | FACID | FNAME | DEV | PROID | PRDESC | SCC | SCC1N | SCC3N | SCC6N | PM | PM10 | PM2_5 | PM2.5 Fraction of Total PM | PM10 Fraction of Total PM | PM2.5 Fraction of PM10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | SC | SC | 129816 | INLAND EMPIRE ENERGY CENTER, LLC | 12 | 1 | 800-MW NATURAL GAS-FIRED, COMBINED-CYCLE ELECTRIC GENERATING | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.4 | 0.28 | 0.168 | 0.420 | 0.700 | 0.600 |
| 33 | SC | SC | 129816 | INLAND EMPIRE ENERGY CENTER, LLC | 11 | 1 | 800-MW NATURAL GAS-FIRED, COMBINED-CYCLE ELECTRIC GENERATING | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.64 | 0.448 | 0.2688 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 17 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 34 | SV | SAC | 193 | CARSON ENERGY/SMUD | 3 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.762635714 | 0.533845 | 0.320307 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 11 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 34 | SV | SAC | 3456 | SMUD COSUMNES POWER PLANT | 3 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 1.843171429 | 1.29022 | 0.774132 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 15 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 34 | SV | SAC | 195 | SACRAMENTO COGENERATION AUTHOY | 4 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 1.247725 | 1.247725 | 0.5240445 | 0.420 | 1.000 | 0.420 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 9 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 10 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 6 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.371 | 0.26 | 0.156 | 0.420 | 0.701 | 0.600 |
| 34 | SV | SAC | 194 | SACRAMENTO POWER AUTHORITY | 2 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 2.434594643 | 1.70421625 | 1.02252975 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 13 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 8 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 15 | SJV | SJU | 3523 | ELK HILLS POWER LLC | 3 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 2.457142637 | 1.719999846 | 1.031999908 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 12 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 7 | 7 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.28 | 0.28 | 0.168 | 0.600 | 1.000 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 16 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104701849 | HIGH DESERT POWER PROJECT | 14 | 1 | COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.412 | 0.288365 | 0.173 | 0.420 | 0.700 | 0.600 |
| 57 | SV | YS | 257 | WOODLAND BIOMASS POWER LTD | 20 | 1 | COOLING TOWER - CIRCULATION RATE | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.014285714 | 0.01 | 0.006 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 11034 | TRIGEN-LA ENERGY CORP | 16 | 1 | DISTRICT HEATING AND COOLING | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 7.12 | 4.984 | 2.9904 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 9053 | TRIGEN- LA ENERGY CORP | 20 | 1 | DISTRICT HEATING AND COOLING | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 1.23 | 0.861 | 0.5166 | 0.420 | 0.700 | 0.600 |
| 30 | SC | SC | 9217 | TRIGEN-LA ENERGY CORP | 3 | 1 | DISTRICT HEATING AND COOLING | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.32 | 0.224 | 0.1344 | 0.420 | 0.700 | 0.600 |
| 36 | MD | MOJ | 104801880 | RRI ENERGY COOLWATER, LLC. | 90011 | 1 | DRIFT CT UNIT 1 | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.5997 | 0.5997 | 0.5997 | 1.000 | 1.000 | 1.000 |
| 36 | MD | MOJ | 104801880 | RRI ENERGY COOLWATER, LLC. | 90012 | 1 | DRIFT CT UNIT 2 | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.5997 | 0.5997 | 0.5997 | 1.000 | 1.000 | 1.000 |
| 36 | MD | MOJ | 104801880 | RRI ENERGY COOLWATER, LLC. | 90013 | 1 | DRIFT CT UNIT 3 | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 6.668 | 6.668 | 6.668 | 1.000 | 1.000 | 1.000 |
| 36 | MD | MOJ | 104801880 | RRI ENERGY COOLWATER, LLC. | 90014 | 1 | DRIFT CT UNIT 4 | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 6.668 | 6.668 | 6.668 | 1.000 | 1.000 | 1.000 |
| 33 | SC | SC | 68042 | CORONA ENERGY PARTNERS, LTD | 2 | 1 | ELECTIC POWER AND STEAM COGENERATION FACILITY | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 5.45 | 3.815 | 2.289 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 51620 | WHEELABRATOR NORWALK ENERGY CO INC | 13 | 1 | ELECTRIC POWER GENERATING FACILITY | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 3.16 | 2.212 | 1.3272 | 0.420 | 0.700 | 0.600 |
| 36 | SC | SC | 115315 | RRI ENERGY ETIWANDA, INC. | 1 | 1 | ELECTRIC POWER GENERATION | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 114.16 | 79.912 | 47.9472 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 128243 | BURBANK CITY,BURBANK WATER & POWER,SCPPA | 1 | 1 | ELECTRIC POWER GENERATION | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 1.24 | 0.868 | 0.5208 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 25638 | BURBANK CITY, BURBANK WATER & POWER | 16 | 1 | ELECTRICAL UTILITY POWER PRODUCTION | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 4.15 | 2.905 | 1.743 | 0.420 | 0.700 | 0.600 |
| 27 | NCC | MBU | 220 | CALPINE KING CITY COGEN, LLC | 6 | 1 | PEAKER COOLING TOWER | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.36 | 0.252 | 0.1512 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 14502 | VERNON CITY, LIGHT & POWER DEPT | 1 | 1 | POWER GENERATION | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.85 | 0.595 | 0.357 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800170 | LA CITY, DWP HARBOR GENERATING STATION | 7 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.05 | 0.035 | 0.021 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800170 | LA CITY, DWP HARBOR GENERATING STATION | 5 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.07 | 0.049 | 0.0294 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800170 | LA CITY, DWP HARBOR GENERATING STATION | 3 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.05 | 0.035 | 0.021 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800170 | LA CITY, DWP HARBOR GENERATING STATION | 4 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.09 | 0.063 | 0.0378 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800193 | LA CITY, DWP VALLEY GENERATING STATION | 6 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.04 | 0.028 | 0.0168 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800170 | LA CITY, DWP HARBOR GENERATING STATION | 6 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 0.06 | 0.042 | 0.0252 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800075 | LA CITY, DWP SCATTERGOOD GENERATING STN | 37 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 13.01 | 9.107 | 5.4642 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800193 | LA CITY, DWP VALLEY GENERATING STATION | 7 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 2.25 | 1.575 | 0.945 | 0.420 | 0.700 | 0.600 |
| 19 | SC | SC | 800193 | LA CITY, DWP VALLEY GENERATING STATION | 8 | 1 | POWER PLANT | 38500101 | COOLING TOWER | PROCESS COOLING | MECHANICAL DRAFT | 9.7 | 6.79 | 4.074 | 0.420 | 0.700 | 0.600 |
| | | | | | | | | | | | | | | **average** | **0.478** | **0.742** | **0.633** |

**ATTACHMENT CEC-3-3**

## ATTACHMENT CEC-3-3

**Calculated PM10 and PM2.5 Cooling Tower Emission Factors as a Function of Recirculating Water TDS**

| Recirculating Water TDS (ppm) | Maximum Drift Droplet Diameter for $PM_{10}$ Particulates (µm) | Maximum Drift Droplet Diameter for $PM_{2.5}$ Particulates (µm) | Percent Particulate Emissions > 10 µm | Percent Particulate Emissions > 2.5 µm |
|---|---|---|---|---|
| 500 | 168 | 41 | 68% | 86% |
| 1000 | 133 | 33 | 73% | 88% |
| 2500 | 86 | 24 | 78% | 89% |
| 5000 | 78 | 19 | 81% | 90% |
| 10000 | 63 | 14 | 83% | 90% |
| 20000 | 49 | 12 | 85% | 91% |
| 30000 | 41 | 11 | 86% | 91% |

Source: After Micheletti, W.C., 2006. "Atmospheric Emissions from Evaporative Cooling Towers." CTI Journal. Vol. 27, No. 1.

Notes:

1 Assumes spherical particulate matter having a density of 2.36 $gm/cm^3$ and 0.002% drift rate.

## CEC COMMENT

***4. <u>General Permit Conditions (All Permit Units):</u> The generic permit conditions that start and end the conditions for each permit unit are not provided consistently. For example, the Gasification Flare (S-7616-3-0) starts with 9 general conditions before the unit specific conditions and the Gasification Cooling Tower (S-7616-3-0) starts with five general conditions before the unit specific conditions. Staff believes that most if not all of these general conditions apply for all of the permit units and requests that the District review consistency of the presentation and inclusion of these general permit conditions across the 16 permit units. Staff also requests, if it is possible based on District permitting rules and policies, that these general, facility-wide conditions be separated into one set of conditions that apply to all relevant permit units. This would provide clarity and avoid a sixteen-fold duplication of conditions.***

## RESPONSE

The Applicant would agree to the CEC recommendation for the conditions.

## CEC COMMENT

***5. <u>Gasification System (S-7616-2-0) and Sulfur Recovery System (S-7616-5-0) Fugitive VOC Emission Source Inspection and Maintenance Requirements:</u> For later compliance demonstration clarity, staff requests that the conditions for these two permit units include more specificity on what parts of these permit units are subject to Rule 4455 – COMPONENTS AT PETROLEUM REFINERIES, GAS LIQUIDS PROCESSING FACILITIES AND CHEMICAL PLANTS, and that the conditions include the specific requirements of the rule.***

## RESPONSE

The Applicant would agree to the SJVAPCD adding compliance demonstration conditions.

## CEC COMMENT

***6. <u>Flares and $CO_2$ Vent Conditions (S-7616-3-0, S-7616-6-0, S-7616-7-0, and S-7616-8-0) Consistency of Conditions:</u> There are certain general conditions (such as no public nuisance, general design conditions, and recordkeeping conditions) as well as other, more unit specific conditions such as emission rate limits that are applied very differently for these four similar event-based emission sources. While staff notes that different regulations such as federal New Source Performance Standards may apply to all of these sources and would require certain differences in the conditions for these four sources, staff believes that greater consistency in the conditions for these four sources, including conditions noted to be required under District Rule 4311 – FLARES, should be investigated and implemented consistently where appropriate.***

## RESPONSE

The Applicant would agree to SJVAPCD standardizing the flare conditions, where applicable.

## CEC COMMENT

***7. <u>$CO_2$ Vent (S-7616-8-0) Condition 12:</u> Staff requests that the methods and frequency (i.e., required for each venting event) for the vent gas composition monitoring that is required under Condition 12 be detailed in this or other conditions for this permit unit.***

## RESPONSE

The $CO_2$ product stream will likely be continuously measured by gas chromatograph for trace constituents. The Applicant intends to use the equipment provided for this purpose to also verify compliance of trace, regulated emissions, as required, during an upset, infrequent $CO_2$ venting occurrence.

## CEC COMMENT

***8. <u>Auxiliary Boiler (S-7616-13-0) Conditions 28 and 30:</u> Conditions 28 and 30 appear to be redundant and staff recommends that one be deleted or that they be combined as necessary into a single condition.***

## RESPONSE

The Applicant would agree to the CEC recommendation for these conditions.

## CEC COMMENT

***9. Firewater Pump Engine (S-7616-16-0) Conditions 15 and 16: Conditions 15 and 16 appear to be redundant and staff recommends that one be deleted or that they be combined as necessary into a single condition.***

## RESPONSE

The Applicant would agree to the CEC recommendation for these conditions.

# RESPONSES TO EPA COMMENTS

## EPA COMMENT

***1. Annual Emissions Estimates:** Applicable federal requirements include thresholds for defining a major source of criteria pollutant or of hazardous air pollutant (HAP) emissions. For those sources where emission estimates and/or emission limits are relatively close to the federal thresholds, EPA encourages the following: (a) refinement of emissions and compliance demonstration methods that would ensure the thresholds would not be exceeded, and/or (b) a 5-10% buffer between the permitted emission limits and the federal threshold.*

***We have identified estimated emissions of certain pollutants that are within a margin of less than 5% of the federal annual threshold limits. These limits include the nonattainment of New Source Review (NSR) threshold of 100 tons per year (tpy) for PM2.5 and the major source of Hazardous Air Pollutant (HAP) thresholds of 10 tpy for a single HAP and 25 tpy for cumulative HAP emissions. If the limits of these pollutants are relaxed, the facility would be subject to the applicable federal requirements; for PM2.5, nonattainment New Source Review would be required, and for HAP emissions, evaluation for case-by-case Maximum Available Control Technology (MACT) would be required. Each is further discussed below.***

## RESPONSE

The response to CEC Comment 3 above provides further discussion regarding the PM emissions from the cooling towers. HECA is requesting additional time to respond to CEC Comment 2 and EPA Comments 1 through 3 regarding the PM emissions from the turbine. The response to EPA Comment 4 below and the responses submitted to the requests for information that EPA issued in April 2010 provides further discussion of the hazardous air pollutant emissions from the $CO_2$ vent. These discussions include how compliance will be demonstrated.

## EPA COMMENT

***2. <u>PM2.5 Federal Nonattainment New Source Review (NSR) Applicability:</u> The San Joaquin Valley APCD presents the major source determination for all criteria pollutants on page 62 (Section VII.C.1.) of the engineering evaluation. PM2.5 is estimated at 198,650 pounds per year, or an equivalent of approximately 99.3 tons per year (tpy). As stated by the District in its evaluation, on May 8, 2008 EPA finalized regulations to implement the NSR program for PM2.5. A source that emits or has the potential to emit 100 tpy or more PM2.5 in a non-attainment area is defined as a major stationary source.***

***The equipment primarily contributing to PM2.5 emissions includes the combined cycle combustion turbine generator (CTG) and the cooling towers; other equipment emitting PM2.5 includes the feedstock handling and combustion-related sources. The District has assumed that all PM10 estimated emissions from the CTG are PM2.5 emissions. The District has assumed that 60% of the PM10 estimated emissions from the cooling towers are PM2.5. If it is determined that the estimated emissions are not representative of the potential-to-emit (PTE) and equal or exceed 100 tpy, the following would also be required: the lowest achievable emission rate control technology and offsetting of PM2.5 emissions with creditable emission reductions.***

***Please note that in the event that PM2.5 offsets are required and the project proponent were to consider using SO2 reductions to offset the project's PM2.5 emissions, paragraph IV.G.5 of Part 51, Appendix S currently provides that offset requirements for direct PM2.5 emissions under Appendix S may be satisfied by offsetting reductions of emissions of SO2 only "if such offsets comply with an interprecursor trading hierarchy and ratio approved by the Administrator." Moreover, although the provisions concerning trading ratios for interpollutant trading for PM2.5 emissions and other aspects of EPA's PM2.5 NSR Implementation Rule (73 FR 28321 (May 16, 2008)) are currently subject to reconsideration by the Agency (see 74 FR 26098 (June 1, 2009)), the modeling conducted by EPA in the context of development of those ratios supports a significantly higher PM2.5 to SO2 ratio than the 1:1 ratio used by the District for PM10 to SO2 interpollutant trading.***

## RESPONSE

For a discussion of the cooling tower PM emissions, please see the response to CEC Comment 3 above. The Applicant is requesting additional time to respond to CEC Comment 2 and EPA Comments 1 through 3 regarding the PM emissions from the turbine.

## EPA COMMENT

***3.*** ***<u>Annual Estimates of PM2.5 Emissions and Compliance Demonstration:</u> As noted above, PM2.5 is estimated at 198,650 pounds per year, or an equivalent of approximately 99.3 tons per year (tpy) for the facility operations. (See Page 61, Table titled "Major Source Determination"; see also Appendix F) The equipment primarily contributing to the PM2.5 emissions estimate include the combined cycle combustion turbine generator (CTG) and the cooling towers. The PDOC indicates that these two sources together contribute an estimated 106.4 tpy of PM10 emissions and 96.8 tpy of PM2.5 emissions. The following highlights our comments regarding CTG and cooling tower PM2.5 emission estimates and the respective compliance demonstration methods.***

- ***<u>Combustion Turbine Generator (S-7616-9-0)</u> – It is assumed that the PM2.5 emissions from the CTG are equal to the PM10 emissions of 19.8 lbs/hr. EPA supports this assumption. Compliance demonstration for the source testing of PM10 emissions is proposed in Condition 47.***

  ***However, it is unclear why these estimated emissions are approximately twice what EPA has permitted and/or reviewed for similar CTGs. Given what appears to be additional conservatism in the hourly emissions, EPA requests further discussion in the engineering evaluation regarding the rationale supporting the higher value, as well as consideration of a further reduction of PM10 emission limits based on source test results. For example, has the District considered further reducing the PM10 emission limits presuming source tests demonstrate lower emissions, similar to the approach for NOx, CO and VOC emissions as proposed in Conditions 81-85.***

- ***<u>Cooling Towers Emissions (S-7616-4-0, S-7616-11-0, S-7616-2-0)</u> – For all three cooling tower operations, the applicant estimates estimated that the PM2.5 emissions from the cooling towers are 60% of the PM10 emissions. (Additionally, the applicant estimates assumed that all PM emissions are PM10 emissions.) Compliance demonstration for PM10 emissions from this equipment is based on a calculation methodology. This methodology includes a 0.0005% drift rate (representing BACT) from the cooling tower drift eliminator, a total dissolved solids (TDS) concentration not to exceed 9,000 ppm, annual operations limited to 8,322 hours per year, and cooling water circulation rates specific to each operation. (See pages 43-44 of PDOC engineering evaluation.)***

  ***The applicant has assumed that the 60% PM2.5 size fraction is likely based on the California Air Resources Board (CARB) database information in its California Emission Inventory Development and Reporting System (CEIDARS). This assumption is based on the applicant's use of information from the South Coast Air Quality Management District (SCAQMD). It is our understanding that the SCAQMD has assumed a 60% size fraction, which is based on a CEIDARS value; however, this CEIDARS value is not specific for cooling towers. Therefore, EPA requests further justification of the size fraction of PM2.5 emissions from the cooling towers and/or additional compliance demonstration requirements. Otherwise, it should be assumed***

***that PM2.5 emissions from the cooling towers are equal to the estimated PM10 emissions.***

***With respect to the District's proposed compliance demonstration, it appears that the compliance demonstration options that EPA is considering may differ from the District's proposed requirements. We acknowledge that the District is requiring quarterly sampling of the blowdown water to estimate TDS. EPA understands that site-specific data is necessary to determine the correlation between TDS and particulate matter emissions (i.e., PM, PM10, PM2.5). PM, PM10, and PM2.5 can vary significantly with plant operations and maintenance. Therefore, in order to use a calculation method, as proposed by the District, site-specific data and testing is necessary to demonstrate compliance with the proposed emission limits. EPA is available to discuss this in more detail for the District's consideration.***

**RESPONSE**

For a discussion of the cooling tower PM emissions, please see the response to CEC Comment 3 above. The Applicant is requesting additional time to respond to CEC Comment 2 and EPA Comments 1 through 3 regarding the PM emissions from the turbine.

## EPA COMMENT

***4. <u>Annual Estimates of HAP Emissions and Compliance Demonstration:</u> Hazardous air pollutant (HAP) emissions are discussed on pages 94-95 of the PDOC engineering evaluation and presented in Appendix I of the PDOC. To remain below the major source MACT threshold, a single HAP must be less than 10 tpy, and the combined HAPs must be less than 25 tpy. Although the HAP emissions section of the PDOC discusses the conduct of testing for speciated HAPs and total VOC source testing for the CTG, the process primarily contributing to the limit of not more than 10 tpy of a single HAP is the intermittent CO2 vent system, which is part of the CO2 recovery and vent system (S-7616-8-0). Operating scenarios for venting are described in the PDOC, pages 30-31.***

***Carbonyl sulfide emissions (COS) are estimated at 9.9 tpy. This estimate is based on imposing operating limits and therefore appears to be a synthetic area source. As a result, the District must require practically and federally enforceable potential-to-emit limits to assure this process is not emitting at the major source level of 10 tpy.***

***In order to remain below the 10 tpy threshold, the District has proposed permit conditions based on assumptions presented in the calculation methodology provided by the applicant. COS annual emission estimates are based on a maximum CO2 vent stream flow rate of 656,000 lbs/hr; proposed Condition 6 limits the vent stream flow rate. Furthermore, Condition 10 requires a gas flowmeter for the vent system flow rate, and Condition 11 requires recordkeeping of venting events. EPA understands this flow rate is estimated to be the same for both early and mature operating scenarios.***

***COS annual emission estimates are also based on operations of the CO2 recovery and vent system of not more than 504 hours per year (or an estimated 21 days per year); proposed Condition 7 limits the annual hours on a rolling 12-month period. Unlike the maximum vent stream flowrate, EPA understands that CO2 venting is expected to be less than one-half (e.g., 5-10 days) during mature operations compared to the early operating scenario.***

***Because the annual tons per year of HAPs is dependent on the hours of venting, including a method for tracking those hours is critical. The flowmeter or another piece of equipment should track the hours of venting. In addition, it is unclear whether the partial hours of venting, e.g., 30-minutes, 45-minutes, are accounted. Therefore, please provide permit conditions and/or require additional monitoring equipment with associated recordkeeping requirements that will assure an accurate accounting of the total hours of operation.***

***Also, EPA suggests that the District include a condition that includes a lower number of allowable annual hours upon achieving mature operations to provide additional assurance that HAP emissions will not exceed 9.9 tpy. Additionally, as outlined on pages 30-31, allowable CO2 venting events (associated with Condition 11) and associated recordkeeping should be included as permit conditions.***

## RESPONSE

The Applicant would accept a condition that tracks the partial hours of venting. The Applicant does not want a change to Condition 7, limiting the annual hours of operation, but would accept a change to Condition 11 to include a condition recording partial hours of operation.

## EPA COMMENT

***5. Federal Requirements for Internal Combustion Engines:** Please include a discussion of the applicability of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Reciprocating Internal Combustion Engines (40 CFR Part 63, Subpart ZZZZ) and of the Standards of Performance for New Stationary Sources (NSPS) for Compression Ignition Internal Combustion Engines (40 CFR 60, Subpart IIII) as they may apply to the diesel fuel-fired emergency generator sets (S-7616-14-0, S-7616-15-0) and firewater pump engine (S-7616-16-0). Based on the applicability determination, EPA suggests that the District incorporate federally enforceable permit conditions to assure compliance with these requirements, as needed.*

## RESPONSE

The Applicant would agree to the EPA recommendations for the internal combustion engines.

## EPA COMMENT

***6. Consistency of PDOC Information with PSD Information:** For the purposes of EPA's review of the PDOC evaluation and PDOC, although not required as part of our PSD permit application review and preparation of proposed permit conditions, we are in the process of identifying whether information provided by the Applicant through the PSD permit application process is consistent with the information in the District's evaluation. We would like to ensure that, at a minimum, those data sets and assumptions shared between the PSD and PDOC processes that contribute to the determination of the potential-to-emit, BACT, and assumptions for the air quality analysis/modeling are consistent. At this time, we simply would like to make the District aware that this evaluation is in process. To the extent that we identify inconsistencies during our review, we will address them as part of our PSD permit process.*

## RESPONSE

The Applicant has no comment.

## EPA COMMENT

***7. Equivalent Equipment, Internal Combustion Engines and Auxiliary Boiler:** The District has included conditions for this equipment (S-7616-13-0, S-7616-14-0, S-7616-15-0, S-7616-16-0) that allows for the use of equivalent equipment upon written District approval. As stated in the proposed permit conditions, approval is granted upon "...determination that the submitted design and performance of the proposed alternate equipment is equivalent to the specifically authorized equipment." EPA suggests that the District also evaluate the air quality modeled impacts of any proposed equivalent equipment.*

## RESPONSE

The Applicant would agree to SJVAPCD conducting air quality modeling of equivalent equipment if the emissions or stack parameters vary from that provided in the ATC application.

## EPA COMMENT

***8.*** ***<u>Operating Work Practices and Annual Hours of Operations:</u> EPA requests the following conditions be added for the equipment listed below:***

- ***<u>Cooling Towers (S-7616-4-0, S-7616-11-0, S-7616-12-0)</u> – For each equipment, please include an operating limit of 8,322 hours per year, along with any necessary recordkeeping requirements.***

- ***<u>Sulfur Recovery System (S-7616-5-0)</u> – Condition 13 required the incinerator firebox temperature to be maintained above 1,200 deg F. Please include a condition that allows compliance demonstration with the temperature.***

- ***<u>Flares (S-7616-3-0, S-7616-6-0, S-7616-7-0)</u> – Condition 10 of the Rectisol AOR emergency flare (S-7616-7-0) allows operations for emergency situations. The PDOC references that the flare will be limited to 200 hours per year of non-emergency operations. Please include a description of the allowable emergency situations, as well as reference to the non-emergency operations.***

- ***<u>Auxiliary Boiler (S-7616-13-0)</u> – For each equipment, please include an operating limit of 2,190 hours per year, along with any necessary recordkeeping requirements. There is reference to flue gas recirculation in Condition 19. Please propose a permit condition that requires the operator to properly operate and maintain the FGR system, which is part of NOx control for the boiler.***

- ***<u>CO2 Recovery and Vent System (S-7616-8-0)</u> – As previously commented under the annual estimates of HAP emissions, allowable CO2 venting events (associated with Condition 11) and associated recordkeeping should be included as permit conditions. Furthermore, specifics about the monitoring requirements for CO, VOC and H2S in Condition 12 should be detailed. Under Condition 8, please clarify the reference for the ppm concentration limits.***

## RESPONSE

The Applicant requests that the annual operating limits for the cooling towers be based on emissions, rather than hours of operation, because these may operate all hours of the year, but at partial capacity for a portion of the time.

The Applicant requests that the auxiliary boiler annual operating limits be based on maximum annual fuel consumption rate of 311 billion British Thermal Units (BTUs) per year, with no annual hours of operation limit.

The $CO_2$ product stream will likely be continuously measured by gas chromatograph for trace constituents. The Applicant intends to use the equipment provided for this purpose to also verify compliance of trace, regulated emissions, as required, during an upset, infrequent $CO_2$ venting occurrence.

The three flares are designed to handle emergency upset conditions that could happen at the facility. These events are never expected to occur, but the flares must be designed to safely dispose of the maximum gas stream. The gasification flare is designed to handle the maximum syngas production from two gasifiers that could occur due to a downstream failure event (or events). The sulfur recovery unit flare is designed to handle the unlikely case of both Claus trains failing simultaneously. The Rectisol flare is designed to handle total flow from an unlikely equipment failure event, such as a major failure in the acid gas removal (AGR) unit. The duration of these upset events is difficult to predict although HECA will do everything reasonably possible to correct the problem that has caused unplanned flaring in a timely manner and begin actions to minimize emissions and the amount of gas flared.

The Applicant would agree to the remaining EPA recommended conditions.

## BACKGROUND

The cooling tower emission estimate uses what staff believes to be an inappropriate assumption that may underestimate the potential PM2.5 (particulate matter) emissions from the cooling towers. The Applicant uses a factor from a South Coast Air Quality Management District (SCAQMD) website table that indicates only 60 percent of the cooling tower PM10 emissions are PM2.5. This table value assumption comes from the Air Resources Board (ARB) CEIDARS (data base) “unspecified” category that clearly is not specific to cooling towers and has not been technically justified for cooling tower use. Staff believes that, unless the applicant can provide technically justified rationale to lower PM2.5 emissions, it should be conservatively assumed that all particulate from cooling tower drift is PM10 and PM2.5. Staff needs the applicant to revise the cooling tower emission calculations.

## DATA REQUEST

***18. Please recalculate the cooling tower particulate emissions considering the mist eliminator drift guarantee of 0.0005 percent of recirculating water flow, and assuming that all particulate emissions are both PM10 and PM2.5.***

## RESPONSE

The factor listed in the SCAQMD guidance indicating that particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is 60 percent of total particulate matter less than 10 microns in diameter ($PM_{10}$) (*Updated CEIDARS Table with $PM_{2.5}$ Fractions)* is specified for cooling tower operation and is not specifically mentioned as being based on an “unspecified” category. Table 18-1 is a copy of the SCAQMD table, presented for reference. Furthermore, the Applicant believes that 60 percent is a conservative overestimate of the $PM_{2.5}$ emissions from the cooling towers as discussed below. Therefore, the Applicant wishes to use the 60 percent factor.

In determining PM emissions from cooling towers, the HECA Project conservatively estimated the total $PM_{10}$ emissions by assuming the full concentration of dissolved solids in any exiting water droplets will be converted to airborne $PM_{10}$, rather than using either the recommended factor provided by the SCAQMD website ($PM_{10}$ emission from cooling towers is 70 percent of the total PM emissions) or the U.S. EPA’s AP-42 guidance, which confirms that it is conservative to use the assumption that all dissolved solids in any exiting water droplets will be converted to airborne $PM_{10}$. Section 13.4.2 of AP-42 states:

> “a conservatively high $PM_{10}$ emission factor can be obtained by multiplying the total liquid drift factor by the total dissolved solids (TDS) fraction in the circulating water and by assuming that, once the water evaporates, all remaining solid particles are within the $PM_{10}$ size range.”

Other studies on similar subjects have also suggested that $PM_{10}$ estimates made with the AP-42 assumptions (all particulate emissions is $PM_{10}$) may exaggerate actual emission rates from cooling towers (Michelleti, 2006). The studies further confirm that the assumption of all particulate emissions is $PM_{2.5}$ is an exaggeration.

For the $PM_{2.5}$ emission estimate, the HECA Project used the CEIDARS factor provided by SCAQMD guidance ($PM_{2.5}$ is 60 percent of total $PM_{10}$). This assumption is nearly identical to the request to use 100 percent of the $PM_{10}$ as $PM_{2.5}$ if only a 70 percent $PM_{10}$ to total solids factor were used in the initial $PM_{10}$ calculation. For example, if the total solids were calculated to be 10, the $PM_{10}$ would be 7 using the SCAQMD factor, and the $PM_{2.5}$ would be 7 using the approach from this data request. This approach compares well to the $PM_{2.5}$ of 6 using the Applicant’s approach. However, both of these approaches are overly conservative, and the Applicant believes that 60 percent is applicable based on the following discussion.

**Table 18-1**
**Updated CEIDARS Table with $PM_{2.5}$ Fractions**

| Source Classification Code (SCC) Main Category | SCC Subcategory | $PM_{2.5}$ Fraction of Total PM | $PM_{10}$ Fraction of Total PM | $PM_{2.5}$ Fraction of $PM_{10}$ |
|---|---|---|---|---|
| Asbestos Removal | | 0.500 | 0.500 | 1.000 |
| Asphalt Paving/ Roofing | Fugitive Emissions | 0.925 | 0.960 | 0.964 |
| | Manufacturing | 0.945 | 0.980 | 0.964 |
| Burning | Agriculture/Field Crops, Weed Abatement | 0.938 | 0.984 | 0.954 |
| | Forest Management, Timber and Brush Fire | 0.854 | 0.961 | 0.889 |
| | Orchard Prunings | 0.925 | 0.981 | 0.943 |
| | Range Management, Waste Burning | 0.932 | 0.983 | 0.948 |
| | Unplanned Structural Fires | 0.914 | 0.980 | 0.933 |
| Cement Manufacturing | | 0.620 | 0.920 | 0.674 |
| Chemical Manufacturing | Fertilizer-Urea | 0.950 | 0.960 | 0.990 |
| | Organic and Inorganic Chemicals | 0.890 | 0.900 | 0.989 |
| Coatings, Solvents, Inks And Dyes | Solvent Based | 0.925 | 0.960 | 0.964 |
| | Water-Based Coating | 0.620 | 0.680 | 0.912 |
| Consumer Products | | 0.925 | 0.960 | 0.964 |
| Cooking | Baking, Charbroiling, Deep Fat Frying | 0.420 | 0.700 | 0.600 |
| Cooling Tower | | 0.420 | 0.700 | 0.600 |
| Dry Cleaning | | 0.925 | 0.960 | 0.964 |
| Electroplating | Hexavalent Chrome, Cadmium | 1.000 | 1.000 | 1.000 |
| | Zinc and Copper | 0.925 | 0.960 | 0.964 |
| External Combustion | Coal, Coke, Lignite | 0.150 | 0.400 | 0.375 |
| | Gaseous Fuel-Except Petroleum and Industrial Process Heaters | 1.000 | 1.000 | 1.000 |
| | Gaseous Fuel – Petroleum and Industrial Process Heater Only | 0.930 | 0.950 | 0.979 |
| | Liquid Fuel – Except Residual Oil | 0.967 | 0.976 | 0.991 |
| | Residual Oil – Except Utility Boilers | 0.760 | 0.870 | 0.874 |
| | Residual Oil – Utility Boilers Only | 0.953 | 0.970 | 0.982 |
| | Steel Furnace | 0.930 | 0.980 | 0.949 |
| | Wood/Bark Waste | 0.927 | 0.997 | 0.930 |

**Table 18-1**
**Updated CEIDARS Table with $PM_{2.5}$ Fractions (Continued)**

| Source Classification Code (SCC) Main Category | SCC Subcategory | $PM_{2.5}$ Fraction of Total PM | $PM_{10}$ Fraction of Total PM | $PM_{2.5}$ Fraction of $PM_{10}$ |
|---|---|---|---|---|
| Fabricated Metals | Abrasive Blasting | 0.790 | 0.860 | 0.919 |
| | Arc Welding, Oxy Fuel, Copper, Zinc, Bath | 0.925 | 0.960 | 0.964 |
| Food and Agriculture | Coffee Roasting | 0.610 | 0.620 | 0.984 |
| | Fermentation, Rendering, Fish and Nut Processing | 0.420 | 0.700 | 0.600 |
| | Grain Elevators | 0.010 | 0.290 | 0.034 |
| | Grain Milling, Drying | 0.400 | 0.540 | 0.741 |
| | Livestock Waste | 0.420 | 0.700 | 0.600 |
| Fugitive Dust | Agricultural Tilling Dust | 0.101 | 0.454 | 0.222 |
| | Construction and Demolition | 0.102 | 0.489 | 0.208 |
| | Landfill Dust | 0.102 | 0.489 | 0.208 |
| | Livestock Dust | 0.055 | 0.482 | 0.114 |
| | Paved Road Dust | 0.077 | 0.457 | 0.169 |
| | Unpaved Road Dust | 0.126 | 0.594 | 0.212 |
| Fugitive Emissions – Organic and Inorganic | Liquid Fuel Storage/Handling, Loading, Unloading Dispensing | 0.925 | 0.960 | 0.964 |
| | Natural Gas Production, Crude Oil Production, Petroleum Refining | 0.555 | 0.610 | 0.910 |
| | Organic and Inorganic Chemcals | 0.925 | 0.960 | 0.964 |
| | Processing | 0.925 | 0.960 | 0.964 |
| | Well Cellears, Pumps, Valves, Flages, Seals | 0.925 | 0.960 | 0.964 |

Notes:

PM = particulate matter
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
$PM_{10}$ = particulate matter less than 10 microns in diameter
SCC = Source Classification Code

A U.S. EPA report provided a calculated estimate on the effect of evaporation on droplet size, which presented an equivalent PM size generation as a function of droplet size (U.S. EPA, 1998) (see Figure 18-1 and Attachment 18-1).

Using manufacturer-provided data on mass distribution of drift droplet size for cooling tower drift dispersed from Marley TU10 and TU12 Excel Drift Eliminators, particulate emissions from the HECA Project cooling towers can be calculated as shown in Table 18-2.

**Figure 18-1**
**Particle Size as Function of Droplet Size**

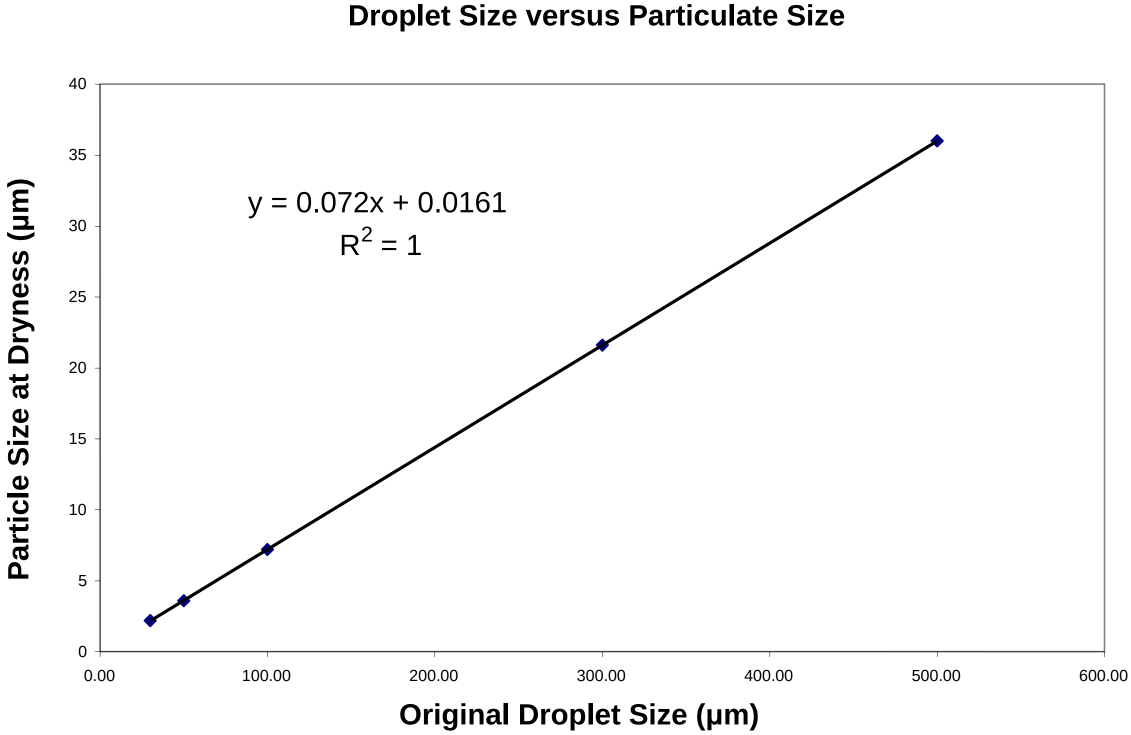



**Table 18-2**
**Cooling Tower Droplet Mass Distribution (U.S. EPA)**

| Droplet Size (Microns)[1] | Mass Fraction[1] | PM Diameter (Microns)[2] |
|---|---|---|
| 525 | 0.2% | 37.82 |
| 375 | 1.0% | 27.02 |
| 230 | 5.0% | 16.58 |
| 170 | 10.0% | 12.26 |
| 115 | 20.0% | 8.30 |
| 65 | 40.0% | 4.70 |
| 35 | 60.0% | 2.54 |
| 15 | 80.0% | 1.10 |
| 10 | 88.0% | 0.74 |

Notes:

[1] Data provided by Marley for Marley TU10 and TU12 Excel Drift Eliminators. Mass Fraction specifies the fraction of particle with diameter larger than the specified diameter—0.2 percent of the drift will have particle sizes larger than 525 microns.

[2] Correlating particle size at dryness based on the data provided in EPA-450/3-87-010a.

A plot of particle distribution based on the last column of Table 18-2 is shown in Figure 18-2.

As shown in Figure 18-2, $PM_{2.5}$ emissions from cooling tower drift using the U.S. EPA methodology are approximately 40 percent of the total particulate emissions. Figure 18-2 shows that the HECA Project's assumption that $PM_{2.5}$ emissions are 60 percent of the $PM_{10}$ (which was assumed as 100 percent particulates) is indeed conservative.

Another approach to estimating fine particulate emissions from cooling towers based on a representative drift droplet size distribution and TDS in the water was also commonly used (Aull, 1999). This approach was presented at the 94th Annual Air & Waste Management Association's Annual Meeting (June 2001) and presented in the State Water Resources Control Board's Draft Substitute Environmental Document on the Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling as an alternative approach to better estimate fine particulate emissions from cooling towers (Reisman, 2001). By assuming that, shortly after being emitted into ambient air, each water droplet was to evaporate into a single, solid, spherical salt (sodium chloride) particle, particulate emissions from the HECA Project cooling towers can be calculated as shown in Table 18-3.

A plot of the last column in Table 18-3 is shown in Figure 18-3.

Using the second approach based on droplet size from the cooling tower manufacturer, and the approach by Aull (1999), $PM_{2.5}$ emissions from cooling towers is approximately 20 percent of the total particulate emission. This approach showed that the HECA Project's assumption that $PM_{2.5}$ emissions are 60 percent of the $PM_{10}$ (which was assumed as 100 percent particulates) is far more conservative than the expected value.

**Figure 18-2**
**Particulate Mass Distribution Curve (U.S. EPA)**

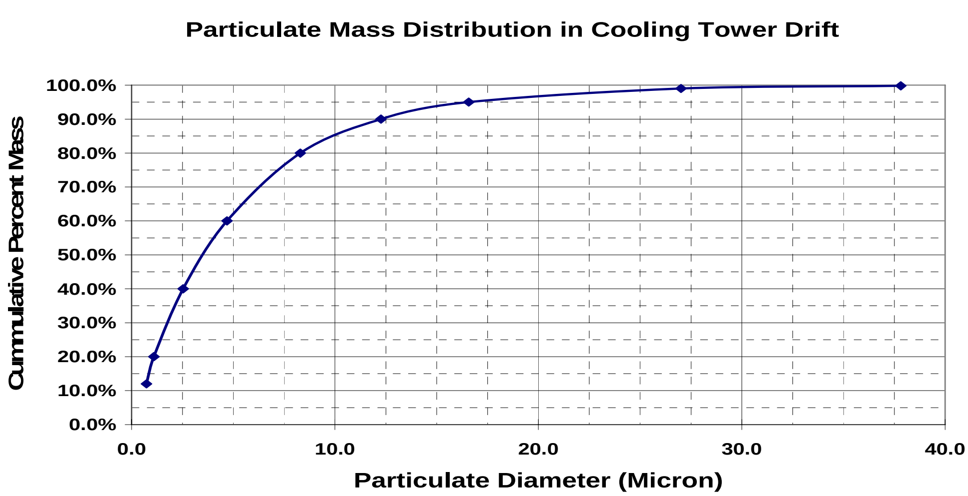


**Table 18-3**
**Cooling Tower Droplet Mass Distribution[1]**

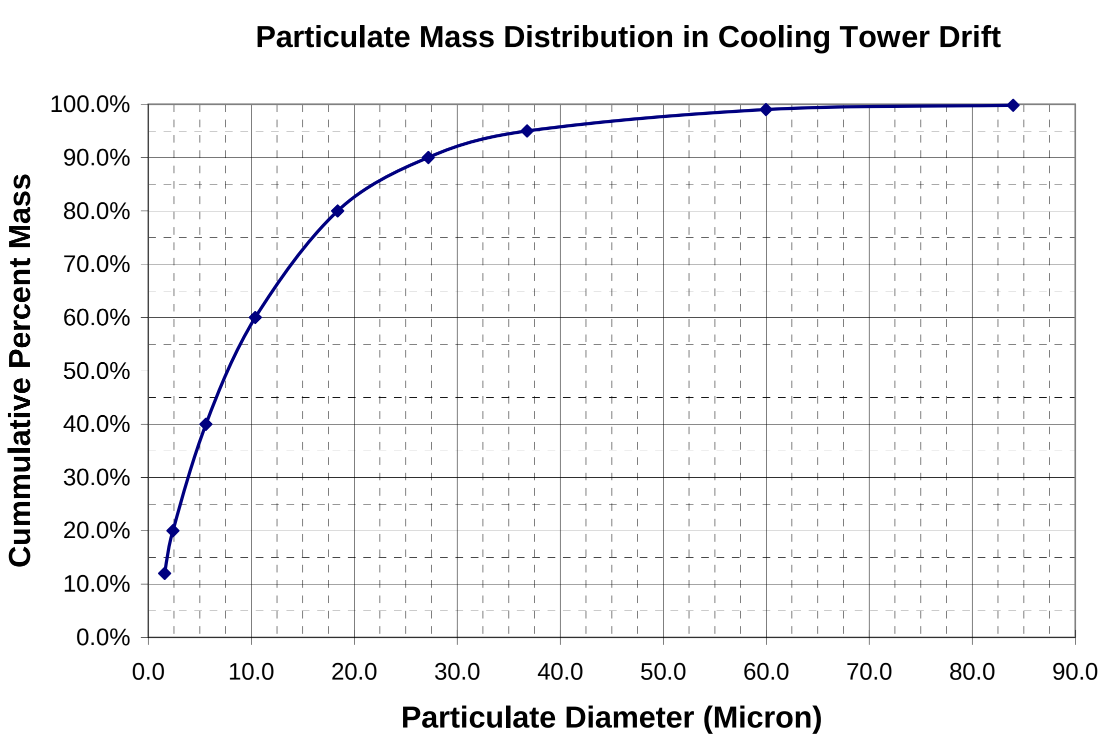
| Droplet Size (Microns)[2] | Mass Fraction[2] | PM Diameter (Microns)[1] |
|---|---|---|
| 525 | 0.2% | 83.97 |
| 375 | 1.0% | 59.98 |
| 230 | 5.0% | 36.78 |
| 170 | 10.0% | 27.19 |
| 115 | 20.0% | 18.39 |
| 65 | 40.0% | 10.40 |
| 35 | 60.0% | 5.60 |
| 15 | 80.0% | 2.40 |
| 10 | 88.0% | 1.60 |

Notes:

[1] Correlating particle size at dryness based on the assumption that, shortly after being emitted into ambient air, each water droplet was to evaporate into a single, solid, spherical salt (sodium chloride) particle.

[2] Data provided by Marley for Marley TU10 and TU12 Excel Drift Eliminators. Mass Fraction specifies the fraction of particle with diameter larger than the specified diameter—0.2 percent of the drift will have particle sizes larger than 525 microns.

**Figure 18-3 Particulate Mass Distribution Curve**



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**ATTACHMENT 18-1**

TABLE 3-4. EFFECT OF EVAPORATION ON DROPLET SIZE

| Original droplet size, µm (mils) | Particle size at dryness, µm (mils)[a] | Droplet size, µm (mils)[b] 80 percent relative humidity | Droplet size, µm (mils)[b] 90 percent relative humidity | Solids concentration, ppm[a] 80 percent relative humidity |
|---|---|---|---|---|
| 500 (19.69) | 36.0 (1.4) | 499.3 (19.66) | 499.7 (19.67) | 1,004 |
| 300 (11.81) | 21.6 (0.85) | 298.9 (11.77) | 299.5 (11.79) | 1,007 |
| 100 (3.94) | 7.2 (0.28) | 96.6 (3.80) | 98.4 (3.87) | 1,109 |
| 50 (1.97) | 3.6 (0.14) | 42.7 (1.68) | 46.7 (1.84) | 1,605 |
| 30 (1.2) | 2.2 (0.09) | 15.0 (0.59) | 24.2 (0.95) | 8,000 |

[a]Assumes total dissolved solids content of droplets is 1,000 µg/ml (0.0624 lb/ft$^3$) and that the dissolved solids are primarily calcium carbonate (35 percent), magnesium carbonate (48 percent), and sodium carbonate (17 percent). Also assumes that the specific gravity of resulting dry particulate is the same as the weighted average of the specific gravity of the three major components.

[b]Assumes an evaporation time of 3 seconds and 26.7°C (80°F) dry bulb temperature. See Reference 29 for the equation used to calculate the droplet size.

29. Chemical Engineers' Handbook. 3rd Edition. John H. Perry, ed. New York, McGraw-Hill. 1950. p. 806.

Source: USEPA, 1998. Chromium Estimate from Comfort Cooling Towers- Background Information for Proposed Standards – Emission Standards Division. EPA-450/3-87-010a.

# Appendix E-5

## Offsite Operational Transportation Emissions

*Hydrogen Energy California LLC* *4/16/2012*
*HECA Project*

| Area | Attainment Status | Emission Source | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|---|
| | | | **Annual Emission Rates (tons/yr)** | | | | | |
| SJVAPCD (San Joaquin Valley) | Ozone Nonattainment - Extreme<br>PM2.5 Nonattainment | Offsite Train | 25.39 | 93.08 | 1.69 | 1.64 | 1.53 | 5.35 |
| | | Offsite Truck | 9.96 | 8.71 | 2.39 | 0.72 | 0.06 | 0.74 |
| | | Offsite Workers Commuting | 4.17 | 0.48 | 1.05 | 0.28 | 0.01 | 0.13 |
| | | Onsite Train | 1.09 | 2.65 | 0.05 | 0.05 | 0.06 | 0.28 |
| | | Onsite Truck | 0.63 | 0.99 | 0.15 | 0.05 | 0.01 | 0.16 |
| | | **Total Emission (ton/yr)** | **41.23** | **105.90** | **5.33** | **2.74** | **1.67** | **6.65** |
| | | **Conformity De minimis (ton/yr)** | **100** | **10** | **NA** | **100** | **NA** | **10** |
| | | **Less than De minimis?** | **Yes** | **No** | **Yes** | **Yes** | **Yes** | **Yes** |
| SCAQMD (South Coast) | Ozone Nonattainment - Extreme<br>PM10 Nonattainment - Serious<br>PM2.5 Nonattainment<br>CO Nonattainment - Serious | Offsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Offsite Truck | 7.80 | 6.82 | 1.87 | 0.56 | 0.05 | 0.58 |
| | | **Total Emission (ton/yr)** | **7.80** | **6.82** | **1.87** | **0.56** | **0.05** | **0.58** |
| | | **Conformity De minimis (ton/yr)** | **100** | **10** | **70** | **100** | **NA** | **10** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| EKAPCD (East Kern County) | Ozone Nonattainment (Former Subpart 1)<br>PM10 Nonattainment - Serious | Offsite Train | 12.16 | 44.57 | 0.81 | 0.79 | 0.73 | 2.56 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **12.16** | **44.57** | **0.81** | **0.79** | **0.73** | **2.56** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **70** | **NA** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| MDAQMD (Mojave Desert) | Ozone Nonattainment - Moderate (San Bernardino County): approximately 75% of the total distance across of MDAQMD<br>PM10 Nonattainment - Moderate (San Bernardino County) | Offsite Train | 24.94 | 70.01 | 1.66 | 1.61 | 1.50 | 4.02 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **24.94** | **70.01** | **1.66** | **1.61** | **1.50** | **4.02** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **100** | **NA** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Sacramento Metro | Ozone Nonattainment - Serious<br>PM10 Nonattainment - Moderate (Sacramento County)<br>PM2.5 Nonattainment | Offsite Train | 1.72 | 6.29 | 0.11 | 0.11 | 0.10 | 0.36 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **1.72** | **6.29** | **0.11** | **0.11** | **0.10** | **0.36** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **50** | **100** | **100** | **NA** | **50** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Yuba City-Marysville | Ozone Nonattainment - Former Subpart 1 (Sutter County)<br>PM2.5 Nonattainment | Offsite Train | 1.07 | 3.93 | 0.07 | 0.07 | 0.06 | 0.23 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **1.07** | **3.93** | **0.07** | **0.07** | **0.06** | **0.23** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **NA** | **100** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Chico | Ozone Nonattainment - Former Subpart 1 (Sutter County)<br>PM2.5 Nonattainment | Offsite Train | 1.07 | 3.93 | 0.07 | 0.07 | 0.06 | 0.23 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **1.07** | **3.93** | **0.07** | **0.07** | **0.06** | **0.23** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **NA** | **100** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Arizona | Ozone Nonattainment (Former Subpart 1) (Maricopa Co, Pinal Co) PM10 Nonattainment (Moderate or Serious) (10 counties) PM2.5 Nonattainment (Santa Cruz and Pinal Counties) SO2 Nonattainment (Pinal county) CO Nonattainment (Phoenix and Tucson, AZ. Maricopa and Pima Counties) | Offsite Train | 31.16 | 57.13 | 3.78 | 0.20 | 1.88 | 3.28 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **31.16** | **57.13** | **3.78** | **0.20** | **1.88** | **3.28** |
| | | **Conformity De minimis (ton/yr)** | **100** | **100** | **70** | **100** | **100** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| New Mexico | PM10 Nonattainment - Moderate (Dona Ana County) CO Nonattainment - Moderate (Bernalillo County) | Offsite Train | 24.15 | 88.56 | 1.61 | 1.56 | 1.46 | 5.09 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **24.15** | **88.56** | **1.61** | **1.56** | **1.46** | **5.09** |
| | | **Conformity De minimis (ton/yr)** | **100** | **NA** | **100** | **NA** | **NA** | **NA** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

Notes:
Onsite worker travel and associated emissions are negligible
SJVAPCD - Carbon Monoxide - Not Classified (Bakersfield, CA, Kern County)
MDAQMD - PM2.5 Unclassified/Attainment (Federal), PM2.5 Non-ttainment (State)
MDAQMD - Approximately 75% of the train route (distance) within MDAQMD is ozone nonattainment area while all MDAQMD is PM10 nonattainment area.

**Annual Number of Train Cars (incoming/outgoing)**

| | Coal Cars (incoming) | Liquid Sulfur Cars (outgoing) | Gasification Cars (outgoing) | Ammonia Cars (outgoing) | Urea Cars (outgoing) | UAN Cars (outgoing) | Maximum Total Trains per period |
|---|---|---|---|---|---|---|---|
| Annual average number of train cars | 13034 | 83 | 2800 | 357 | 1795 | 1983 | 20051 |

| | | Line-Haul Engine for Product Trains | | | | |
|---|---|---|---|---|---|---|
| | Line-Haul Engine for Coal Train | Liquid Sulfur | Gasification | Ammonia | Urea | UAN |
| ton-mile/gallon | 480 | 480 | 480 | 480 | 480 | 480 |
| Train car capacity (ton) | 117 | 100 | 100 | 117 | 117 | 117 |
| Unloaded train car weight (ton) | 25 | 25 | 25 | 25 | 25 | 25 |

480 ton-mile/gallon is based on 2009 *class I rail freight fuel consumption and travel* data (Association of American Railroads, *Railroad Facts*)

| | Coal Trains | | | Liquid Sulfur Product Train | | | Gasification Solid Product Train | | |
|---|---|---|---|---|---|---|---|---|---|
| Area | Miles traveled per Train (mile/engine) - One Way * | Coal Train (ton-miles/year) - Round Trip | Fuel Use for Coal Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip |
| SJVAPCD | 63 | 137,132,692 | 285,683 | 150 | 1,856,250 | 3,867 | 63 | 26,460,000 | 55,123 |
| EKAPCD | 62 | 134,955,983 | 281,148 | | 0 | 0 | 83 | 34,852,294 | 72,606 |
| MDAQMD (PM10 nonattainment and total distance) | 150 | 326,506,410 | 680,198 | | 0 | 0 | 52 | 21,847,706 | 45,514 |
| MDAQMD (Ozone nonattainment) | 113 | 244,879,808 | 510,148 | | 0 | 0 | | 0 | 0 |
| Arizona (PM10 nonattainment and total distance) | 364 | 792,322,222 | 1,650,613 | | 0 | 0 | | 0 | 0 |
| Arizona (PM2.5 nonattainment) | 20 | 43,534,188 | 90,693 | | 0 | 0 | | 0 | 0 |
| Arizona (Ozone nonattainment) | 100 | 217,670,940 | 453,465 | | 0 | 0 | | 0 | 0 |
| Arizona (SO2 and CO nonattainment) | 200 | 435,341,880 | 906,930 | | 0 | 0 | | 0 | 0 |
| New Mexico | 155 | 337,389,957 | 702,871 | | 0 | 0 | | 0 | 0 |

* Since exact route of coal train was not determined yet, It was assumed that the coal train would travel across the maximum distance of the nonattainment area for all pollutants in Arizona.

| | Ammonia Product Train | | | Urea Product Train | | | UAN Product Train | | |
|---|---|---|---|---|---|---|---|---|---|
| Area | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip |
| SJVAPCD | 264 | 15,732,256 | 32,774 | 287 | 86,026,410 | 179,215 | 264 | 87,422,359 | 182,123 |
| Sacramento Metro | | 0 | 0 | 80 | 23,979,487 | 49,956 | | 0 | 0 |
| Yuba City-Marysville | | 0 | 0 | 50 | 14,987,179 | 31,222 | | 0 | 0 |
| Chico | | 0 | 0 | 50 | 14,987,179 | 31,222 | | 0 | 0 |
| Other Area in California and Oregon/Washington | | 0 | 0 | 161 | 48,258,718 | 100,535 | | 0 | 0 |

| | Line-Haul Emission Factors | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| | Tier 3 Emission Factor (g/bhp-hr) | 1.50 | 5.50 | 0.10 | 0.10 | 0.09 | 0.32 |
| | Tier 3 Emission Factor (g/gal) | 31.20 | 114.40 | 2.08 | 2.02 | 1.88 | 6.57 |

**Annual Emission Rates Using ton-mile/gallon factor**

| Area | | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| | | **Annual Emission Rates (tons/year) all trains** | | | | | |
| SJVAPCD (San Joaquin Valley), CA | Line-haul coal engines | 9.82 | 35.99 | 0.65 | 0.63 | 0.59 | 2.07 |
| | Line-haul liquid sulfur product engines | 0.13 | 0.49 | 0.01 | 0.01 | 0.01 | 0.03 |
| | Line-haul gasification product engines | 1.89 | 6.95 | 0.13 | 0.12 | 0.11 | 0.40 |
| | Line-haul ammonia product engines | 1.13 | 4.13 | 0.08 | 0.07 | 0.07 | 0.24 |
| | Line-haul urea product engines | 6.16 | 22.58 | 0.41 | 0.40 | 0.37 | 1.30 |
| | Line-haul UAN product engines | 6.26 | 22.95 | 0.42 | 0.40 | 0.38 | 1.32 |
| | **Total Trains (ton/yr)** | **25.39** | **93.08** | **1.69** | **1.64** | **1.53** | **5.35** |
| EKAPCD (East Kern County), CA | Line-haul coal engines | 9.66 | 35.42 | 0.64 | 0.62 | 0.58 | 2.03 |
| | Line-haul gasification product engines | 2.49 | 9.15 | 0.17 | 0.16 | 0.15 | 0.53 |
| | **Total Trains (ton/yr)** | **12.16** | **44.57** | **0.81** | **0.79** | **0.73** | **2.56** |
| MDAQMD (Mojave Desert), CA | Line-haul coal engines | 23.37 | 64.27 | 1.56 | 1.51 | 1.41 | 3.69 |
| | Line-haul gasification product engines | 1.56 | 5.73 | 0.10 | 0.10 | 0.09 | 0.33 |
| | **Total Trains (ton/yr)** | **24.94** | **70.01** | **1.66** | **1.61** | **1.50** | **4.02** |
| Sacramento Metro, CA | Line-haul urea product engines | 1.72 | 6.29 | 0.11 | 0.11 | 0.10 | 0.36 |
| | **Total Trains (ton/yr)** | **1.72** | **6.29** | **0.11** | **0.11** | **0.10** | **0.36** |
| Yuba City-Marysville, CA | Line-haul urea product engines | 1.07 | 3.93 | 0.07 | 0.07 | 0.06 | 0.23 |
| | **Total Trains (ton/yr)** | **1.07** | **3.93** | **0.07** | **0.07** | **0.06** | **0.23** |
| Chico, CA | Line-haul urea product engines | 1.07 | 3.93 | 0.07 | 0.07 | 0.06 | 0.23 |
| | **Total Trains (ton/yr)** | **1.07** | **3.93** | **0.07** | **0.07** | **0.06** | **0.23** |
| Other Area in California and Oregon/Washington | Line-haul urea product engines | 3.45 | 12.67 | 0.23 | 0.22 | 0.21 | 0.73 |
| | **Total Trains (ton/yr)** | **3.45** | **12.67** | **0.23** | **0.22** | **0.21** | **0.73** |
| Arizona | Line-haul coal engines | 31.16 | 57.13 | 3.78 | 0.20 | 1.88 | 3.28 |
| | **Total Trains (ton/yr)** | **31.16** | **57.13** | **3.78** | **0.20** | **1.88** | **3.28** |
| New Mexico | Line-haul coal engines | 24.15 | 88.56 | 1.61 | 1.56 | 1.46 | 5.09 |
| | **Total Trains (ton/yr)** | **24.15** | **88.56** | **1.61** | **1.56** | **1.46** | **5.09** |

**Emission Factors**

**40 CFR Part 1033**

**Table 1 to §1033.101—Line-Haul Locomotive Emission Standards**

| Year of original manufacture | Tier of standards | Standards (g/bhp-hr) | | | |
|---|---|---|---|---|---|
| | | CO | $NO_X$ | PM | HC |
| 1973–1992 | Tier 0 | 5 | 8 | 0.22 | 1 |
| 1993–2004 | Tier 1 | 2.2 | 7.4 | 0.22 | 0.55 |
| 2005–2011 | Tier 2 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2012–2014 | Tier 3 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2015 or later | Tier 4 | 1.5 | 1.3 | 0.03 | 0.14 |

Reference: 40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards

| Emission Factors For all Locomotives | | | |
|---|---|---|---|
| SOx (3) | $CO_2$ | $CH_4$ (4) | $N_2O$ (4) |
| g/gal | g/gal | g/gal | g/gal |
| 1.88 | 10217 | 0.80 | 0.26 |

| Locomotive Application | Conversion Factor (bhp-hr/gal) |
|---|---|
| Large Line-haul & Passenger | 20.8 |
| Small Line-haul | 18.2 |
| Switching | 15.2 |

Note:

(1) EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).

(2) Line-haul engine emissions of CO, Nox, PM, and HC are based on EPA Tier 3.

(3) Based on 300 ppm sulfur diesel fuel.

(4) $CH_4$ and $N_2O$ factors are derived from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type).

VOC emissions can be assumed to be equal to 1.053 times the HC emissions

(5) $PM_{2.5}$ Fraction of $PM_{10}$, = 0.97

(6) No off-site switching or idling was assumed for train transportation.

## Summary of Truck Emissions - HECA

4/16/2012

**Calculations for Trucks Operation Modeling**

| Data Supplied By Client | | | | | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Coke and Coal Trucks (Max @ 50 or 60 mph) | Liquid Sulfur Product Trucks (Max @ 50 or 60 mph) | Gasification Product Trucks (Max @ 50 or 60 mph) | Ammonia Product Trucks (Max @ 50 or 60 mph) | Urea Product Trucks (Max @ 50 or 60 mph) | UAN Sulfur Product Trucks (Max @ 50 or 60 mph) | Equipment and Miscellaneous Trucks (Max @ 50 or 60 mph) |
| | Running Emissions | Running Emissions | | | | | Running Emissions |
| Distance traveled per truck in SJVAPCD (mi) | 104 | 104 | 160 | 80 | 80 | 80 | 80 |
| Distance traveled per truck in SCAQMD (mi) | 176 | 180 | 0 | 0 | 0 | 0 | 0 |
| **Maximum number of trucks or loads:** | | | | | | | |
| Annual average trucks or loads | 15,200 | 990 | 2,800 | 5,010 | 2,800 | 9,280 | 1,818 |

No off-site idling was assumed for truck transportation.
Distance traveled per truck is based on round-trip.

**EMFAC2007 Emission Factors + Fugitive Dust (g/mi) For Truck Model year 2010, Scenario year 2015**

| Pollutant | Coke and Coal Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | Liquid Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | Gasification Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | Ammonia Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) | Equipment and Miscellaneous Trucks (Max @ 50 or 60 mph) Running Emissions (g/mile/trk) |
|---|---|---|---|---|---|---|---|
| CO | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 |
| NOx | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 |
| ROG | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| SOx | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| PM10 * | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| PM2.5 * | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
The maximum emission factor from either truck speed at 50 mph or 60 mph was used.
Most California highways have speed limits of 60 or 70 mph and large trucks travel more slowly than the speed limit.

**Annual Emission Rates for AERMOD (ton/yr) all trucks**

| Pollutant | Coke and Coal Trucks (Max @ 50 or 60 mph) Running Emissions | Liquid Sulfur Product Trucks (Max @ 50 or 60 Running Emissions | Gasification Product Trucks (Max @ 50 or 60 Running Emissions | Ammonia Product Trucks (Max @ 50 or 60 mph) Running Emissions | Urea Product Trucks (Max @ 50 or 60 mph) Running Emissions | UAN Sulfur Product Trucks (Max @ 50 or 60 mph) Running Emissions | Equipment and Miscelleneous Trucks (Max Running Emissions | Total Truck Emission Rates (tons/yr) |
|---|---|---|---|---|---|---|---|---|
| **SJVAPCD (San Joaquin Valley)** | | | | | | | | |
| CO | 4.32 | 0.28 | 1.22 | 1.10 | 0.61 | 2.03 | 0.40 | **9.96** |
| NOx | 3.78 | 0.25 | 1.07 | 0.96 | 0.54 | 1.77 | 0.35 | **8.71** |
| ROG | 0.32 | 0.02 | 0.09 | 0.08 | 0.05 | 0.15 | 0.03 | **0.74** |
| SOx | 0.03 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | **0.06** |
| PM10 | 1.04 | 0.07 | 0.29 | 0.26 | 0.15 | 0.49 | 0.10 | **2.39** |
| PM2.5 | 0.31 | 0.02 | 0.09 | 0.08 | 0.04 | 0.15 | 0.03 | **0.72** |
| **SCAQMD (South Coast)** | | | | | | | | |
| CO | 7.31 | 0.49 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **7.80** |
| NOx | 6.39 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **6.82** |
| ROG | 0.54 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.58** |
| SOx | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.05** |
| PM10 | 1.76 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1.87** |
| PM2.5 | 0.53 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.56** |

## Summary of Worker Commute Vehicle Emissions - HECA

4/16/2012

**Calculations for Worker Commute Vehicle Operation Modeling**

| OFFSITE - 50 MPH | | | | | | | | EF (g/mile) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Onroad Vehicle** | **Fuel Type** | **Vehicle Type** | **Total Number of Workers per day** | **Daily Vehicle Count** | **Round Trip Distance (miles/vehicle/day)** | **Trips per day** | **VMT (Annual)** | **CO** | **NOx** | **$PM_{10}$** | **$PM_{2.5}$** | **$SO_2$** | **TOC** |
| Personal Commuting Vehicles | G/D | LDA/ LDT | 200 | 154 | 40.0 | 1 | 2,246,154 | 1.6825 | 0.1930 | 0.4234 | 0.1134 | 3.50E-03 | 0.0540 |

**Assumptions:**

Assumed average distance traveled off site for all employees commuting will be 20 miles

times 2 for return trip = 40 miles

365 days per year

Number of workers per commuter vehicle = 1.3

EMFAC2007 emissions are for fleet mix years 1971-2015 travelling at 50 mph.

| Area | Description | **CO** | **NOx** | **PM10** | **PM2.5** | **SO2** | **VOC** |
|---|---|---|---|---|---|---|---|
| | | **Annual Emission Rates (tons/year) all worker commute vehicles** | | | | | |
| SJVAPCD (San Joaquin Valley), CA | Personal Commuting Vehicles | 4.17 | 0.48 | 1.05 | 0.28 | 0.01 | 0.13 |

## Fugitive dust on Paved Road - HECA

4/16/2012

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [ k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

| | **k** |
|---|---|
| | **g/VMT** |
| **PM2.5** | 0.25 |
| **PM10** | 1.00 |

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

**Fleet mix on highway**

| | | | |
|---|---|---|---|
| W= | 9.1 | tons, average | |
| sL= | 0.031 | g/m2 | Default value from URBEMIS 9.2 for Kern County |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | |

E=

| | |
|---|---|
| 0.09836 | g/VMT PM2.5 |
| 0.39344 | g/VMT PM10 |

| Vehicle weight (tons) | | fraction of each vehicle type |
|---|---|---|
| 1.6 | passenger vehicles | 0.75 |
| 40 | large trucks | 0.18 |
| 9 | 2-4 axle trucks | 0.07 |

9.1 weighted average for all vehicles (ton)

On I-5 near the Project, 75% of all vehicles are passenger vehicles,
of the remaining vehicle, 73% are 5-axle trucks and the remainder are 2-4 axle trucks.
From information provided by California Department of Transportation for the traffic analysis.

**Summary of Transportation Vehicles and Routes**

16-Apr-2012

| Commodity Handled | Petcoke | Coal | Liquid Sulfur | Gasification | Ammonia | Urea | UAN | Equipment | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|
| **Expected plant operation** | | | | | | | | | |
| Expected plant operation is 8000 hours / year | | | | | | | | | |
| The plant will operate 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day |
| The plant will operate 333 days / year | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr |
| Shipment by trucks | 100 % | 0 % | 75 % | 25 % | 75 % | 25 % | 50 % | 100 % | 100 % |
| Shipment by train | 0 % | 100 % | 25 % | 75 % | 25 % | 75 % | 50 % | 0 % | 0 % |
| **Production rate** | | | | | | | | | |
| Required Normal Flow / day | 1,140 tons / day | 4,580 tons / day | 100 tons / day | 839 tons / day | 500 tons / day | 833 tons / day | 1,392 tons / day | | |
| Required Normal Flow / year | 380,000 tons / yr | 1,525,000 tons / yr | 33,000 tons / yr | 280,000 tons / yr | 167,000 tons / yr | 280,000 tons / yr | 464,000 tons / yr | | |
| Required Maximum Flow day | 1,368 tons / day (3) | 6,107 tons / day (4) | 200 tons / day (5) | 1,678 tons / day (6) | 1,000 tons / day (6) | 1,666 tons / day (6) | 2,784 tons / day (6) | | |
| **Truck Shipments** | | | | | | | | | |
| Truck Capacity | 25 tons / truck | | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck |
| Required trucks loads for normal operation / day | 46 trucks / day | | 4 trucks / day | 8 trucks / day | 15 trucks / day | 8 trucks / day | 28 trucks / day | 2 trucks / day | 3 trucks / day |
| Required trucks loads for normal operation / yr | 15,200 truck / yr | | 990 truck / yr | 2,800 truck / yr | 5,010 truck / yr | 2,800 truck / yr | 9,280 truck / yr | | |
| Required trucks loads for maximum operation /day | 55 trucks / day | | 8 trucks / day | 17 trucks / day | 30 trucks / day | 17 trucks / day | 56 trucks / day | | |
| **Train Shipments** | | | | | | | | | |
| Railcar Capacity | | 117 tons / car | 100 tons / car | 100 tons / car | 117 tons / car | 117 tons / car | 117 tons / car | | |
| Assume a train has 13,000 ton capacity | | | | | | | | | |
| Required railcars for normal operation / day | | 39 cars / day | 0.25 cars / day | 6 cars / day | 1 cars / day | 5 cars / day | 6 cars / day | | |
| Required railcar loads for normal operation / yr | | 13,034 cars / yr | 83 cars / yr | 2,800 cars / yr | 357 cars / yr | 1,795 cars / yr | 1,983 cars / yr | | |
| Required railcars for maximum operation / day | | 200 cars / day | 1 cars / day | 16 cars / day | 2 cars / day | 11 cars / day | 12 cars / day | | |
| **Basis** | - 91% availability<br>- 25% petcoke (heat input)<br>- 25 ton/truck<br>- 7 days/week receiving<br>- 25% excess truck | - 91% availability<br>- 75% coal (heat input) per<br>- 117 tons/car<br>- 100% coal for maximum<br>- Rack sized to handle two | - 91% availability<br>- High sulfur case - 100<br>- 25 ton/truck<br>- Weekdays only<br>- Can only move up to 25% of | - 91% availability<br>- 75% coal max annual<br>- 100% capable by rail<br>- 25% capable by truck<br>- Maximun is double the daily | - 91% availability<br>- 500 t/d NH3 sales<br>- 75% by truck<br>- Ability to ship 7500 tons ove | - 91% availability<br>- 75% by rail<br>-empty 45 day storage in 10<br>' | - 91% availability<br>- 75% by rail<br>-empty 45 day storage in 10 | ' | |

## Summary of Transportation Vehicles and Routes

16-Apr-2012

| Traffic route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route |
|---|---|---|---|---|---|---|---|---|---|
| Destination/Origin | Carson Refinery | None | California Sulfur | Various | Various | Various | Various | Various | Various |
| Address | 1801 E Sepulveda, Carson | | 2509 E Grant Street, Wilmington | | | | | | |
| Distance | 140 Miles | | 142 Miles | 80 Mile radius | 40 mile radius | 40 mile radius | 40 mile ratius | 40 mile ratius | 40 mile ratius |
| Route | Alameda | | Grant | 40 mile radius | Station Road | Station Road | Station Road | 5 fwy | 5 fwy |
| | 405 Fwy | | Henry Ford | Station Road | Morris Road | Morris Road | Morris Road | Stockdale Hwy | Stockdale Hwy |
| | 5 Fwy | | Alameda | Morris Road | Stockdale Hywy | Stockdale Hywy | Stockdale Hywy | Dairy Road | Dairy Road |
| | Stockdale hwy | | 405 Fwy | Stockdale Hywy | 5 Fwy | 5 Fwy | 5 Fwy | | |
| | Morris Road | | 5 Fwy | 5 Fwy | | | | | |
| | Station Road | | Stockdale hwy | | | | | | |
| | | | Morris Road | | | | | | |
| | | | Station Road | | | | | | |
| | Station Road | | | | | | | | |
| | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route |
| Destination/Origin | None | Elk Ranch New Mexico | In SJVAPCD | CEMEX, Victorville | Calamco | Oregon/Washington | Calamco | None | None |
| Address | | | | | Port Rd G15, Stockton, CA | | Port Rd G15, Stockton, CA | | |
| Distance | | 794 miles | | 198 miles | 264 miles | 628 Miles | 264 miles | | |
| Route | | Kern County: 132.2 miles (County Line near Boron, CA to north pro | | SJVR/BNSF | SJVR/UPRR | SJVR/UPRR | | | |
| | | Mine to Boron, CA: 662 miles | | | | | | | |
| | | Total Distance: 794.2 miles | | | | | | | |

**Notes**

1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation.
3) The maximum flow rate of coke is ratioed up from the normal flow rate at 25% to 30% of feed
4) The maximum flow rate of coal is ratioed up from the normal flow rate at 75% to 100% of feed
5) The maximum flow rate of sulfur is 2 times the normal production
6) The maximum flow rate of these commodities is 2 times the normal production
7) The sources of flow data used in the Production Rate calculation were based on the flow rates provided in "Conference Note: Rail and Truck Traffic - Planning Session" and the "FertilizerProductMovement Update", 01-25-12.

# Appendix E-6

# Operational Greenhouse Gas Emissions

# Appendix E-6
# Hydrogen Energy California LLC
# HECA Project
# Operational Greenhouse Gas Emissions
# April 26, 2012

**HECA Maximum Annual CO2e Emissions**

| Source | Permitted CO2e Emissions (tonne/year) |
|---|---|
| CTG/HRSG Hydrogen-Rich Fuel and PSA Off-gas | 269,153 |
| CTG/HRSG Natural Gas | 44,772 |
| $CO_2$ Vent | 174,113 |
| $SF_6$ Circuit breakers | 86 |
| Flares | 8,257 |
| Thermal Oxidizer | 5,946 |
| Emergency generators and fire pump | 181 |
| Auxiliary boiler | 24,782 |
| Ammonia Synthesis Plant Startup Heater | 409 |
| Urea Absorber Vents | 116 |
| Nitric Acid Unit | 7,426 |
| Fugitives | 35 |
| **Total CO2e Annual Emissions** | **535,278** |

Notes:

Maximum permitted emissions include periods of startup and shutdown.

**HECA Annual CO2e Emissions for SB1368 Emission Performance Standard**

| Operating Parameters | Early Operations (Maximum Permitted) | Mature Operations | Expected Mature Syngas Operations |
|---|---|---|---|
| Natural Gas Operation, hours per year | 351 | 351 | 15 |
| Hydrogen-rich Fuel Operation, hours per year | 8,108 | 8,108 | 8,108 |
| Intermittent $CO_2$ Venting, hours per year | 504 | 120 | 0 |
| Electricity Generated, MWh | 2,699,860 | 2,699,860 | 2,599,060 |
| **Source** | **CO2e Emissions (Metric Ton/year)** | | |
| CTG/HRSG Hydrogen-Rich Fuel and PSA Off-gas | 269,153 | 269,153 | 269,153 |
| CTG/HRSG Natural Gas | 44,772 | 44,772 | 1,913 |
| $CO_2$ Vent | 174,113 | 41,456 | 0 |
| $SF_6$ Circuit breakers | 86 | 86 | 86 |
| Flares, thermal oxidizer, emergency engines, aux boiler | 0 | 0 | 0 |
| Manufacturing Complex | 0 | 0 | 0 |
| Fugitives | 35 | 35 | 35 |
| **Total CO2e Annual Emissions** | **488,160** | **355,502** | **271,187** |
| CO2e lb/MWh | 398.5 | 290.2 | 230.0 |

Notes:

Early operations Maximum permitted emissions include 2 periods of start-up and shut-down, natural gas use in the CTG and 504 hours of CO2 venting.

Mature operations emissions include 2 periods of start-up and shut-down, natural gas use in the CTG and 120 hours of CO2 venting.

During expected mature operation, the CTG and duct burners will fire only hydrogen-rich fuel and PSA off-gas, it includes 2 startups and shutdown (which includes natural gas), but no natural gas backup use and no CO2 venting.

The fugitive $CO_2$ emissions are from all process areas, therefore overestimate the emissions from the sequestration process.

**Power Production**

| | | |
|---|---|---|
| **Hydrogen-rich Fuel Operation** | | |
| Net Power Exported | 267 | MW |
| Fertilizer Production Power | 58 | MW |
| Steam Produced by Fertilizer Production | -5 | MW |
| **Net Power** | **320** | MW |
| | | |
| | | |
| **Natural Gas Operation** | | |
| Net Power Exported | **300** | MW |

**SB1368**

**Emission caclulation**

Emissions include annual carbon dioxide emissions from each fuel used in any component directly involved in electricity production associated with the sequestration of the CO2.

Emissions from electricity production come from the CTG/HRSG and coal dryer when burning syngas, PSA off-gas and natural gas and SF6 from Circuit breakers.

Emissions associated with the CO2 sequestration include CO2 vent and fugitives from CO2 preparation for sequestration.

The SB1368 emission calculations do not include emissions associated with the gasification block (flares, thermal oxidizer), fertilizer complex (Ammonia Synthesis Plant Startup Heater, Urea Absorbers, nitric acid unit), auxiliary boiler, emergency generators, fire pump, and vehicles.

**MW caclulation**

The net electricity production includes the net power exported plus the power used onsite for fertilizer production minus the steam generated from the ammonia production unit.

The net power exported justification is provided in Section 2, Project Description.

GHG emissions are numerically depicted as metric tons (tonne) of carbon dioxide equivalents ($CO_2e$). $CO_2e$ represents $CO_2$ plus the additional warming potential from $CH_4$ and $N_2O$. $CH_4$ and $N_2O$ have 21 and 310 times the warming potential of $CO_2$, respectively.

**Natural Gas GHG Emission Factors**

| | | | | |
|---|---|---|---|---|
| $CO_2$ = | 53.06 | kg/MMBtu = | 116.98 | lb/MMBtu |
| $CH_4$ = | 0.001 | kg/MMBtu = | 0.002 | lb/MMBtu |
| $N_2O$ = | 0.0001 | kg/MMBtu = | 0.00022 | lb/MMBtu |

**Diesel GHG Emission Factors**

| | | | | |
|---|---|---|---|---|
| $CO_2$ = | 10.15 | kg/gal = | 22.38 | lb/gal |
| $CH_4$ = | 0.0004 | kg/gal = | 0.001 | lb/gal |
| $N_2O$ = | 0.0001 | kg/gal = | 0.0002 | lb/gal |

$CO_2$, $CH_4$, and $N_2O$ emission factors are taken from Appendix C of the California Climate Action Registry (CCAR) General Reporting Protocol Version 3.1 (Jan 2009)

**Turbine - Burning Hydrogen-Rich Fuel - released to HRSG and Coal Dryer Stacks**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8108 | hr/yr | | | |
| Heat Input (HHV) | | 2,537 | MMBtu/hr | | | |
| $CO_2$ = | 165,200 | tonne/yr | | | | |
| $CH_4$ = | 291 | tonne/yr = | 6,116 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 2.06 | tonne/yr = | 638 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 171,953 |

| Syngas GHG Emission Factors | | |
|---|---|---|
| $CO_2$ = | 17.7 | lb/MMBtu |
| $CH_4$ = | 0.03 | lb/MMBtu |

HRSG heat input rate is based Case 5, average ambient temperature and peak load.
Operating hours include startup and shutdown operations
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

**Duct burner - Burning Hydrogen-Rich Fuel - released to HRSG and Coal Dryer Stacks**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8000 | hr/yr | | | |
| Heat Input (HHV) | | 165 | MMBtu/hr | | | |
| $CO_2$ = | 10,603 | tonne/yr | | | | |
| $CH_4$ = | 19 | tonne/yr = | 393 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.13 | tonne/yr = | 41 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 11,036 |

| Syngas GHG Emission Factors | | |
|---|---|---|
| $CO_2$ = | 17.7 | lb/MMBtu |
| $CH_4$ = | 0.03 | lb/MMBtu |

Duct burner heat input rate is based Case 5, average ambient temperature and peak load.
Duct burner not operated during turbine startup and shutdown
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

**Duct burner - Burning PSA Offgas - released to HRSG and Coal Dryer Stacks**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8,000 | hr/yr | | | |
| Heat Input (HHV) | | 149 | MMBtu/hr | | | |
| $CO_2$ = | 83,053 | tonne/yr | | | | |
| $CH_4$ = | 146 | tonne/yr = | 3,073 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.12 | tonne/yr = | 37 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 86,163 |

| Syngas GHG Emission Factors | | |
|---|---|---|
| $CO_2$ = | 153.6 | lb/MMBtu |
| $CH_4$ = | 0.3 | lb/MMBtu |

Duct burner heat input rate is based Case 5, average ambient temperature and peak load.
Duct burner not operated during turbine startup and shutdown
Although N2O emissions are expected to be lower than from the combustion of natural gas, N2O emissions were conservatively estimated using the natural gas emission factor.

**Turbine - Burning Natural Gas - released to HRSG Stack**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 351 | hr/yr | | | |
| Heat Input (HHV) | | 2,401 | MMBtu/hr | | | |
| $CO_2$ = | 44,729 | tonne/yr | | | | |
| $CH_4$ = | 0.84 | tonne/yr = | 18 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.08 | tonne/yr = | 26 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 44,772 |

HRSG heat input rate is assumed to be the maximum heat input rate firing natural gas. Hours of operation include startup and shutdown.

**Auxiliary Boiler**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 2,190 | hr/yr | | | |
| Heat Input | | 213 | MMBtu/hr | | | |
| $CO_2$ = | 24,758 | tonne/yr | | | | |
| $CH_4$ = | 0 | tonne/yr = | 10 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.05 | tonne/yr = | 14 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 24,782 |

**Emergency Generators (2)**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 50 | hr/yr | | | |
| Heat Input | | 2,922 | Bhp | | | |
| $CO_2$ = | 3,341 | lb/hr = | 76 | tonne $CO_2$/yr | | |
| $CH_4$ = | 0.13 | lb/hr = | 0.063 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.03 | lb/hr = | 0.2315 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr* = | 152 |

The following conversions were used to convert from lb/gallon to lb/hp-hour; and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu; and 7,000 Btu/hp-hour.

* Total tonnes $CO_2$e per year represent the contributions from both generators.

**Fire Water Pump**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 100 | hr/yr | | | |
| Heat Input | | 556 | Bhp | | | |
| $CO_2$ = | 636 | lb/hr = | 29 | tonne $CO_2$/yr | | |
| $CH_4$ = | 0.03 | lb/hr = | 0.024 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.01 | lb/hr = | 0.0881 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 29 |

The following conversions were used to convert from lb/gallon to lb/hp-hour; and then multiplying by the rated horsepower rating: 1 gallon/137,000 Btu; and 7,000 Btu/hp-hour.

**Gasification Flare**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pilot Operation** | | | | | | |
| Operating Hours | | 8,760 | hr/yr | | | |
| Heat Input | | 0.5 | MMBtu/hr | | | |
| $CO_2$ = | 232 | tonne/yr | | | | |
| $CH_4$ = | 0.00 | tonne/yr = | 0.1 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.0004 | tonne/yr = | 0.1 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 233 |
| **Flaring Events** | | | | | | |
| Total Operation | | 70,536 | MMBtu/yr | | | |
| $CO_2$ = | 3,744 | tonne/yr | | | | |
| $CH_4$ = | 0.1 | tonne/yr = | 1 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.01 | tonne/yr = | 2 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 3,747 |

GHG emissions from flaring events are conservatively estimated using GHG emission factors for natural gas combustion.

**Rectisol Flare**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pilot Operation** | | | | | | |
| Operating Hours | | 8,760 | hr/yr | | | |
| Heat Input | | 0.3 | MMBtu/hr | | | |
| $CO_2$ = | 139 | tonne/yr | | | | |
| $CH_4$ = | 0.00 | tonne/yr = | 0.1 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.0003 | tonne/yr = | 0.08 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 140 |
| **Flaring Events** | | | | | | |
| Operating Hours | | 40 | hr/yr | | | |
| Vent gas flow | | 4542 | lb-mole/hr | | | |
| $CO_2$ = | 3,627 | tonne/yr | | | | |
| $CH_4$ = | | tonne/yr = | | tonne $CO_2$e/yr | | |
| $N_2O$ = | | tonne/yr = | | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 3,627 |

GHG emissions from flaring event based on 100% carbon content of the gas during startup.

**SRU Flare**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pilot Operation** | | | | | | |
| Operating Hours | | 8,760 | hr/yr | | | |
| Heat Input | | 0.3 | MMBtu/hr | | | |
| $CO_2$ = | 139 | tonne/yr | | | | |
| $CH_4$ = | 0.00 | tonne/yr = | 0.1 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.0003 | tonne/yr = | 0.08 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 140 |
| **Flaring Events - natural gas assist for acid gas venting during startup** | | | | | | |
| Operating Hours | | 40 | hr/yr | | | |
| Heat Input | | 36 | MMBtu/hr | | | |
| **Throughput (inerts) - acid gas venting during startup** | | | | | | |
| $CO_2$ = | | 140000 | scf/hr | | | |
| $CO_2$ = | | 16,240 | lb/hr | | | |
| $CO_2$ = | 371 | tonne/yr | | | | |
| $CH_4$ = | 0.001 | tonne/yr = | 0.03 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.00014 | tonne/yr = | 0.045 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 371 |

Throughtput (inerts) provided from design engineers.

**Tail Gas Thermal Oxidizer**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Process Vent Disposal Emissions** | | | | | | |
| Operating Hours | | 8,314 | hr/yr | | | |
| Heat Input | | 13 | MMBtu/hr | | | |
| $CO_2$ = | 5,736 | tonne/yr | | | | |
| $CH_4$ = | 0.11 | tonne/yr = | 2.3 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.0108 | tonne/yr = | 3.4 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 5,742 |
| **SRU Startup Waste Gas Disposal** | | | | | | |
| Operating Hours | | 48 | hr/yr | | | |
| Heat Input | | 80 | MMBtu/hr | | | |
| $CO_2$ = | 204 | tonne/yr | | | | |
| $CH_4$ = | 0.004 | tonne/yr = | 0.08 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.00038 | tonne/yr = | 0.119 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 204 |

GHG emissions from thermal oxidizer are estimated using GHG emission factors for natural gas combustion for the assist gas.

**Intermittent $CO_2$ Vent**

| | | | | |
|---|---|---|---|---|
| Operating Hours | 504 | hr/yr | | |
| $CO_2$ Emission Rate | 761,400 | lb/hr | | |
| | | | Total tonne $CO_2$e/yr = | 174,113 |

Assumes 504 hours per year venting at full rate.

**Fugitives**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8,760 | hr/yr | | | |
| $CO_2$ = | 32.3 | tpy | 31.37 | tonne $CO_2$e/yr | | |
| $CH_4$ = | 0.19 | tpy | 3.86 | tonne $CO_2$e/yr | | |
| | | | | | Total tonne $CO_2$e/yr = | 35 |

Detailed emission calculations are provided in Appendix M, Public Health.

**Ammonia Synthesis Plant Startup Heater**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 140 | hr/yr | | | |
| Heat Input | | 55 | MMBtu/hr | | | |
| $CO_2$ = | 409 | tonne/yr | | | | |
| $CH_4$ = | 0 | tonne/yr = | 0 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 0.00 | tonne/yr = | 0 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 409 |

**Urea Absorber Vents**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8,000 | hr/yr | | | |
| $CO_2$ | | 32 | lb/hour | | | |
| $CO_2$ = | 116 | tonne/yr | | | | |
| $CH_4$ = | | tonne/yr = | 0 | tonne $CO_2$e/yr | | |
| $N_2O$ = | | tonne/yr = | 0 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 116 |

Emission rate provided by project engineers.

**Nitric Acid Unit**

| | | | | | | |
|---|---|---|---|---|---|---|
| Operating Hours | | 8,000 | hr/yr | | | |
| $N_2O$ uncontrolled | | 6.32 | lb/ton NHO3 | | | |
| Production rate | | 501 | ton/day | | | |
| $N_2O$ uncontrolled | | 132 | lb/hour | | | |
| destruction efficiency | | 95 | % | | | |
| $N_2O$ controlled | | 6.6 | lb/hour | | | |
| $CO_2$ = | | tonne/yr | | | | |
| $CH_4$ = | | tonne/yr = | 0 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 24 | tonne/yr = | 7,426 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 7,426 |

Emission factor and destruction efficiency provided by design engineer.

**230 kV Circuit Breakers**

| | | | | | | |
|---|---|---|---|---|---|---|
| Number of Circuit Breakers | | 6 | | | | |
| $SF_6$ capacity | | 240 | lb/breaker | | | |
| Annual Leakage rate | | 0.5% | | | | |
| $SF_6$ = | 0.003 | tonne/yr = | 78 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 78 |

SF6 GWP = 23,900 http://www.epa.gov/electricpower-sf6/faq.html)
Sources: SF6 inventory and maximum leakage rates from electrical equipment suppliers

**18 kV Circuit Breakers**

| | | | | | | |
|---|---|---|---|---|---|---|
| Number of Circuit Breakers | | 2 | | | | |
| $SF_6$ capacity | | 73 | lb/breaker | | | |
| Annual Leakage rate | | 0.5% | | | | |
| $SF_6$ = | 0.000 | tonne/yr = | 8 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 8 |

SF6 GWP = 23,900 http://www.epa.gov/electricpower-sf6/faq.html)
Sources: SF6 inventory and maximum leakage rates from electrical equipment suppliers

| | |
|---|---|
| **Total tonne $CO_2$e/yr for Stationary Sources=** | **535,278** |

## Gas Composition for the Syngas and PSA Off-gas

| | | Greenhouse Gas Fuel Summary and Durations of Major Fuel Consumers | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Syngas | | | | | | PSA Off-Gas | | | | | |
| COMPONENTS | MW | mol% | mol*MW (lb/lbmole) | Wt% | MW C | % C | wt%Cmix | mol% | mol*MW (lb/lbmole) | Wt% | MW C | % C | wt%Cmix |
| CO (CARBON MONOXIDE) | 28.01 | 1.92 | 0.54 | 8.48% | 12 | 42.84% | 3.63% | 9.10 | 2.55 | 11.36% | 12 | 42.84% | 4.87% |
| H2 (HYDROGEN) | 2.02 | 83.80 | 1.69 | 26.62% | - | 0.00% | 0.00% | 23.78 | 0.48 | 2.14% | - | 0.00% | 0.00% |
| CO2 (CARBON DIOXIDE) | 44.01 | 1.50 | 0.66 | 10.38% | 12 | 27.27% | 2.83% | 7.09 | 3.12 | 13.92% | 12 | 27.27% | 3.79% |
| H2O (WATER) | 18.02 | - | - | 0.00% | - | 0.00% | 0.00% | - | - | 0.00% | - | 0.00% | 0.00% |
| CH4 (METHANE) | 16.04 | 1.07 | 0.17 | 2.69% | 12 | 74.81% | 2.01% | 5.03 | 0.81 | 3.60% | 12 | 74.81% | 2.69% |
| Ar (ARGON) | 39.95 | 0.13 | 0.05 | 0.79% | - | 0.00% | 0.00% | 0.59 | 0.23 | 1.04% | - | 0.00% | 0.00% |
| N2 (NITROGEN) | 28.01 | 11.58 | 3.24 | 51.02% | - | 0.00% | 0.00% | 54.38 | 15.23 | 67.90% | - | 0.00% | 0.00% |
| H2S (HYDROGEN SULFIDE) | 34.08 | 0.00 | 0.00 | 0.00% | - | 0.00% | 0.00% | 0.00 | 0.00 | 0.00% | - | 0.00% | 0.00% |
| COS (CARBONYL SULFIDE) | 60.07 | 0.00 | 0.00 | 0.00% | 12 | 19.98% | 0.00% | 0.00 | 0.00 | 0.00% | 12 | 19.98% | 0.00% |
| CH3OH (METHANOL) | 32.03 | 0.01 | 0.00 | 0.03% | 12 | 37.46% | 0.01% | 0.03 | 0.01 | 0.04% | 12 | 37.46% | 0.01% |
| C2H6 (ETHANE) | 30.07 | - | - | 0.00% | 24 | 79.81% | 0.00% | - | - | 0.00% | 24 | 79.81% | 0.00% |
| C3H8 (PROPANE) | 44.10 | - | - | 0.00% | 36 | 81.63% | 0.00% | - | - | 0.00% | 36 | 81.63% | 0.00% |
| C4H10 (N-BUTANE) | 58.12 | - | - | 0.00% | 48 | 82.59% | 0.00% | - | - | 0.00% | 48 | 82.59% | 0.00% |
| C4H10 (ISO-BUTANE) | 58.12 | - | - | 0.00% | 48 | 82.59% | 0.00% | - | - | 0.00% | 48 | 82.59% | 0.00% |
| C5H12 (N-PENTANE) | 72.15 | - | - | 0.00% | 60 | 83.16% | 0.00% | - | - | 0.00% | 60 | 83.16% | 0.00% |
| C5H12 (ISO-PENTANE) | 72.15 | - | - | 0.00% | 60 | 83.16% | 0.00% | - | - | 0.00% | 60 | 83.16% | 0.00% |
| C6+ (HEXANES, ETC) | 86.18 | - | - | 0.00% | 72 | 83.55% | 0.00% | - | - | 0.00% | 72 | 83.55% | 0.00% |
| NH3 (AMMONIA) | 17.04 | - | - | 0.00% | - | 0.00% | 0.00% | - | - | 0.00% | - | 0.00% | 0.00% |
| HCl (HYDROGEN CHLORIDE) | 36.48 | - | - | 0.00% | - | 0.00% | 0.00% | - | - | 0.00% | - | 0.00% | 0.00% |
| HCN (HYDROGEN CYANIDE) | 27.03 | - | - | 0.00% | 12 | 44.40% | 0.00% | - | - | 0.00% | 12 | 44.40% | 0.00% |
| **Total** | | **100.00** | **6.36** | **100.00%** | | | **8.48%** | **100.00** | **22.43** | **100.00%** | | | **11.37%** |

| | | Duration (hr) | Fuel input HHV (MMBtu/hr) | fuel consumption (MMscf/hr) | Duration (hr) | Fuel input HHV (MMBtu/hr) | fuel consumption (MMscf/hr) |
|---|---|---|---|---|---|---|---|
| Gas Turbine | mmBTU/h | 8,108 | 2,536.57 | 8.79 | - | - | |
| Duct Burner | mmBTU/h | 8,000 | 165.00 | 0.57 | 8,000 | 149.00 | 0.95 |
| HHV (Btu/scf) | | 288.6 | | | 157.3 | | |
| Percentage of destruction of CH4 | | 98.0% | | | 98.0% | | |
| CO2 lb/MMBtu HHV | | 17.704 | | | 153.56 | | |
| CH4 lb/MMBtu HHV | | 0.031 | | | 0.27 | | |

| | | Hourly Emissions (lb/hr) | Annual Emissions (ton/yr) | Annual Emissions (tonnes/yr) | Hourly Emissions (lb/hr) | Annual Emissions (ton/yr) | Annual Emissions (tonnes/yr) |
|---|---|---|---|---|---|---|---|
| CO2 emissions (lb/hr) | Gas Turbine | 44,906 | 182,050 | 165,200 | 22,881 | 91,524 | 83,053 |
| CH4 emissions (lb/hr) | Gas Turbine | 79 | 321 | 291 | 40 | 161 | 146 |
| CO2 emissions (lb/hr) | Duct Burner | 2,921 | 11,684 | 10,603 | | | |
| CH4 emissions (lb/hr) | Duct Burner | 5 | 21 | 19 | | | |

Notes:

All Data based on Case 5 Performance Avg Ambient On-Peak

Includes startup and shutdown hours in the turbine operations. Assumed max heating value during SU/SD hours.

No startup or shutdown for duct burners

**Greenhouse Gas Emissions Associated with the Mobile Sources During Project Operations**

| Source | Annual CO2e Emissions (tonne/year) |
|---|---|
| Onsite Trucks | 413 |
| Onsite Trains | 291 |
| Offsite Workers Commuting | 824 |
| Offsite Trucks | 10,866 |
| Offsite Trains | 45,226 |
| **Total CO2e Annual Emissions** | **57,619** |

Notes:

Onsite worker travel and associated emissions are negligible

*Hydrogen Energy California LLC* *4/11/2012*
*HECA Project*

GHG emissions are numerically depicted as metric tons (tonne) of carbon dioxide equivalents ($CO_2e$). $CO_2e$ represents $CO_2$ plus the additional warming potential from $CH_4$ and $N_2O$. $CH_4$ and $N_2O$ have 21 and 310 times the warming potential of $CO_2$, respectively.

**Onsite LHD Gasoline Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Onsite Trucks | | 10 | trucks | | EF $CO_2$ = | 1,175 | g/mi |
| Total Annual VMT | | 10,000 | miles/ truck | | EF $CH_4$ = | 0.0157 | g/mi |
| | | | | | EF $N_2O$ = | 0.0101 | g/mi |
| $CO_2$ = | 118 | tonne/yr | | | | | |
| $CH_4$ = | 1.57E-03 | tonne/yr = | 3.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.01E-03 | tonne/yr = | 3.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 118 |

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty gasoline trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light gasoline trucks.

**Onsite LHD Diesel Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Onsite Trucks | | 10 | trucks | | EF $CO_2$ = | 519 | g/mi |
| Total Annual VMT | | 10,000 | miles/ truck | | EF $CH_4$ = | 0.001 | g/mi |
| | | | | | EF $N_2O$ = | 0.0015 | g/mi |
| $CO_2$ = | 52 | tonne/yr | | | | | |
| $CH_4$ = | 1.00E-04 | tonne/yr = | 2.E-03 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.50E-04 | tonne/yr = | 5.E-02 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 52 |

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty diesel trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light diesel trucks.

**Onsite Petcoke Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 15,200 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 1.0 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| Truck Idle Time | | 0.08 | hr/load | | EF $N_2O$ = | 0.0048 | g/mi |
| | | | | | EF $CO_2$ = | 6,542 | g/ idle hr |
| | | | | | EF $CH_4$ = | 0.011 | g/ idle hr |
| | | | | | EF $N_2O$ = | 0.010 | g/ idle hr |
| $CO_2$ = | 54 | tonne/yr | | | | | |
| $CH_4$ = | 8.75E-05 | tonne/yr = | 2.E-03 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 8.23E-05 | tonne/yr = | 3.E-02 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 54 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Onsite Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 20,880 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 2.49 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| Truck Idle Time | | 0.08 | hr/load | | EF $N_2O$ = | 0.0048 | g/mi |
| | | | | | EF $CO_2$ = | 6,542 | g/ idle hr |
| | | | | | EF $CH_4$ = | 0.011 | g/ idle hr |
| | | | | | EF $N_2O$ = | 0.010 | g/ idle hr |
| $CO_2$ = | 176 | tonne/yr | | | | | |
| $CH_4$ = | 2.83E-04 | tonne/yr = | 6.E-03 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.66E-04 | tonne/yr = | 8.E-02 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 176 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Onsite Miscellaneous Diesel Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 1,818 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 2.2 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| | | | | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 13 | tonne/yr | | | | | |
| $CH_4$ = | 2.04E-05 | tonne/yr = | 4.E-04 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.92E-05 | tonne/yr = | 6.E-03 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 13 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles.

**Onsite Switching Engines**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of engines | | 1 | per year | | EF $CO_2$ = | 672 | g/bhp-hr |
| Avg power used onsite | | 260 | hp | | EF $CH_4$ = | 0.053 | g/bhp-hr |
| Annual operations | | 1248 | hours/yr | | EF $N_2O$ = | 0.0171 | g/bhp-hr |
| $CO_2$ = | 218 | tonne/yr | | | | | |
| $CH_4$ = | 1.71E-02 | tonne/yr = | 4.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 5.55E-03 | tonne/yr = | 2.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 220 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Onsite Coal Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains | | 109 | per year | | EF $CO_2$ = | 491 | g/bhp-hr |
| Number of engines | | 218 | per year | | EF $CH_4$ = | 0.038 | g/bhp-hr |
| Avg power used onsite | | 220 | hp | | EF $N_2O$ = | 0.0125 | g/bhp-hr |
| Time to unload each train | | 2 | hours | | | | |
| $CO_2$ = | 47 | tonne/yr | | | | | |
| $CH_4$ = | 3.69E-03 | tonne/yr = | 8.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.20E-03 | tonne/yr = | 4.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 48 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Onsite Product Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains | | 153 | per year | | EF $CO_2$ = | 491 | g/bhp-hr |
| Number of engines | | 153 | per year | | EF $CH_4$ = | 0.038 | g/bhp-hr |
| Avg power used onsite | | 150 | hp | | EF $N_2O$ = | 0.0125 | g/bhp-hr |
| Time to unload each train | | 2 | hours | | | | |
| $CO_2$ = | 23 | tonne/yr | | | | | |
| $CH_4$ = | 1.77E-03 | tonne/yr = | 4.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 5.74E-04 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 23 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Offsite Coal Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 13,034 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 794 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 142 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 1.73E+09 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 3,600,461 | gal/year | | | | |
| $CO_2$ = | 36,786 | tonne/yr | | | | | |
| $CH_4$ = | 2.88 | tonne/yr = | 60.49 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 0.94 | tonne/yr = | 290.20 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 37,137 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

*Hydrogen Energy California LLC* *4/11/2012*
*HECA Project*

**Offsite Liquid Sulfur Product Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 83 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 150 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 125 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 1.87E+06 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 3,890 | gal/year | | | | |
| $CO_2$ = | 39.75 | tonne/yr | | | | | |
| $CH_4$ = | 3.11E-03 | tonne/yr = | 7.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.01E-03 | tonne/yr = | 3.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 40 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Offsite Gasification Solid Product Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 2,800 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 198 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 125 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 8.32E+07 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 173,244 | gal/year | | | | |
| $CO_2$ = | 1,770 | tonne/yr | | | | | |
| $CH_4$ = | 1.39E-01 | tonne/yr = | 3.E+00 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 4.50E-02 | tonne/yr = | 1.E+01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 1,787 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Offsite Ammonia Product Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 357 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 264 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 142 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 1.57E+07 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 32,789 | gal/year | | | | |
| $CO_2$ = | 335 | tonne/yr | | | | | |
| $CH_4$ = | 2.62E-02 | tonne/yr = | 6.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 8.53E-03 | tonne/yr = | 3.E+00 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 338 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Offsite Urea Product Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 1,795 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 628 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 142 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 1.88E+08 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 392,179 | gal/year | | | | |
| $CO_2$ = | 4,007 | tonne/yr | | | | | |
| $CH_4$ = | 3.14E-01 | tonne/yr = | 7.E+00 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.02E-01 | tonne/yr = | 3.E+01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 4,045 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

### Offsite UAN Product Trains

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trains cars per year | | 1,983 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 264 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 142 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 8.74E+07 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 182,132 | gal/year | | | | |
| $CO_2$ = | 1,861 | tonne/yr | | | | | |
| $CH_4$ = | 1.46E-01 | tonne/yr = | 3.E+00 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 4.74E-02 | tonne/yr = | 1.E+01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 1,879 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

### Offsite Petcoke Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 15,200 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 280 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 4,256,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 7,110 | tonne/yr | | | | | |
| $CH_4$ = | 2.17E-02 | tonne/yr = | 5.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.04E-02 | tonne/yr = | 6.E+00 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 7,117 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite Liquid Sulfur Product Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 990 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 284 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 281,160 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 470 | tonne/yr | | | | | |
| $CH_4$ = | 1.43E-03 | tonne/yr = | 3.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.35E-03 | tonne/yr = | 4.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 470 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite Gasification Solids Product Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 2,800 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 160 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 448,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 748 | tonne/yr | | | | | |
| $CH_4$ = | 2.28E-03 | tonne/yr = | 5.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.15E-03 | tonne/yr = | 7.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 749 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite Ammonia Product Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 5,010 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 400,800 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 670 | tonne/yr | | | | | |
| $CH_4$ = | 2.04E-03 | tonne/yr = | 4.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.92E-03 | tonne/yr = | 6.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 670 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite Urea Product Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 2,800 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 224,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 374 | tonne/yr | | | | | |
| $CH_4$ = | 1.14E-03 | tonne/yr = | 2.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.08E-03 | tonne/yr = | 3.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 375 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite UAN Product Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 9,280 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 742,400 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 1,240 | tonne/yr | | | | | |
| $CH_4$ = | 3.79E-03 | tonne/yr = | 8.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 3.56E-03 | tonne/yr = | 1.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 1,241 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

### Offsite Equipment and Miscellaneous Trucks

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 1,818 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 145,440 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 243 | tonne/yr | | | | | |
| $CH_4$ = | 7.42E-04 | tonne/yr = | 2.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 6.98E-04 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 243 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

## GHG Emissions Summary for Mobile Sources — Emissions Summary

*Hydrogen Energy California LLC* *4/11/2012*
*HECA Project*

**Offsite Employee Commute Vehicles**

| | | | | | | |
|---|---|---|---|---|---|---|
| Total Number of Employee | 200 | employees/day | | EF $CO_2$ = | 364 | g/mi |
| Number of Worker per Commuter Vehicle | 1.3 | | | EF $CH_4$ = | 0.0159 | g/mi |
| Daily Vehicle Count | 154 | vehicles/day | | EF $N_2O$ = | 0.0093 | g/mi |
| Distance traveled per vehicle (Round Trip) | 40 | miles/ vehicle/ day | | | | |
| Day of Commute per Month | 365 | days/yr | | | | |
| Total Annual VMT | 2,246,154 | miles/year | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| $CO_2$ = | 817 | tonne/yr | | | | |
| $CH_4$ = | 3.57E-02 | tonne/yr = | 7.E-01 | tonne $CO_2$e/yr | | |
| $N_2O$ = | 2.09E-02 | tonne/yr = | 6.E+00 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | 824 |

CO2 emission factor for CO2 is from EMFAC 2007 (average of light duty automobile and light duty truck) for the vehicle model year fro m1971 to 2015. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for average of gasoline passenger cars, gasoline light trucks, diesel passenger cars, and diesel light truck.

| | |
|---|---|
| **Total tonne $CO_2$e/yr for Mobile Sources=** | **57,619** |

# Appendix E-7

# NO2 1-Hour Regional Analysis

# MODELING REPORT FOR

# 1-HOUR $NO_2$ NAAQS REGIONAL MODELING

# FOR THE HYDROGEN ENERGY CALIFORNIA (HECA) PROJECT

*Prepared for:*

**U.S. Environmental Protection Agency Region IX**

**San Joaquin Valley Air Pollution Control District**

**California Energy Commission**

*Prepared on behalf of:*

**Hydrogen Energy California LLC**

April 2012

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# 1. INTRODUCTION

On January 22, 2010, the United States Environmental Protection Agency (USEPA) announced a new primary nitrogen dioxide ($NO_2$) 1-hour National Ambient Air Quality Standard (NAAQS). The standard is attained when the 3-year average of the 98$^{th}$ percentile of the annual distribution of the daily maximum 1-hour concentrations does not exceed 100 parts per billion (ppb). This new standard will apply to the Hydrogen Energy California (HECA) Project.

In February 2010, the USEPA issued *Notice Regarding Modeling for New Hourly $NO_2$ NAAQS* (USEPA, 2010b). In June 2010, the USEPA issued a compliance guidance document, *Guidance Concerning the Implementation of the 1-hour $NO_2$ NAAQS for the Prevention of Significant Deterioration Program* (USEPA, 2010c). These guidance documents include a description of Tier 3 "detailed screening methods" for modeling compliance with the 1-hour $NO_2$ federal standard.

In preparation for conducting the regional $NO_2$ modeling analysis described in the guidance document, HECA sought concurrence from USEPA Region IX and from the USEPA Office of Air Quality Planning and Standards (OAQPS) through submittal of a protocol document entitled "*Modeling Protocol for Parameter Selection Specific to the 1 Hour $NO_2$ NAAQS Regional Modeling for the Hydrogen Energy California (HECA) Project*" dated January 20, 2011 (referred to as the "January 2011 protocol"). The January 2011 protocol proposed source screening methodology and input parameters for the HECA Project's regional $NO_2$ modeling analysis. The January 2011 protocol document received approval from both USEPA Region IX and the OAQPS on March 11, 2011. This document describes and presents the results of the Tier 3 "detailed screening methods" modeling analysis performed to satisfy the 1-hour $NO_2$ federal standard.

In March 2011, the USEPA issued an additional guidance document: *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard* (USEPA, 2011). This guidance, hereafter referred to as the "March 2011 USEPA Memo," provided further clarification on uncertainties raised since the earlier USEPA June 2010 modeling guidance document. Because this document was released after the HECA Project's submittal of the January 2011 protocol document, HECA prepared the *Modeling Protocol Supplement for the Hydrogen Energy California (HECA) Project*, February 2012, outlining any variances in modeling techniques from the January 2011 protocol.

## 1.1 PROJECT DESCRIPTION

Hydrogen Energy California LLC (HECA) is proposing an Integrated Gasification Combined Cycle (IGCC) polygeneration project (hereafter referred to as HECA or the Project). The Project will gasify a 75 percent coal and 25 percent petroleum coke (petcoke) fuel blend to produce synthesis gas (syngas). Syngas produced via gasification will be purified to hydrogen-rich fuel and used to generate a nominal 300-megawatt (MW) output of low-carbon baseload electricity in a Combined Cycle Power Block, and to produce low-carbon nitrogen-based products in an integrated Manufacturing Complex. Carbon dioxide ($CO_2$) from the HECA facility will be captured and transported to the adjacent Elk Hills Oil Field (EHOF) for use in enhanced oil recovery (EOR), which results in sequestration (storage) of the $CO_2$. Occidental of Elk Hills Incorporated (OEHI) will use the $CO_2$ for EOR at the EHOF.

The HECA Project is approximately 7 miles west of the outermost edge of the city of Bakersfield and 1.5 miles northwest of the unincorporated community of Tupman in western Kern County, California. Figure 1 presents an overview map of the HECA Project location, as well as the locations of regional monitoring stations in relation to the HECA Project. Figure 2 presents close-up aerial images of the HECA Project Site next to the surface meteorological station. The HECA Project is within the San Joaquin Valley Air Basin and is within the jurisdiction of the San Joaquin Valley Air Pollution Control District (SJVAPCD). The Project area is in attainment for $NO_2$, and therefore HECA is subject to Prevention of Significant Deterioration (PSD) requirements. Since annual HECA emissions are greater than the $NO_2$ PSD Significant Emission Rate (SER) of 40 tons/yr, HECA must conduct modeling for compliance with the $NO_2$ 1-hour NAAQS.

This introduction provides a brief description of the HECA Project. Additional details are provided in the AFC Amendment (2012), Section 2.0, Project Description.

# 2. OVERALL MODELING APPROACH

This section outlines the overall modeling approach that was undertaken by the HECA Project to show compliance with the new 1-hour $NO_2$ NAAQS. Subsequent sections describe the details of individual parameters that were included in the modeling analysis.

The new 1-hour $NO_2$ NAAQS is 100 ppb (or 188.68 micrograms per cubic meter [$\mu g/m^3$]). The NAAQS is a statistical standard based on the 3-year average of the annual 98th percentile of the daily maximum 1-hour concentrations.

Modeling was conducted per the techniques described in the HECA January 2011 protocol and February 2012 protocol supplement. In addition HECA conducted the $NO_2$ 1-hour NAAQS analysis incorporating guidance from the March 2011 USEPA Memo, the USEPA June 2010 modeling guidance, CAPCOA *Modeling Compliance of The Federal 1-Hour $NO_2$ NAAQS,* October 2011, and SJVAPCD *Assessment of Non-Regulatory Option in AERMOD Specifically OLM and PVMRM*, September 2010.

The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) version 12060 was used to estimate the 1-hour ground level concentrations of $NO_2$. The model has received a scientific peer review. As noted in the USEPA's June 2010 guidance document, AERMOD is the preferred model for dispersion for a wide range of applications.

To address $NO_X$ chemistry, the ozone-limiting method (OLM) plume volume molar ratio method (PVMRM) algorithm was used in AERMOD, which is explained in detail later. The AERMOD model was run using the rural dispersion setting.

The first step of the $NO_2$ 1-hour analysis was to model the HECA sources alone to determine if the multiyear average first high 1-hour concentrations at every receptor within 50 kilometers are less than the interim Significant Impact Level (SIL) of 4 ppb. Modeling showed concentrations greater than or equal to the SIL at receptors out approximately 13 kilometers, which is the Area of Impact (AOI).

Because the Project's impacts exceeded the SIL at several receptors based on this initial impact analysis, a cumulative (or regional) impact assessment was completed to determine whether the project would cause or contribute to any modeled violations of the NAAQS.

The cumulative analysis was completed including emissions from HECA sources, nearby sources, and background concentrations measured at a nearby monitoring station. Only receptors that were shown to have Project impacts greater than or equal to the SIL were included in the cumulative modeling.

Modeled concentrations from HECA and regional emissions sources were added to hourly background monitoring $NO_2$ data to determine the cumulative average $98^{th}$ percentile maximum daily 1-hour impacts for all ranks below the $98^{th}$ percentile until the NAAQS was no longer exceeded. In AERMOD, the design value is calculated as the eighth-highest ($98^{th}$ percentile) daily maximum 1-hour concentration averaged across the 5 modeled years at each receptor.

The MAXDCONT option in AERMOD was run to determine the $NO_2$ 1-hour impact contribution from HECA. The option was run from rank 8 (or the 98th percentile daily maximum value per receptor averaged over 5 years) to rank 20, with a threshold value equal to the $NO_2$ 1-hour NAAQS (188 $\mu g/m^3$). The target source group was set to all sources (HECA, regional sources, and background). This setup option continues to examine the concentrations for all ranks until the impacts from all sources are less than the threshold value of 188 $\mu g/m^3$. This option was used to determine if there are any exceedances of the NAAQS from all sources and, if an exceedance occurs, to determine whether HECA's contribution is greater than or equal to the SIL at that point in time and space.

If the total regional impacts (i.e., model result plus background) were predicted to be less than the NAAQS, then compliance with the NAAQS was shown. However, if the total regional impacts were predicted to be greater than the NAAQS, then for that hour and receptor, the impact from HECA Project operations sources was compared to the interim SIL. If the predicted impact from just the HECA sources was less than the interim SIL, then it could be concluded that the HECA Project does not contribute to the violation, and thus, compliance with the standard was demonstrated.

## 2.1 THE PLUME VOLUME MOLAR RATIO METHOD (PVMRM)

The PVMRM algorithm within AERMOD was the OLM used in the modeling analysis. PVMRM accounts for the role of ambient ozone ($O_{3)}$ in limiting the conversion of emitted $NO_X$—which occurs mostly in the form of nitrogen oxides (NO)—to $NO_2$, the pollutant regulated by ambient standards.

The chemistry for PVMRM has been peer-reviewed, as noted by the documents posted on the USEPA's Support Center for Regulatory Air Modeling web site. The posted documents include *Sensitivity Analysis of PVMRM and OLM in AERMOD* (MACTEC, 2004) and *Evaluation of Bias in AERMOD-PVMRM* (MACTEC, 2005). Both documents indicate that the models appear to perform as expected.

The PVMRM algorithm has been demonstrated to be applicable for calculating $NO_X$ chemistry on a theoretical basis. As noted in *Sensitivity Analysis of PVMRM and OLM in AERMOD* (MACTEC, 2004), which was prepared by Roger W. Brode of MACTEC (now with USEPA OAQPS):

> *"Overall the PVMRM option appears to provide a more realistic treatment of the conversion of $NO_X$ to $NO_2$ as a function of distance downwind from the source than OLM or the other $NO_2$ screening options (Hanrahan, 1999a; Hanrahan, 1999b). No anomalous behavior of the PVMRM or OLM options was identified as a result of these sensitivity tests."*

Based on this report, the model appears to appropriately account for $NO_2$ formation and provides a better estimation of the $NO_2$ impacts, compared to other screening options.

As noted in *Evaluation of Bias in AERMOD-PVMRM* (MACTEC, 2005), which was prepared by Roger W. Brode, PVMRM has been judged to provide unbiased estimates based on criteria that are comparable to, or more rigorous than, evaluations performed for other dispersion models.

The data obtained to conduct the PVMRM run for the HECA Project were: (1) hourly meteorological data, (2) hourly $O_3$ data, and (3) in-stack $NO_2/NO_X$ ratio. Further refinement of the modeling entailed use of hourly ambient $NO_2$ data (discussed later). SJVAPCD processed the meteorological, $O_3$, and $NO_2$ data following applicable USEPA guidance, as discussed in Section 3. The analysis used $NO_2/NO_X$ in-stack ratios obtained from published references or engineering estimates.

## 2.2 RECEPTOR DESCRIPTION

USEPA considers most steady-state Gaussian plume models, including AERMOD, to be applicable out to 50 kilometers, but not beyond. Therefore, impacts from the HECA Project operations and nearby sources were examined out to a distance of 50 kilometers from the HECA Project Site in the initial impact analysis. Preliminary modeling with receptors out to 50 kilometers showed that potential impacts from HECA Project operations would generally fall below the interim SIL within 15 kilometers of the HECA Project Site. Although the receptor grid ended at 50 kilometers, large sources located beyond 50 kilometers were included in the nearby source inventory.

The same receptor grid used in the air quality impact analyses presented in the AFC Amendment (2012) was used out to 10 kilometers, with additional receptors out to 50 kilometers. The Project Site is located within the Controlled Area and the property line extends around the outside of the Controlled Area. The receptor grid used in the SIL modeling analysis is as follows:

- 25-meter spacing along the property line and extending from the property line out 100 meters;
- 50-meter spacing from 100 to 250 meters beyond the property line;
- 100-meter spacing from 250 to 500 meters beyond the property line;
- 250-meter spacing from 500 meters to 1 kilometer beyond the property line;
- 500-meter spacing from 1 to 2 kilometers beyond the property line; and
- 1,000-meter spacing from 2 to 50 kilometers beyond the property line.

Terrain heights at receptor grid points were determined from U.S. Geological Survey (USGS) digital national elevation datum (NED) files using AERMAP.

## 2.3 BUILDING DOWNWASH AND GOOD ENGINEERING PRACTICE STACK HEIGHTS

The effects of building wakes (i.e., downwash) on plumes from the Project's operational sources were evaluated in accordance with USEPA guidance (USEPA, 1985). The USEPA Building Profile Input Program – Prime (BPIP-Prime) (Version 04274) was used to determine data on the buildings on the Project Site that could potentially cause plume downwash effects for different wind directions.

As defined in *Guideline for Determination of Good Engineering Practice Stack Height* (USEPA, 1985), good engineering practice (GEP) is the height necessary to ensure that emissions from a stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes that may be created by the source itself, nearby structures, or nearby terrain obstacles.

All stacks in the HECA Project will be less than or equal to the GEP default height of 65 meters, except for the coal dryer, the three flares, and the $CO_2$ vent. The $CO_2$ vent is not a $NO_X$ emission source; therefore, it was not included in this modeling. The height of the coal dryer stack is 92.9 meters, and the height of all three flare stacks (SRU, Gasification and Rectisol) is 76.2 meters.

BPIP Prime has been run to determine the GEP height for each stack. The output of this model shows that the GEP for the three flares is 65 meters, and for the coal dryer is 223.91 meters. BPIP files are provided with this application.

GEP is calculated based on the following equation:

$$Hg = H + 1.5 * L$$

Where: Hg = GEP stack height (in meters)
H = height of the nearby structure (in meters)
L = lesser dimension of the height or projected width of the nearby structure (in meters)

The largest structure near these stacks is the gasifier building, which is 92.9 meters high, 27.7 meters long, and 83 meters wide. Therefore, L = 87.3 meters, H = 92.9 meters, and Hg = 223.9 meters.

The gasifier building is located at a distance within five times L (436.5 meters) from the coal dryer; therefore, GEP for this source is calculated based on the gasifier building dimensions. The height of the coal dryer is well below the GEP height of 223.9 meters.

The flares are located upwind of the gasification building along its shorter axis, thus L = 27.7 meters and Hg = 134.5 meters. The flares are not within 5 times L (138.5 meters) of the gasification structure or any other structure that is large enough to create downwash for the flares in BPIP Prime. It is important to note that the flares will be built to a height of 76.2 meters for safety from a project engineering perspective. However, a 65 meter stack height, or GEP, was used to calculate effective stack heights for each flare modeling scenario based on the flare's heat release rate during that modeling scenario. The effective stack height is the height of the stack plus the height above the stack where the flare flame ends and a plume can begin. The effective stack parameters were calculated using the SCREEN3 technique, and were input into the AERMOD model (USEPA, 1995b). Therefore, the lower 65 meter stack height was used as the stack height in the calculation of the effective stack heights for the flares, rather than the actual stack height. Appendix E-3, Operational Criteria Pollutant Emissions, of the AFC Amendment (2012), presents the calculation of the effective stack parameters for the flares.

The results of the BPIP-Prime analysis were included in the AERMOD input files to enable downwash effects to be simulated. Input and output files for the BPIP-Prime analyses are included in the electronic files submitted with the AFC Amendment (2012).

## 2.4 TEMPORAL PAIRING

To estimate the total $NO_2$ concentration, modeling included HECA sources, nearby sources and background $NO_2$ data. Background data encompass emission sources not specifically modeled, such as mobile sources.

The 1-hour $NO_2$ NAAQS was developed for monitoring to allow for the elimination of outlier hours with high monitored concentrations which may not accurately reflect typical conditions near the monitoring station. In order to conduct modeling to comply with this standard, the March 2011 USEPA Memo recommends running AERMOD with the MAXDCONT output option to examine the contribution from the Project emissions to the cumulative impacts at each receptor paired in time and space. AERMOD adds the hourly modeled $NO_2$ concentrations to the concurrent hourly $NO_2$ background data, and determines the design value, the eighth-highest (98th percentile) daily maximum 1-hour $NO_2$ concentration at each receptor averaged across the 5 modeled years.

MAXDCONT was run with the threshold option to output the 8th (design value) through 20th daily maximum 1-hour $NO_2$ concentrations from all sources including background to ensure the cumulative impact was below the NAAQS. MAXDCONT also presents the contribution from each source at each receptor, paired in time and space if the NAAWS threshold is met. This use of AERMOD and MAXDCONT will provide modeling results that comply with the statistical nature of the $NO_2$ 1-hour NAAQS.

The standard is based on the $98^{th}$ percentile (eighth-highest) daily maximum 1-hour concentration; as a result, more than one hourly average concentration above the standard on the same day will only result in one concentration greater than the standard for that day. This allows a monitor or model receptor to have 8 hours or more with concentrations greater than the standard on an annual basis, yet to still be considered in compliance as long as there are fewer than 8 days with a daily maximum 1-hour concentration above the standard. The hourly monitoring concentration was greater than or equal to 100 ppb twice during the 5-year data set (2006-2010), but because the standard is based on the eighth-highest daily maximum 1-hour concentration, compliance was able to be shown even with these high outliers.

During the 5-year monitoring period selected for the HECA Project (2006-2010), the $NO_2$ 1-hour monitoring yielded concentrations greater than the standard. The "first tier" assumption (a term defined in the June 2010 USEPA guidance document [USEPA, 2010c]) of adding the overall highest hourly background $NO_2$ concentration to the model results was not reasonable to apply to the HECA Project. Thus, the additional refinement to the "first tier" approach that HECA has employed is temporal pairing of modeled and monitored values on an hourly basis. Justification for this refinement technique was provided in the January 2011 protocol, and its use was approved by both USEPA Region IX and OAQPS on March 11, 2011.

The approved method of combining the hourly $NO_2$ monitoring data with the hourly $NO_2$ impacts predicted from the modeling to show the maximum potential regional $NO_2$ impacts was employed in this analysis. Temporally pairing monitoring values with meteorological conditions is consistent with language in Appendix W, where monitored background concentrations are used to reflect contribution of regional levels of pollution not explicitly accounted for in the modeled inventory (USEPA, 2011).

The use of 5 years of hourly data will account for fluctuations in the background $NO_2$ concentrations. The model was run with sources operating at peak emissions, thus ensuring maximum impacts are predicted for every hour. These impacts are combined with the hourly background concentrations; thus when the background concentrations are high, the model predicted concentrations are also high, as modeled impacts are always maximized. Using the hourly temporal pairing technique of combining the modeled and background monitoring concentrations, the HECA regional modeling determines whether the "$NO_X$ emissions increase from the proposed source will have a significant impact at the *point and time* of any violation" (USEPA, 2010c).

An exceptionally inclusive modeling emission inventory clearly represents the majority of emissions that could potentially contribute to the regional impact assessment, and the monitoring concentrations are intended to represent the contribution from minor sources and transportation sources not represented in the modeling inventory (USEPA, 2011). The use of temporal pairing of monitored background concentrations with modeled predicted concentrations on an hourly basis does not under-predict impacts because of numerous conservative assumptions used in the modeling analysis. All conservative assumptions employed in this modeling analysis are outlined in Section 6 of this modeling analysis.

# 3. BACKGROUND AIR QUALITY AND METEOROLOGICAL DATA

In preparation of demonstrating to show HECA Project operations compliance with the new 1-hour $NO_2$ NAAQS through modeling, a representative monitoring station with both hourly $NO_2$ and $O_3$ ambient monitoring data was chosen, an ambient $NO_2/NO_X$ ratio was calculated, and meteorological data sets were obtained. The following sections provide further detail on those efforts. Additionally, based on information contained in the March 2011 USEPA Memo, the SJVAPCD was contacted and confirmed that the ambient air quality monitoring observation times are based upon the hour-beginning convention, and the meteorological monitoring observations recorded in the files obtained from their website are based upon the hour-ending convention. SJVAPCD prepared and provided the monitoring data to match the meteorological data time stamp format.

## 3.1 SELECTION OF A REPRESENTATIVE AMBIENT MONITORING STATION

Selection of a representative monitoring station was an important process because hourly $O_3$ data are used in conjunction with the PVMRM algorithm in AERMOD, and hourly $NO_2$ data would be used to represent ambient background $NO_2$ concentrations. The hourly $NO_2$ data were combined with the hourly $NO_2$ modeled impacts to estimate regional $NO_2$ impacts.

Several monitoring stations in Kern County, part of the San Joaquin Valley Air Basin, were considered for the $NO_2$ and $O_3$ data; these are shown in Figure 1 and Figures 3 through 5. The monitoring station nearest to the proposed Project Site that measured both pollutants from 2006-2010 is in Shafter, California. Data were processed and provided by the SJVAPCD. The data demonstrated completeness requirements during all quarters (more than 75 percent data capture) for all 5 years, per 40 Code of Federal Regulations Parts 50 and 58, February 9, 2010, Appendix S, 3.2(b) (USEPA, 2010a). The $NO_2$ and $O_3$ monitoring data cover the same years as the meteorological data used in the modeling; because both $NO_2$ and $O_3$ were obtained from the same monitoring station, they provide a better representation of the chemistry and balance between ambient $NO_2$ and $O_3$ concentrations.

The Shafter monitoring station is most representative of the rural location at the HECA Project Site. The Shafter monitoring station is on the roof of the local Department of Motor Vehicles building, which is surrounded by parking lots and near several roadways and a railroad, seen in Figure 3. California State Route 43 is 540 feet to the west of the Shafter monitoring station, and currently has an average daily traffic (ADT) volume of 14,000 trips (Caltrans, 2010). The Shafter monitoring station is 350 feet to the west of the Burlington Northern Santa Fe railroad. Due to the close proximity to State Route 43 and the railroad, the data from this station account for potential impacts from sources related to transportation. Since the HECA Project location is several miles from any major roadway, the Shafter monitoring station is expected to measure significantly more pollution from mobile sources than if a monitor were located next to the completed HECA Project. The ADT volumes at the HECA Project Site for the current year and future year (2017, with and without the Project), for both Alternative 1 (rail transportation) and Alternative 2 (truck transportation) are given in Table 1. The traffic volume near the Shafter monitoring station is currently more than 20 times larger than the volume near the Project Site. In future year 2017, with Project operations, the Shafter monitoring station will have approximately nine times the traffic volume than the traffic volume near the Project Site. Therefore, it is very conservative to represent the background pollution from transportation sources near the HECA Project Site with Shafter monitoring station data, although the Shafter data will represent the transportation emissions in the region appropriately.

The $NO_2$ and $O_3$ data used in the regional $NO_2$ analysis should adequately account for mobile emission sources; thus, the monitoring station chosen is located near mobile sources. Because the 1-hour $NO_2$ analysis that is being conducted is a regional analysis, it would be inappropriate to use $O_3$ data from a station heavily influenced by local sources.

**Table 1**
**HECA Project Site Average Daily Traffic Counts**

| Road Segment | Existing (2012) ADT | 2017 ADT without Project Trips | 2017 ADT with Project Trips (Alternative 1) | 2017 ADT with Project Trips (Alternative 2) |
|---|---|---|---|---|
| Adohr Road between Dairy and Tupman | 273 | 301 | 775 | 787 |
| Tupman Road between Adohr Road and Station Road | 128 | 141 | 357 | 357 |
| Dairy Road between Adohr Road and Stockdale Highway | 188 | 206 | 464 | 476 |
| **Total ADT around Project Site** | 589 | 648 | 1,596 | 1,620 |

Source: Caltrans, 2010; HECA, 2012

The monitoring station is not near large industrial sources, but such sources will be accounted for in the regional modeling. Figures 6 and 7 graphically present the hourly and annual emissions (respectively) of stationary sources within 10 kilometers of the Shafter monitoring station. As can be seen, the stationary sources within the city limits are primarily smaller sources. Eight of the 10 sources within 2 kilometers of the Shafter monitoring station are owned and operated by the City of Shafter, and are electrical generators or pumps powered by emergency standby IC engines. The remaining two sources consist of an emergency standby IC engine and a small natural gas-fired heater, both under different ownership. On Figure 6, the larger hourly contributors (i.e., those with hourly emissions estimated at greater than 10 pounds per hour), beginning due west of the monitor and rotating counter-clockwise around the monitoring station are the following: Oasis Holstein Dairy; Vermeer Goedhart Dairy; North of River Sanitary District; Plains LPG Services, L.P.; and Performance Food Group. Comparison of the respective hourly and annual emissions for these facilities implies that the only equipment that operates on a regular (or non-emergency) basis is the equipment at Plains LPG Services, L.P., and, to a lesser extent, Oasis Holstein Dairy. The equipment at the remaining facilities consists largely of smaller sources or sources that do not operate on a regular basis (e.g., standby emergency ICengines). It is important to note that neither the smaller sources (i.e., those with $NO_X$ emissions lower than 48 pounds/day) that are less frequently operated nor sources close to the monitoring station (as presented in Figures 6 and 7) will be included in the PSD modeling performed to assess compliance with the 1-hour $NO_2$ standard.

A description of the nearby sources included in the $NO_2$ analysis is provided in Section 4.2, presented in Figure 8, and a listing of the sources included in the modeling analysis is provided in Attachment A of this document.

Examination of the Shafter monitoring station 2006-2010 $NO_2$ hourly data provided by SJVAPCD showed that the 98th percentile daily maximum 1-hour concentration averaged over the 5 years was 62 ppb, which is below the standard. There were very few hours when the measured background concentration is near or above 100 ppb.

Because the Shafter monitoring station is near mobile sources but no large industrial sources, and is not downwind from an urban area, the data appropriately represent ambient $NO_2$ and $O_3$

concentrations expected to be found throughout the rural San Joaquin Valley. Therefore, the Shafter monitoring station was chosen to represent the background $NO_2$ and $O_3$ data in the modeling.

Other monitoring stations that were considered for $NO_2$ and $O_3$ data are shown in Table 2. These other stations did not meet the following criteria:

1. Meet data completeness requirements;
2. Match the rural land use surface parameters of the proposed Project Site;
3. Show close proximity to the Project Site compared to other monitoring stations; or
4. Monitor $NO_2$ or $O_3$ data.

**Table 2**
**Monitoring Stations Considered for Ozone and Nitrogen Dioxide Data, Kern County, San Joaquin Valley Air Basin**

| Monitoring Station | $NO_2$ Data Availability Years | $O_3$ Data Availability Years | Distance from Project Site (Miles) | All Quarters Between 2006-20010 Have 75% Raw Data Capture for $NO_2$ and $O_3$?[1] |
|---|---|---|---|---|
| Shafter-Walker Street | 1989-2010 | 1989-2010 | 13 | Yes |
| Taft College | Not Available | Not Available | 13 | Not Applicable |
| Bakersfield-5558 California Avenue | 1994-2010 | 1994-2010 | 18 | Yes |
| Maricopa-Stanislaus Street | Not Available | 1987-2010 | 19 | Not Applicable |
| Bakersfield-Golden State Highway | 1994-2008 | 1994-2009 | 21 | No; Station has been shut down. Ozone sampling ended in 2009, and $NO_2$ sampling ended in early 2010. |
| Bakersfield-410 E Planz Road | Not Available | Not Available | 21 | Not Applicable |
| Oildale - 3311 Manor Street | Not Available | 1980 - 2010 | 28 | Not Applicable |
| Arvin - Bear Mountain Blvd | 1989-2008 | Not Available | 34 | Not Applicable |
| Arvin- Di Giorgio | Not Available | 2009 - 2010 | 39 | Not Applicable |

Notes:
[1] Raw data per quarter must meet 75 percent data capture, per 40 Code of Federal Regulations Parts 50 and 58, February 9, 2010, Appendix S, 3.2(b).
Data from CARB (2010): http://www.arb.ca.gov/aqmis2/aqdselect.php?tab=specialrpt.

Bakersfield $NO_2$ and $O_3$ data were not used. The Bakersfield Golden State Highway station did not meet data completeness requirements. The Bakersfield California Avenue station's suburban location is not representative of the rural HECA Project Site. Figure 1 displays an overview image of the HECA Project Site and locations of several nearby monitoring stations. Close-up aerial images of the HECA Project Site next to the surface meteorological station used in the AERMET files are shown in Figure 2. Finally, zoomed-in locations of the monitoring stations at Shafter, Bakersfield-California Avenue, and Bakersfield-Golden State Highway are presented in Figures 3 through 5, respectively.

### 3.1.1 Handling of Missing Hourly $O_3$ & $NO_2$ Data for Shafter Monitoring Station

To run PVMRM in AERMOD, hourly $O_3$ data are required. These data cannot have any missing values for the model to function correctly, thus missing data must be filled appropriately. Likewise, $NO_2$ background data added to modeled $NO_2$ concentrations must be complete. SJVAPCD used the following convention to fill in missing hours in the raw hourly Shafter $NO_2$ and $O_3$ background data.

The maximum raw monitoring value for each hour in each month of the 5 years was obtained. Missing hours were filled with the maximum value that occurred for that hour in that month for all years. This method of handling missing data will not underestimate the missing background $O_3$ or $NO_2$ concentrations because the maximum concentration for the given hour was substituted.

## 3.2 AMBIENT $NO_2/NO_X$ RATIO

The PVMRM algorithm uses the ambient or equilibrium $NO_2/NO_X$ ratio in calculating the predicted $NO_2$ concentrations. On an hourly basis, the ambient $NO_2/NO_X$ ratio will vary depending on nearby sources, meteorological conditions, and ambient $O_3$ concentrations. The PVMRM algorithm in AERMOD is not designed to accept hourly ambient $NO_2/NO_X$ ratios; therefore, a regional annual ratio was used in the model.

The highest seasonal average $NO_2/NO_X$ equilibrium ratio from the Shafter $NO_2$ monitoring station based on hourly data for 2006 through 2010 was 0.83, occurring in the summer (CARB, 2012). However, the modeling analysis presented in this report used a $NO_2/NO_X$ equilibrium ratio of 0.9, which represents the hourly upper bound, as recommended by USEPA Region IX. With this point considered, the use of the default $NO_2/NO_X$ equilibrium ratio of 0.9 in PVMRM is another conservative assumption in the HECA $NO_2$ modeling analyses, as it will allow more conversion of $NO_X$ to $NO_2$ than has been observed in ambient data.

## 3.3 METEOROLOGICAL DATA

Hourly surface data were obtained from the SJVAPCD for the Bakersfield Meadows Field Airport (BFL) meteorological station for the years 2006 through 2010. When using off-site meteorological data, USEPA requires 5 years of the most recent and representative data available. The SJVAPCD hourly surface observation data included meteorological parameters of temperature, dew point, pressure, wind speed, wind direction, cloud cover, and ceiling height. SJVAPCD has prepared a document describing their meteorological processing methodology, "Procedures for Downloading and Processing NCDC Meteorological Data" (SJVAPCD, 2010a), provided in Attachment B.

The BFL station is approximately 20 miles northeast of the HECA Project, as shown in Figure 1. The data meet the USEPA criteria for representativeness, and are suitable based on proximity and terrain similarities between the Project Site and BFL. The terrain immediately surrounding the meteorological station and the HECA Project is rural, as shown in the aerial photographs of Figure 2. Circles with a 1-kilometer radius around the HECA Project Site and the meteorological station show similar terrain, including open fields and semi-developed land use categories. Projected HECA Project structures will create a more developed site at the Project location, producing some developed land use similar to the airport. There are no major geographical features that could influence the meteorological conditions between or near the locations.

The BFL station and the HECA Project Site both lie within the southern portion of the San Joaquin Valley, between the foothills of the Sierra Nevada Mountains to the east, the Diablo Mountain Range to the west, and the Tehachapi mountains to the south. The HECA Project Site will sit at 288 feet above sea level, while the BFL station sits at 489 feet. The climate in the valley is warm and semi-arid, with the wet season occurring between October and April. The Bakersfield 30-year average for normal sky coverage is 189 days of clear skies per year, 80 days of partly cloudy skies, and 92 days of cloudy skies. Summers are clear and dry. The relative humidity is low in the summer and high in the winter, with an average annual relative humidity of 54 percent. Winds in the San Joaquin Valley often flow with the axis of the valley, and thus blow frequently from the northwest. During the summer the northwest sea breezes frequent the Bakersfield area, especially during hot summer periods, which may carry dust and bring thermal instability. As air descends downward over the mountain ranges, it warms and dries out, allowing temperatures in the city and adjacent areas of the southeastern San Joaquin Valley to run warmer than areas farther north. A very strong eastern Chinook wind will often blow through the Tehachapi Pass during the winter months. Frontal passages are also common in winter months throughout the valley (NCDC, 2010; NOAA, 2008).

An annual wind rose based on the 5 years of Bakersfield surface data was provided in Appendix E-1, Seasonal and Annual Wind Roses, of the AFC Amendment (2012). Winds blow predominantly from the northwest, with an average annual speed of 6.5 miles per hour, but winds are often calm. Western Regional Climate Center Bakersfield Meadows Airport temperature data for the years 1940 through 2012 indicate the average annual high and low temperature for this station are 78 degrees Fahrenheit (°F) and 49°F, respectively (WRCC, 2012).

Only two long-term upper air stations exist for the entire state of California that collect enough data for use in air quality modeling. These stations are in Oakland and San Diego. There is an upper air station at Vandenberg Air Force Base in California, but this station has insufficient hourly data for modeling. SJVAPCD chose the Oakland International Airport upper air station for all meteorological data processing. Data were obtained from the National Oceanic and Atmospheric Administration Radiosonde Database for the same years as the surface station data (NOAA, 2010). The Oakland Airport upper air station is approximately 235 miles northwest of the Project Site. Using the Oakland upper air data and the Bakersfield surface data, AERMET creates an hourly vertical wind profile to estimate wind parameters at different plume heights (USEPA, 2004).

The USEPA AERMOD Implementation Guide (USEPA, 2008a) discussed a fairly new tool called AERSURFACE, which may be used to establish realistic and reproducible surface characteristic values around the meteorological surface station (USEPA, 2008b). SJVAPCD used the AERSURFACE program to determine surface characteristics for input into the AERMET processor program for the Bakersfield meteorological data set. AERSURFACE uses USGS National Land Cover Data 1992 archives to determine the Albedo, Bowen ratio, and surface roughness length representative of the surface meteorological station.

For the AERSURFACE input, the USEPA-recommended surface parameter distance of 1 kilometer was used to develop surface roughness values, and a 10-kilometer radius was used for Albedo and Bowen ratios. Figure 2 displays an aerial view of the HECA Project Site and BFL meteorological station site, with a circle 1 kilometer in radius surrounding both locations. The meteorological station is at an airport, does not receive continuous snow cover in the winter, and is not in an arid region. The Bowen ratio calculation is based on comparison of precipitation during the study period to a 30-year climate average. If conditions are within the upper 30$^{th}$ percentile moisture conditions, it is considered wet conditions; the lower 30$^{th}$ percentile represents dry conditions, and the middle 40$^{th}$ percentile represents average conditions.

The HECA Project Site is in close proximity to the BFL meteorological station, so the locations have a similar climate, the land use surrounding each location is comparable, and there are no major geographical features between the HECA site and weather station that could cause a difference between the meteorological conditions at the two locations. Therefore, the meteorological data used in the $NO_2$ regional modeling analysis from the BFL station are representative.

# 4. EMISSIONS SOURCES

## 4.1 HECA PROJECT

The emission scenario used in the $NO_2$ 1-hour SIL and NAAQS cumulative modeling was developed following guidance from the March 2011 USEPA Memo. To minimize emissions, all HECA emissions sources will use best available control technology (BACT).

For this modeling, the CTG/HRSG and coal dryer operate in normal on-peak (Case 1) power mode. Start-up emissions for the CTG/HRSG are limited to 105 hours per year, while shut-down emissions are limited to 18 hours per year. Start-up emissions for the coal dryer are limited to 104 hours per year, with shut-down emissions at 8 hours per year. Annualized maximum 1-hour $NO_2$ start-up/shut-down emission rates for these two sources are lower than their normal maximum $NO_2$ 1-hour rates; therefore, the maximum normal $NO_2$ 1-hour emission rates for the CTG/HRSG and coal dryer were used.

Similarly, the SRU flare and tail gas thermal oxidizer have maximum impacts during normal operations with pilot and process vent disposal, respectively, rather than during an annualized start-up period. The Rectisol® and gasification flares were included with maximum annualized start-up flaring emission rates, which are higher than their normal emission rate during pilot mode.

The auxiliary boiler and nitric acid unit operations were included at their peak hourly emission rate. The ammonia plant start-up heater also was included with an annualized start-up 1-hour $NO_2$ emission rate. Finally, all three ancillary diesel engines, including the two emergency diesel generators and firewater pump, were included in the modeling with annualized emission rates. Mobile sources were not included in this modeling scenario.

The emission rates and stack parameters used in these analyses for the HECA sources can be found in Table 3.

**Table 3**
**HECA Source Emission Rates and Stack Parameters**
**Used in the $NO_2$ SIL and NAAQS Analyses**

| Source | Operating Condition Associated with Emission Rate | Stack Height | Temperature | Exit Velocity | Stack Diameter | $NO_2$ emissions |
|---|---|---|---|---|---|---|
| | | (ft) | (°F) | (ft/sec) | (ft) | (lb/hr) |
| HRSG Stack | Normal On-Peak Emissions (Case 1) | 213.00 | 200.00 | 53.81 | 23.00 | 25.01 |
| Coal Dryer | Normal On-Peak Emissions (Case 1) | 305.00 | 200.00 | 19.16 | 16.00 | 4.37 |
| Tail Gas Thermal Oxidizer Stack | Normal operations | 165.00 | 1200.00 | 50.93 | 2.50 | 3.12 |
| Auxiliary Boiler | Normal operations | 80.00 | 300.00 | 30.18 | 4.50 | 1.28 |
| Rectisol® Flare | Annualized emissions, start-up flaring | 217.83 | 1831.73 | 65.62 | 0.87 | 0.24 |
| Gasification Flare | Annualized emissions, start-up and shut-down flaring | 219.63 | 1831.73 | 65.62 | 1.22 | 0.66 |
| SRU Flare | Normal Operations, Pilot | 215.00 | 1831.73 | 65.62 | 0.32 | 0.04 |
| Nitric Acid Plant Stack | Normal operations | 145.00 | 239.00 | 17.11 | 8.00 | 4.18 |
| Emergency Diesel Generator 1 | Annualized emissions | 20.00 | 760.00 | 221.05 | 1.20 | 0.02 |
| Emergency Diesel Generator 2 | Annualized emissions | 20.00 | 760.00 | 221.05 | 1.20 | 0.02 |
| Emergency Diesel Firewater Pump | Annualized emissions | 20.00 | 850.00 | 155.91 | 0.70 | 0.02 |
| Ammonia Synthesis Plant Start-up Heater | Annualized emissions | 80.00 | 300.00 | 18.71 | 3.50 | 0.01 |

Notes:
ft = foot/feet
Lb = pound
Hr = hour
HRSG = heat recovery steam generator
NAAQS = National Ambient Air Quality Standard
$NO_2$ = nitrogen dioxide
sec = second
SIL = Significant Impact Level
SRU = sulfur recovery unit

### 4.1.1 $NO_2/NO_X$ In-Stack Ratios for HECA Sources

In stack $NO_2/NO_X$ ratios were determined for all sources in the $NO_2$ modeling for use in the ozone limiting method PVMRM. For the emergency generators, firewater pump, ammonia start-up heater, and auxiliary boiler, the $NO_2/NO_X$ in-stack ratios were obtained from the SJVAPCD 2010 draft guidance document, *Assessment of Non-Regulatory Options in AERMOD Specifically OLM and PVMRM* and the CAPCOA *Modeling Compliance of the Federal 1-hour $NO_2$ NAAQS*

(Attachment C). For the emergency generators and fire water pump, an in-stack ratio of 0.2 was used from the "IC Engines (Diesel)" category. The ammonia start-up heater used an in-stack ratio of 0.32 from the "Heaters (NG)" category. For the auxiliary boiler, an in-stack ratio of 0.1 was used from the "Boilers (NG)" category.

Limited information is available regarding in-stack $NO_2/NO_X$ ratios for thermal oxidizers and flares. The exhaust from the thermal oxidizer or flares will have very little to no residence time in the stack, so almost no conversion of nitrogen oxide (NO) to $NO_2$ is expected. For these sources, it was conservatively assumed that 10 percent of the $NO_X$ will be $NO_2$.

No data exist for the $NO_2/NO_X$ in-stack ratio for turbines burning hydrogen-rich fuel or the associated coal dryer. The turbine vendor expects the $NO_2/NO_X$ in-stack ratio will be similar to turbines that burn natural gas. Based on the in-stack $NO_2/NO_X$ ratio of 0.091 for a natural gas turbine as determined by SJVAPCD guidance, and accounting for the conversion of NO to $NO_2$ across the oxidation catalyst that could be as high as 20 percent ($NO_2/NO_X$ ratio 0.2), HECA proposes to use the conservative $NO_2/NO_X$ in-stack ratio of 0.3 for all turbine and coal dryer operating conditions. Neither the turbine nor oxidation catalyst vendor could provide written documentation regarding the $NO_2/NO_X$ in-stack ratio, although this ratio was their professional engineering estimate.

Emissions from the nitric acid plant will be cleaned before being discharged to the atmosphere by catalytic decomposition and reduction of both nitrous oxide ($N_2O$) and $NO_X$. The $N_2O$ emissions are treated in a tertiary reduction system, in a reducing catalyst that uses high temperature rather than a reducing agent, to convert 95 percent of the remaining $N_2O$ emission to molecular nitrogen ($N_2$) and nitric oxide (NO). The $NO_X$ emissions (including the NO formed in the $N_2O$ converter) are then reduced in one or more selective catalytic reduction (SCR) units, with injected ammonia as a reducing agent, as is typical for $NO_X$ control in flue gas systems. The nitric acid unit vendor and Project design engineers estimate that approximately 50 percent of the NO converts to $NO_2$ in the exhaust, therefore an in-stack ratio of 0.5 was used.

## 4.2 NEARBY SOURCES

Section 8.2 of Appendix W of 40 CFR, Part 51 (the USEPA's *Revision to the Guideline on Air Quality Models* [USEPA, 2005]) refers to background concentrations as "an essential part of the total air quality concentration to be considered in determining source impacts." When a source is not isolated, a multi-source model (i.e., AERMOD) is prescribed to establish the potential impact of nearby sources. In the recommendations subsections for multi-source areas, the following key points are made:

- Contributions from ***nearby sources*** and contributions from ***other sources*** should be determined.

- ***Nearby sources*** are those expected to cause a significant concentration gradient in the vicinity of the source or sources under consideration; the number of such sources is "expected to be small," given the complexities of modeling specific projects (i.e., unique modeling situations, large numbers of variables). It specifically states that the definition is provided merely as guidance and is not intended to alter professional judgment.

- An appropriate model should be employed along with emission input data as shown in Table 8-1 or 8-2 of the USEPA guidelines (USEPA, 2005); any unpermitted sources should be modeled at their maximum physical capacity to emit.
- Only sources that would run simultaneously with the primary source being modeled (i.e., HECA) are to be modeled. As an example: "emergency backup generators that never operate simultaneously with the sources that they back up would not be modeled as nearby sources."
- Interactions between the primary source and the various nearby sources should be evaluated by examining the areas of maximum impact for each separately, followed by examination of the area of maximum impact where the two are combined, on a "trial and error" basis.
- ***Other sources*** are defined as the "portion of the background attributable to all other sources (e.g., natural sources, minor sources, and distant major sources)" to be determined using prescribed methods.

Other sources that were not accounted for in the background data, such as minor sources and distant major sources, were included in the modeling analysis. For simplicity in discussion, other sources and nearby sources are collectively referred to as "nearby sources."

### 4.2.1 Nearby Source Screening and Selection Process

URS requested information on $NO_2$ emissions sources surrounding the HECA Project Site from the SJVAPCD for the PSD analysis. SJVAPCD provided a list of over 8,500 permitted sources to a distance of approximately 75 kilometers from the center of the HECA Project Site. Upon closer inspection, the $NO_X$ emissions data for approximately 75 percent of these sources contained either no values for the daily or annual emission rates or presented values of zero. For the most part, the zero emissions sources consisted of processes or equipment that would not emit $NO_X$ (e.g., VOC sources, such as gasoline stations, storage tank operations, etc., or particulate matter [PM] sources, such as wood processing, dust control equipment, etc.). The zero emissions sources were further screened for dormant $NO_X$ equipment that was flagged as such in the SJVAPCD's equipment description (i.e., dormant equipment typically contained the word "DORMANT" in the SJVAPCD's equipment description). This was also done by searching the zero emissions equipment description for the terms "ENGINE" and/or "TURBINE." Any engines and/or turbines with zero emissions were labeled as "assumed dormant."

Furthermore, equipment was analyzed based upon its distance from the HECA Project Site. The fairly large distance between the HECA Project Site centroid and its property fence line (approximately 1.3 miles) resulted in URS extending the radii (or distance) to screen. The following distances were used to evaluate the sources surrounding the HECA Project Site:

- Source distance less than 11.4 miles (18.3 kilometers)

- Source distance greater than or equal to 11.4 miles (18.3 kilometers), and less than or equal to 32.4 miles (52.1 kilometers)
- Source distance greater than 32.4 miles (52.1 kilometers)

After omitting sources for which $NO_X$ emissions were either zero or not provided, URS used a qualitative approach to further refine the sources used in this modeling analysis. This approach was based upon professional judgment and made use of various source metrics or a combination thereof, including, but not limited to the following:

- size (e.g., horsepower [hp], heat input rating, or emissions)
- type of source
- frequency of use (e.g., emergency/standby internal combustion (IC) engine/ emergency fire pump, test operation)
- relative emission rate (Q) divided by source distance from HECA centroid (d), Q/d

and, specifically for IC engines:

- USEPA Tier emission rating
- Emergency or non-emergency IC engine

The use of Q/d was prescribed as a viable screening method for PSD projects in a 1985 letter by the State of North Carolina Department of Natural Resources and Community Development (NCDNRCD) (NCDNRCD, 1985). That particular reference suggested that this simple screening method could be employed to:

> "rapidly and objectively eliminate from the emissions inventory those sources that are beyond the PSD impact area yet within the screening area, but are not likely to have significant interaction with the PSD source."

Two Q/d values labeled Q/D-1 and Q/D-2, with units of tons per year per kilometer (ton/yr/km), were calculated for each source by dividing the respective daily and annual emissions values by its distance from HECA. As expected, the values calculated using daily emissions are more conservative (except in the case of several flagged sources [errant data]); that is, they would cause more sources to be included in the analysis.

A summary of the number of nearby sources included in the modeling analyses that exceed a Q/d threshold of 2, one order of magnitude less than the threshold of 20 used in the NCDNRCD document (NCDNRCD, 1985), is provided in Table 4.

Using professional judgment, a number of facilities (especially oil production/refining operations, cogeneration plants, etc.) were included based upon the fact that they had a significant number of sources or yielded significant emissions, even if they had Q/d values less than the screening threshold presented in Table 4.

As a conservative check on information presented in Table 4, additional effort was made to evaluate a "totalized" facility Q/d, whereby the sum of the Q/d values for a facility's sources

**Table 4**
**Summary of Number of Sources with a Q/D Threshold of 2**

| Distance | Threshold Value | No. of Sources Included, Using ONLY Q/d Calc | |
|---|---|---|---|
| | | Q/D-1 ([ton/yr]/km) (based on daily emissions) | Q/D-2 ([ton/yr]/km) (based on annual emissions) |
| < 11.4 mi (18.3 km) | 2 | 33 | 22 |
| ≥ 11.4 mi (18.3 km) and ≤ 32.4 mi (52.1 km) | 2 | 90 | 39 |
| > 32.4 mi (52.1 km) | 2 | 3 | 0 |

Notes:
< = less than
> = greater than
≤ = less than or equal to
≥ = greater than or equal to
mi = mile
km = kilometer
[ton/yr]/km = tons per year per kilometer

(those sources with $NO_X$ emission rates greater than 2 pounds per hour [or 48 pounds per day]) was compared to the Q/d threshold of 2 used above. No such cases were found; therefore, no additional facilities were included based upon totalized facility emissions.

Smaller co-located sources within the lesser 10-mile radius were also more likely to be included than those at greater distances.

The result of adding the various co-located sources, the sources found at fairly large facilities (even those below threshold values), removal of intermittent sources, plus all the other factors resulted in the modeled source count presented in Table 5.

**Table 5**
**Sources Included in the 1-hour $NO_2$ PSD Analysis**

| Distance Range | Total |
|---|---|
| < 11.4 mi (18.3 km) | 108 |
| ≥ 11.4 mi (18.3 km) and ≤ 32.4 mi (52.1 km) | 257 |
| > 32.4 mi (52.1 km) | 6 |
| **Total** | 371 |

Notes:
< = less than
> = greater than
≤ = less than or equal to
≥ = greater than or equal to
mi = mile
km = kilometer
NO2 = nitrogen dioxide
PSD = Prevention of Significant Deterioration

The source counts above are based upon professional judgment, while also taking into account the sources with a Q/D-1 or Q/D-2 greater than or equal to 2; in addition, small sources that could not have a significant impact were removed. Small sources (co-located or not) with a daily emission rate less than or equal to 48 pounds per day (equates to 2 pounds per hour) were omitted from the source list due to their limited size. Emergency/standby engines at nearby facilities were not included based on the March 2011 USEPA Memo modeling guidance. However, 78 IC engines powering compressors, 13 IC engines for agricultural pumping, and 3 IC engines used to start gas turbines were included for the regional modeling analysis.

The number of sources discussed above may differ from that discussed in the January 2011 modeling protocol; such reasons for removing sources may include, but are not limited to, the following:

1. duplicative/backup sources;
2. additional information provided for a given source;
3. omitting emergency engines at nearby facilities from the modeling inventory; and
4. if a source closer to HECA does not result in a significant concentration gradient, a similar source farther from HECA may be eliminated.

Several source data handling assumptions were used as follows:

- Multiple Flares: If SJVAPCD information showed that a facility has more than one (1) flare or emergency flare in its permitted inventory, then at least one of any duplicate flares (i.e., flares of equivalent heat input capacity that result in equivalent pseudo-stack parameters, as discussed later) or the most conservative flare was used; professional judgment was used to estimate the conservativeness of stack parameters in combination with the emission rates provided by the SJVAPCD;
- Sources immediately adjacent to the Shafter monitoring station that are already included in the background data were excluded from the analysis.

All nearby sources included in the $NO_2$ analysis were modeled using their maximum hourly emission rate. The maximum hourly emission rates were estimated by dividing each source's maximum permitted daily emissions (as provided by SJVAPCD) by 24 hours. The modeling analysis includes all nearby sources operating simultaneously with maximum emissions; this is an extremely conservative assumption and is guaranteed to overestimate potential impacts from these sources during actual HECA Project operations. The SJVAPCD provided nearby source list of over 8,000 sources, which is presented electronically with the modeling files. The list of the modeled nearby sources with stack parameters is provided in Attachment A.

Figure 8 presents the hourly emissions from nearby sources included in the modeling analysis. Sources located at the same facility have been combined in order to simplify the plot. The largest facilities within 10 kilometers of the HECA Project are OEHI (IC engines and heaters) and Elk Hills Power (turbine). The largest contributors (greater than 100 pounds per hour) are several cogeneration plants (Sycamore Cogeneration Co. and Kern River Cogeneration Co.) and oil and gas facilities (Aera Energy, LLC and Chevron, USA Inc.) located greater than

30 kilometers from the HECA Project Site. A complete list of all sources is included as Attachment A and in the modeling files presented electronically with this submittal.

#### 4.2.2 Nearby Source Emissions and Stack Parameters

The emissions for the nearby sources included in the modeling analysis are tabulated in Attachment A. A collective sum of approximately 1.5 tons of $NO_2$ per hour is assumed to be emitted by all nearby sources, running continuously with the modeled HECA emissions.

Stack parameters for the nearby sources included in the analysis were either provided by SJVAPCD or derived from similar equipment based on professional judgment. URS filed a Public Records Request with the SJVAPCD in early-November 2009 for permit-related information from 25 facilities within approximately 10 miles of the HECA Project Site. The request included the following document types: permit applications, emissions inventory statements, AB2588 “Hot Spots” Information, engineering evaluations, and determinations of compliance. Furthermore, the request called for documents that included a summary of modeling files, including information on stack parameters and source coordinates. In late November 2009, URS received two DVDs of information for the 25 facilities. A very large number of PDF files were provided on the disks for each facility; however, review of each PDF file proved overwhelming and instead only the larger files were perused for useful information. The most useful information was typically a source test, air toxics inventory, or engineering evaluation; however, few such documents were found. As stack parameter information was found for particular sources, such information was applied to other sources based upon their similarity in size and/or orientation.

If adequate source information was not provided to approximate source parameters (e.g., a flare without a heat input rating), parameters for a similar source with a similar emission rate at the same facility or similar facility were used. Similarly, if stack parameters could not be readily found in information provided by the SJVAPCD via a literature search or via internet searches, then reasonable stack parameters for similar equipment were used, or approximate values were used based upon the professional judgment of a URS technical staff member.

Pertinent source information provided by the SJVAPCD included locations (as UTM coordinates), emission rates, equipment descriptions, facility number, permitted source number, etc. Due to the size of the modeled area and number of sources, the accuracy of facility locations provided by the SJVAPCD was not questioned, nor investigated.

In parallel with the request for information from SJVAPCD, Occidental of Elk Hills, Inc. (OEHI) was approached independently. OEHI is located fairly close to the HECA project and consists of a very large number of sources. The following information received for approximately two-thirds of the sources at OEHI proved useful in the modeling analysis:

- source coordinates
- stack temperature
- stack height
- stack diameter
- base elevation

- exhaust stack temperature
- equipment status (active/dormant/emergency)
- equipment make, model and permit number

Coordinates for the remaining one-third of OEHI sources were estimated; stack parameters for those same sources (and stack flow rates or velocities for the above two-thirds) were estimated based upon professional judgment and/or research of parameters for similar equipment.

One type of regional $NO_X$ source found in great numbers and densities in oil field applications was a gas- and/or vapor-fired steam generator (most common size was 62.5 MMBtu/hr). Source parameters for these steam generators, including stack height, stack diameter, exhaust stack temperature, and a stack flow rate and/or velocity, were found in a Human Health Risk Assessment (HRA) produced by the SJVAPCD for a document entitled “Notice of Preliminary Decision - ATC/Cert of Conformity,” addressed to Chevron USA and dated 12-8-10. The HRA was dated 10-29-10 and addressed 62.5 MMBtu/hr steam generators specifically.

In general, SJVAPCD-provided UTM coordinates were identical for all sources at a given facility (with the same facility ID). This resulted in a considerable amount of co-located sources being input to the modeling. In some instances, all of which are noted appropriately, the SJVAPCD-provided coordinates were adjusted using aerial imaging software, the facility footprint (where appropriate), and professional judgment to distribute sources across a larger area. Such was the case for several apparent oil fields (e.g., Aera Energy LLC [Facility ID No. 1135]; Chevron USA, Inc. [Facility ID No. 1141]) that consisted of the steam generator equipment previously mentioned and/or combined cycle gas turbines equipment providing both electricity and steam. The coordinates of selected sources at OEHI [Facility ID Nos. 382, 2234]) were also adjusted where facility information was not provided; this facility included a wide variety of equipment.

Notes pertaining to the source of input information (e.g., emissions rates or stack parameters used) for all nearby sources included in modeling are tabulated in Attachment A.

#### *4.2.2.1 Nearby Source $NO_2/NO_X$ In-Stack Ratios*

$NO_2/NO_X$ in-stack ratios were obtained from the SJVAPCD 2010 draft guidance documents, *Assessment of Non-Regulatory Options in AERMOD Specifically OLM and PVMRM* and the updated Recommended In-Stack $NO_2/NO_X$ Ratios (Attachment C), and Master List of $NO_2/NO_X$ ratios from EPA Region 10, which is provided electronically with the modeling files in the submittal of the AFC Amendment (2012). Table 6 contains a listing of the $NO_2/NO_X$ in-stack ratios used for the various combinations of nearby source types and fuels.

As seen in Table 6, the $NO_2/NO_X$ in-stack ratio for the nearby sources was chosen by equipment and fuel type, as provided from SJVAPCD guidance, and USEPA Region 10 for large gas turbines. Where good information regarding a particular type of source was not available, a high ratio was used. In-stack ratios used for each nearby source are provided with the modeling source input parameters in Attachment A.

**Table 6**
**$NO_2$ / $NO_X$ In-stack Ratios Used in Modeling**

| Source Type | Fuel | In-stack Ratio Used | |
|---|---|---|---|
| Boilers/Steam generators | biomass, NG, vapor | 0.1 | |
| Turbines (including cogeneration, simple-/ combined-cycle, and gas compressor applications) | NG | 0.1032<br>0.17 | (small turbines)<br>(large turbines) |
| Emergency turbine | diesel | 0.1 | |
| Other cogeneration sources | solid fuel, multi-fuel | 0.1 | |
| Process heaters/dryers | NG, vapor | 0.32 /<br>0.1 | (heaters or both) /<br>(dryers) |
| IC engines (including those acting as gas turbine starters or powering pumps) | diesel | 0.2 | |
| | NG | 0.1 | |
| IC engines (acting as compressors) | diesel | 0.2 | |
| | NG | 0.6 | |
| Ovens | NG | 0.32 | |

Notes:
$NO_2$ = nitrogen dioxide
$NO_X$ = nitrogen oxide
NG = natural gas

## 5. MODELING RESULTS

Because $NO_2$ impacts from HECA sources exceeded the 1-hour SIL, a cumulative impact assessment was completed to determine whether the Project would cause or contribute to a modeled violation of the NAAQS. HECA sources were combined with nearby sources and modeled in AERMOD with PVMRM, and hourly $NO_2$ ambient background concentrations were added to the hourly model predictions. Section 5.1 presents the results from HECA sources alone compared with the 1-hour $NO_2$ SIL, and defines the area of impact receptors to be subsequently used in the regional analysis. Section 5.2 presents results from the regional analysis, which presents the HECA sources, nearby sources, and background modeled design value in comparison to the NAAQS.

### 5.1 RESULTS FOR SIL AND AREA OF IMPACT FROM HECA SOURCES

Screening modeling determined whether HECA operational impacts had the potential to cause or contribute to a violation of the NAAQS, comparing the modeled maximum first high concentration averaged over 5 years to the $NO_2$ 1-hour Class II interim SIL of 4 ppb. Only permitted stationary sources were included in the modeling analyses.

The modeled $NO_2$ concentration from HECA was predicted to be 24 µg/m$^3$, compared with the interim $NO_2$ 1-hour SIL of 7.55 µg/m$^3$ (4 ppb) for Class II areas. This $NO_2$ 1-hour concentration is the maximum first high concentration averaged over 5 years. In this initial impact analysis, approximately 2,500 receptors exceeded the $NO_2$ 1-hour SIL within 15 kilometers of the site, and were used as the HECA area of impact for the refined modeling analysis.

## 5.2 RESULTS FOR CUMULATIVE MODELING ANALYSIS

The MAXDCONT option in AERMOD was run to determine the $NO_2$ 1-hour impact contribution from HECA. The option was run from rank 8 (or, the 98th percentile daily maximum value per receptor averaged over 5 years) to rank 20, with a threshold value equal to the $NO_2$ 1-hour NAAQS (188 µg/m$^3$). The target source group was set to all sources (HECA, regional sources, and background). This setup option continues to examine the concentrations for all ranks until the impacts from all sources are less than the threshold value of 188 µg/m$^3$. This option was used to obtain any exceedances of the NAAQS from all sources and, if an exceedance occurs, whether or not HECA's contribution is greater than or equal to the SIL at that point in time and space. HECA stationary sources were modeled using the higher of their normal operating emission rate or an annualized intermittent operation emission rate.

The maximum modeled 5-year average 8th high (98th percentile) 1-hour daily concentration (design value) at any receptor was 126 µg/m$^3$, which complies with the 1-hour $NO_2$ NAAQS of 188 µg/m$^3$. The total predicted design value includes HECA sources, nearby regional sources and background measured concentrations of $NO_2$.

The regional modeling analysis showed that no concentrations were predicted to be greater than the NAAQS. Therefore, HECA does not cause or significantly contribute to a violation of the $NO_2$ 1-hour NAAQS.

# 6. CONSERVATISM IN THE MODELING ANALYSIS

Following the USEPA modeling guidance documents resulted in the inclusion of many conservative assumptions within the modeling analysis. The conservative data assumptions used as input to the modeling analysis are outlined below:

1. Emissions from the nearby sources were input at maximum potential to emit out as far as 75 kilometers. For most sources the maximum permitted emission rates are significantly higher than their actual emission rates, and thus the modeling over-predicts the impacts from these sources.

2. Simultaneous operation of HECA sources and nearby sources, all with maximum hourly permitted emission rates, for all hours of the 5-year meteorological data set.

3. For $NO_2/NO_X$ in-stack ratios, a high ratio was used where good information regarding a particular type of source was not available.

4. The hourly upper bound $NO_2/NO_X$ equilibrium ratio of 0.9 was used, and this value is higher than the maximum seasonal hourly ratio of 0.83.

5. Hourly $NO_2$ background data from the Shafter monitoring station are used as a surrogate for emissions from transportation sources near the HECA Project, although they will also contain contributions from sources near the monitoring station.

6. The traffic volume near the Shafter monitoring station is expected to be approximately nine times larger than the traffic volume near the HECA when operation starts. The $NO_2$ data from the Shafter monitoring station represents significantly more vehicular emissions than are expected near HECA.

7. HECA has purchased Emission Reduction Credits (ERC) to cover the total HECA Project annual $NO_X$ emissions at a 1.5-to-1 ratio. No credit has been taken for these emission reductions in the modeling analysis.

The use of so many conservative inputs into the model have the effect of removing accuracy from the analysis and analyzing a situation that could never be observed in reality, thereby grossly overestimating the potential impact from HECA Project operations and nearby sources.

# 7. CONCLUSION

The HECA Project is a revolutionary power and manufacturing facility and one of the first projects in USEPA Region IX that is faced with showing compliance with the new, statistically based 1-hour $NO_2$ NAAQS. Although USEPA has created guidance documents for conducting modeling to show compliance with the new standard, many aspects of conducting a regional analysis are still controversial between different permitting agencies. HECA has been in constant contact with USEPA Region IX and SJVAPCD, seeking additional modeling guidance in order to show compliance with the new 1-hour $NO_2$ NAAQS. This analysis was based on techniques agreed to with USEPA Region IX, OAQPS, and SJVAPCD.

The modeling results compiled and presented in the report clearly show that the HECA Project, combined with nearby sources to a distance of 75 kilometers, conservative ambient air quality background values, and a number of other of other conservative assumptions, would comply with the 1-hour $NO_2$ NAAQS.

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# Appendix E-8

# Commissioning Scenario Emissions and Modeling Results

**HECA Emissions for all Commissioning Scenarios**

**Maximum Hourly Emission Rates (lb/hr)**

| **Case 1** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| One Diesel Generator | 0.0 | 3.2 | 16.7 | 1.9 | 0.5 |
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| **Total** | **0.03** | **3.2** | **16.7** | **1.9** | **1.6** |

| **Case A** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power Block CT | 0 | 0 | 0 | 0 | 1.1 |
| CTG @ 20% No Controls | 2.1 | 67.1 | 2270 | 65 | 15 |
| **Total** | **2.1** | **67.1** | **2270** | **65** | **16.1** |

| **Case B** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power Block CT | 0 | 0 | 0 | 0 | 1.1 |
| CTG @ 80% No Controls | 4.8 | 391.2 | 344.5 | 3.8 | 15 |
| **Total** | **4.8** | **391.2** | **344.5** | **3.8** | **16.1** |

| **Case A2** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| Flare Unshifted | 4.1 | 140 | 4000 | 0 | 0 |
| (NG) Coal Drying | 0.3 | 4.5 | 44.2 | 1.9 | 0.9 |
| (NG) HRSG 80% | 4.7 | 34.1 | 26 | 5.9 | 15 |
| Tail Gas Oxidizer | 2.2 | 22.3 | 18.6 | 0.6 | 0.7 |
| No CO2 Venting | | | | | |
| **Total** | **11.2** | **201.0** | **4088.8** | **8.4** | **19.8** |

| **Case B2** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| Flare Shifted | 4.1 | 140.0 | 740.0 | 0.0 | 0.0 |
| (NG) Coal Drying | 0.3 | 4.53 | 44.22 | 1.9 | 0.9 |
| (NG) HRSG 80% | 4.7 | 34.1 | 26 | 5.9 | 15 |
| Tail Gas Oxidizer | 42.7 | 22.3 | 18.6 | 0.6 | 0.7 |
| No CO2 Venting | | | | | |
| **Total** | **51.8** | **201.0** | **828.8** | **8.4** | **19.8** |

| **Case C2** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| H2 Rich Gas Flare | 4.1 | 140.0 | 740.0 | 0.0 | 0.0 |
| (NG) Coal Drying | 0.3 | 4.53 | 44.22 | 1.9 | 0.9 |
| (NG) HRSG 80% | 4.7 | 34.1 | 26 | 5.9 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| CO2 Vent | 0 | 0 | 246 | 5.5 | 0 |
| **Total** | **11.1** | **181.8** | **1058.8** | **13.4** | **19.2** |

| **Case D2** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| H2 Rich Gas Flare | 3.6 | 123.8 | 654.2 | 0.0 | 0.0 |
| PSA Off-Gas Flare | 0.5 | 16.2 | 85.8 | 0.0 | 0.0 |
| (NG) Coal Drying | 0.3 | 4.53 | 44.22 | 1.9 | 0.9 |
| (NG) HRSG 80% | 4.7 | 34.1 | 26 | 5.9 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| No CO2 Venting | | | | | |
| **Total** | **11.1** | **181.8** | **812.8** | **7.9** | **19.2** |

| **Case E2** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| H2 Rich Gas Flare | 1.0 | 35.0 | 185.0 | 0.0 | 0.0 |
| Coal Drying (H2) | 0.9 | 17.6 | 21.4 | 0.6 | 1.4 |
| HRSG (40% H2) | 2.4 | 66.6 | 81 | 4.6 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| CO2 Vent | 0 | 0 | 246 | 5.5 | 0 |
| **Total** | **6.3** | **122.3** | **536.0** | **10.8** | **19.7** |

| **Case A3** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| H2 Purified Flare | 0.0 | 79.9 | 0.0 | 0.0 | 0.0 |
| Coal Drying (Normal) | 0.9 | 4.4 | 3.2 | 0.6 | 1.4 |
| HRSG (normal) | 4.1 | 25 | 18.3 | 3.5 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| CO2 Vent (blend to CO2 purification) | 0 | 0 | 103.4 | 0 | 0 |
| **Total** | **7.0** | **112.4** | **127.5** | **4.2** | **19.7** |

| **Case B3** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| H2 Rich Gas Flare | 0.0 | 79.9 | 0.0 | 0.0 | 0.0 |
| Coal Drying (Normal) | 0.9 | 4.4 | 3.2 | 0.6 | 1.4 |
| HRSG (normal) | 4.1 | 25 | 18.3 | 3.5 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| CO2 Vent (high purity) | 0 | 0 | 103.4 | 0 | 0 |
| Ammon S/U Heater | 0.1 | 0.5 | 1.5 | 0.2 | 0.2 |
| **Total** | **7.1** | **112.9** | **129.0** | **4.3** | **19.9** |

| **Case C3** | SO2 | Nox | CO | VOC | PM10 |
|---|---|---|---|---|---|
| Power CT | 0 | 0 | 0 | 0 | 1.1 |
| ASU CT | 0 | 0 | 0 | 0 | 0.2 |
| Process CT | 0 | 0 | 0 | 0 | 1.9 |
| Coal Drying | 0.9 | 4.4 | 3.2 | 0.6 | 1.4 |
| HRSG (normal) | 4.1 | 25 | 18.3 | 3.5 | 15 |
| Tail Gas Oxidizer (Normal Operation) | 2.0 | 3.1 | 2.6 | 0.1 | 0.1 |
| Nitric Acid Nox Abator | 0.0 | 60.0 | 0.0 | 0.0 | 0.2 |
| **Total** | **7.0** | **92.5** | **24.1** | **4.2** | **19.9** |

**Flare Stack Parameters for Commissioning Modeling Scenarios**

| **Parameter** | **Gasification Flare (unshifted) Case A2** | **Gasification Flare (shifted) Case B2** | **Gasification Flare (H2 Rich) Case C2** | **Gasification Flare (H2 Rich gas, PSA Off-Gas Flare) Case D2** | **Gasification Flare (H2 Rich Gas) Case E2** | **Gasification Flare (H2 Purified) Case A3 and B3** |
|---|---|---|---|---|---|---|
| Heat release rate for flare+pilot, ($10^6$ Btu/hr HHV) | 2000 | 2000 | 2,000 | 2,000 | 500 | 1142 |
| H = Total Heat release rate (cal/s) | 1.40E+08 | 1.40E+08 | 1.40E+08 | 1.40E+08 | 3.50E+07 | 7.99E+07 |
| Fb = Buoyancy flux | 2.32E+03 | 2.32E+03 | 2.32E+03 | 2.32E+03 | 5.81E+02 | 1.33E+03 |
| $Q_H$ = sensible heat release rate | 6.30E+07 | 6.30E+07 | 6.30E+07 | 6.30E+07 | 1.57E+07 | 3.60E+07 |
| Actual Stack height (m) | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 | 76.2 |
| GEP stack height for modeling (m) | 65 | 65 | 65 | 65 | 65 | 65 |
| AERMOD Input parameters | | | | | | |
| He = Effective stack height (m) as calculated in SCREEN3 | 100.71 | 100.71 | 100.71 | 100.71 | 83.41 | 92.32 |
| T = Stack temperature (K) | 1273 | 1273 | 1273 | 1273 | 1273 | 1273 |
| v = Exit velocity (m/s) | 20 | 20 | 20 | 20 | 20 | 20 |
| d = effective stack diameter (m) | 7.842 | 7.842 | 7.842 | 7.842 | 3.921 | 5.926 |

Flare stack parameters are based on calculated using the SCREEN3 technique
Fb = Buoyancy flux = 1.66 x 10-5 x H
QH = sensible heat release rate = 0.45 x H
He = Effective stack height (m) = Hs + 4.56E-03 * H^0.478
BTU/hr to cal/sec 0.06999882

**HECA Modeling Results for all Commissioning Scenarios**

| Modeling Scenario | Pollutant | Averaging Period | Maximum Estimated Impact ($mg/m^3$) | Background[1] ($mg/m^3$) | Monitoring Station Description[1] | Total Predicted Concentration ($mg/m^3$) | Most Stringent Standard ($mg/m^3$)[2] |
|---|---|---|---|---|---|---|---|
| Case 1 | CO | 1-hour | 144.64 | 4,581 | a | 4725.64 | 23,000 |
| | | 8-hour | 46.38 | 2,485 | a | 2531.38 | 10,000 |
| | $SO_2$ | 1-hour | 0.26 | 42 | d | 42.26 | 655 |
| | | 24-hour | 0.03 | 13 | d | 13.03 | 105 |
| | $NO_2$[3] | 1-hour | 24.94 | 140 | b | 164.94 | 339 |
| | $PM_{10}$ | 24-hour | 0.95 | 264 | c | 264.55 | 50 |
| Case A | CO | 1-hour | 1975.17 | 4,581 | a | 6556.17 | 23,000 |
| | | 8-hour | 801.25 | 2,485 | a | 3286.25 | 10,000 |
| Case B | $SO_2$ | 1-hour | 4.18 | 42 | d | 46.18 | 655 |
| | | 24-hour | 0.85 | 13 | d | 13.85 | 105 |
| | $NO_2$[3] | 1-hour | 149.73 | 140 | b | 289.73 | 339 |
| Case A2 | CO | 1-hour | 565.85 | 4,581 | a | 5146.85 | 23,000 |
| | | 8-hour | 147.91 | 2,485 | a | 2632.91 | 10,000 |
| | $SO_2$ | 1-hour | 4.18 | 42 | d | 46.18 | 655 |
| | | 24-hour | 0.85 | 13 | d | 13.85 | 105 |
| | $NO_2$[3] | 1-hour | 38.36 | 140 | b | 178.36 | 339 |
| | $PM_{10}$ | 24-hour | 3.40 | 264 | c | 267.00 | 50 |
| Case B2 | $SO_2$ | 1-hour | 97.43 | 42 | d | 139.43 | 655 |
| | | 3-hour | 37.51 | 26 | d | 63.51 | 1,300 |
| | | 24-hour | 7.48 | 13 | d | 20.48 | 105 |
| | $NO_2$[3] | 1-hour | 38.36 | 140 | b | 178.36 | 339 |
| Case C2 | CO | 1-hour | 1097.41 | 4,581 | a | 5678.41 | 23,000 |
| | | 8-hour | 178.21 | 2,485 | a | 2663.21 | 10,000 |
| Case D2 | $NO_2$[3] | 1-hour | 23.43 | 140 | b | 163.43 | 339 |
| Case E2 | CO | 1-hour | 914.50 | 4,581 | a | 5495.50 | 23,000 |
| | | 8-hour | 146.67 | 2,485 | a | 2631.67 | 10,000 |
| | $NO_2$[3] | 1-hour | 66.76 | 140 | b | 206.76 | 339 |
| Case B3 | CO | 1-hour | 384.78 | 4,581 | a | 4965.78 | 23,000 |
| | | 8-hour | 61.38 | 2,485 | a | 2546.38 | 10,000 |
| | $SO_2$ | 1-hour | 5.53 | 42 | d | 47.53 | 655 |
| | | 24-hour | 0.92 | 13 | d | 13.92 | 105 |
| | $NO_2$[3] | 1-hour | 23.23 | 140 | b | 163.23 | 339 |
| Case C3 | $NO_2$[3] | 1-hour | 128.32 | 140 | b | 268.32 | 339 |
| | $PM_{10}$ | 24-hour | 3.51 | 264 | c | 267.11 | 50 |

Source: HECA Project 2012
Notes:
1. Background Concentrations are maximum concentrations from the last 3 years of available EPA AirData and/or CARB data at the following stations

a) Bakersfield Golden State Highway Monitoring Station, Maximum Concentration 2007-2009
b) Shafter Monitoring Station, Maximum Concentration 2009-2011
c) Bakersfield California Avenue Monitoring Station, Maximum Concentration 2008-2010
d) Fresno 1st Street Monitoring Station Maximum Concentrations, 2007-2009 for 3-hour $SO_2$, 2009-2011 for 1-hour and 24 -hour SO2

2. Although there is a NAAQS for SO2 and NO2 1-hour impacts from commissioning activities are only be compared to the CAAQS due to the infrequent nature of the commissioning activities.
3. $NO_2$ modeling for commissioning was conducted with the PVMRM algorithm.

CO = carbon monoxide
$NO_2$ = nitrogen dioxide
$PM_{10}$ = particulate matter less than 10 microns in diameter
$SO_2$ = sulfur dioxide
$\mu g/m^3$ = micrograms per cubic meter

# Appendix E-9

# Fumigation Modeling Results

**SCREEN3 Fumigation Modeling**

**Nocturnal Fumigation - Inversion Break-up Fumigation**

| Max model scenario from crit pollutants modeling | | Max Conc X/Q (ug/m^3/g/s) | Distance to max (m) | |
|---|---|---|---|---|
| NO2 1hr HRSG and coal dryer in startup 40% NG mode, TO startup, nitric acid plant on | HRSG max impact no fumigation simple terrain | 0.9827 | 1,100 | NO2 1hr HRSG Startup 40% NG mode Max Impact Scenario |
| | HRSG inversion Break-up Fumigation max impact | 0.9865 | 18,896 | |
| | Coal Dryer max impact no fumigation simple terrain | 4.1410 | 900 | NO2 1hr Coal Dryer Startup 40% NG mode Max Impact Scenario |
| | Coal Dryer Inversion Break-up Fumigation max impact | 2.0100 | 10,783 | |
| | TAIL TO max impact no fumigation simple terrain | 6.5320 | 700 | NO2 1hr Tail Gas Thermal Oxidizer Startup Max Impact Scenario |
| | TAIL TO Inversion Break-up Fumigation max impact | 6.2710 | 4,785 | |
| | Nitric Acid Plant max impact no fumigation simple terrain | 6.2610 | 713 | NO2 1hr Nitric Acid Plant |
| | Nitric Acid Plant max impact no fumigation simple terrain | 6.3410 | 4,787 | |
| SO2 1hr HRSG startup 80% natural gas mode, coal dryer normal emissions mix, TO startup | HRSG no fumigation simple terrain | 0.9783 | 1,100 | SO2 1hr HRSG Startup 80% NG mode Max Impact Scenario |
| | HRSG inversion Break-up Fumigation max impact | 0.9620 | 19,252 | |
| | Coal Dryer max impact no fumigation simple terrain | 2.6240 | 1,000 | SO2 1hr Coal Dryer Normal Ops mode |
| | Coal Dryer Break-up Fumigation max impact | 1.5430 | 13,219 | |
| | TAIL TO max impact no fumigation simple terrain | 6.5320 | 700 | SO2 1hr Tail Gas Thermal Oxidizer Startup Max Impact Scenario |
| | TAIL TO Inversion Break-up Fumigation max impact | 6.2710 | 4,785 | |
| CO 1hr HRSG shutdown 20% load NG mode, no coal dryer, TO normal process vent | HRSG max impact no fumigation simple terrain | 0.9777 | 1,100 | CO 1hr HRSG Shutdown 20% NG mode Max Impact Scenario |
| | HRSG inversion Break-up Fumigation max impact | 0.9590 | 19,298 | |
| | TAIL TO max impact no fumigation simple terrain | 6.5320 | 700 | CO 1hr Tail Gas Thermal Oxidizer normal process vent |
| | TAIL TO Inversion Break-up Fumigation max impact | 6.2710 | 4,785 | |

Since the peak impacts occur at different locations the peak concentrations predicted from fumigation of all together sources will be greatly overpredicted.

| | Emission Rate (g/s) | Xf = 1 hour fumigation conc (ug/m3) | X1 = 1 hour no fumigation conc (ug/m3) | Predicted conc for averaging time (ug/m3) | Background conc (ug/m3) | Total model + background conc (ug/m3) | |
|---|---|---|---|---|---|---|---|
| **NO2 1 hr** | | | | | | | |
| HRSG startup | 13.5064 | **13.324** | 13.273 | 13.32 | | | |
| COAL DRYER startup | 1.9064 | 3.832 | 7.894 | 7.89 | | | |
| TAIL_TO startup | 2.8123 | 17.636 | 18.370 | 18.37 | | | **NO OLM** |
| NITRIC ACID PLANT | 0.5260 | **3.336** | 3.294 | 3.34 | | | |
| | | | | 42.92 | 140 | 183 | |
| **SO2 1 hr** | | | | | | | |
| HRSG Startup natural gas mode | 0.5984 | 0.576 | 0.585 | 0.59 | | | |
| COAL DRYER normal operations mode | 0.1180 | 0.182 | 0.310 | 0.31 | | | |
| TAIL_TO startup | 0.2726 | 1.709 | 1.780 | 1.78 | | | |
| | | | | 2.68 | 42 | 45 | |
| **CO 1 hr** | | | | | | | |
| HRSG Shutdown 20% CTG load on NG no Coal Dryer | 285.9802 | 274.255 | 279.603 | 279.60 | | | |
| TAIL_TO normal process vent | 0.3276 | 2.054 | 2.140 | 2.14 | | | |
| | | | | 281.74 | 4581 | 4863 | |

for **2** cases the Xf is more than X1, therefore fumigation must be considered

Scenarios match worst case criteria pollutant modeling

**Assumptions**

Average annual temp: 63.4 F daily average Buttonwillow, WRCC AFC Table 5.1-2
Flat terrain only
No downwash
Add max impacts from all sources regardless of location, conservative
Distance to nearest fenceline:
HRSG: 454 m
Coal Dryer: 514 m
Thermal Oxidizer: 618 m
Nitric Acid Plant: 713 m
Closest receptor for each source are the distances above, plus receptors out to 10 km with receptor spacing every 100 m from fenceline receptor to 3 km, and every 500 m from 3 km to 10 km.

# Appendix E-10

# Offset Package

## HECA EMISSION REDUCTION CREDIT PACKAGE SUMMARY

Section 4.5.3 of San Joaquin Valley Air Pollution Control District (SJVAPCD) Rule 2201 requires a project with operational emissions of nonattainment pollutants and precursors above specific thresholds to provide offsets as mitigation for net emissions increases resulting from the Project, unless otherwise exempt from the offset requirement. Applicable thresholds are 10 tons per year (tpy) of nitrogen oxide ($NO_X$) or volatile organic compounds (VOC), 100 tpy of carbon monoxide (CO), 14.6 tpy of particulate matter less than 10 microns in diameter ($PM_{10}$), 100 tpy of particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and 27.375 tpy of sulfur oxides ($SO_X$). In the case of the Project, offsets will not be required for CO per Section 4.6.1 of SJVAPCD Rule 2201, "Emission Offsets shall not be required for the following: Increases in carbon monoxide in attainment areas if the applicant demonstrates to the satisfaction of the APCO, that the Ambient Air Quality Standards are not violated in the areas to be affected, and such emissions will be consistent with Reasonable Further Progress, and will not cause or contribute to a violation of Ambient Air Quality Standards." Modeling results presented in Section 5.1, Air Quality, of the Application for Certification (AFC) Amendment provide this demonstration for carbon monoxide. Thus, CO offsets are not proposed.

Emissions of $PM_{2.5}$ are less than the SJVAPCD offset threshold; therefore, emissions reduction credits (ERCs) are not required for $PM_{2.5}$.

To demonstrate compliance with SJVAPCD rules, the Project is required to provide emission offsets in the form of ERCs equal to increases in gross emissions of $NO_X$, $SO_X$, $PM_{10}$, and VOCs that will result from the operation of the Project, minus the specified thresholds. As discussed below, the Project proposes to further mitigate emissions of these pollutants beyond applicable offset requirements by offsetting the full amount of the Project net emission increase.

SJVAPCD Rule 2201 Section 4.8 specifies distance ratios that must be applied in determining the quantity of ERCs to be provided for a new source. If the location of the offsetting emission reduction is less than 15 miles from the new source, the ratio for a major source is 1.3 to 1. If the location of the offsetting emission reduction is 15 miles or more from the new source, the applicable offset ratio is 1.5 to 1. In the case of the Project, the VOC ERCs procured resulted from an emission reduction less than 15 miles from the Project Site, and a factor of 1.3 was applied. For all other pollutants for which offsets are required, the location of the emission reduction resulting in the ERC is greater than 15 miles from the Project Site, and a factor of 1.5 was applied.

The Project will use $SO_X$ ERCs to offset $PM_{10}$ emissions on an inter-pollutant basis. The SJVAPCD has developed an inter-pollutant trading ratio for $SO_X$ to $PM_{10}$ of 1:1 and concluded that this is protective of managing regional particulate matter impacts and progress towards attainment.

Based on operational emissions data presented in Section 5.1, Air Quality, and applying the appropriate ratios, the calculation of offsets is presented in Table E-10-1. HECA has procured sufficient ERCs to satisfy these offset requirements. The ERCs that have been procured are detailed in Table E-10-2.

**Table E-10-1. Emission Reduction Credits Determination**

| | $NO_X$ | $SO_X$[2] | $PM_{10}$ | $PM_{2.5}$[3,4] | CO | VOC[5] |
|---|---|---|---|---|---|---|
| Gross Emissions, lb/yr [1] | 327,400 | 58,780 | 180,700 | 160,340 | 550,380 | 70,800 |
| **SJVAPCD Requirements** | | | | | | |
| Offset Threshold Levels per Section 4.5.3 of DR2201, lb/yr | 20,000 | 54,750 | 29,200 | 200,000 | 200,000 | 20,000 |
| Required ERCs, lb/yr | 307,400 | 4,030 | 151,500 | -39,660 | 350,380 | 50,800 |
| Offsets Triggered? | yes | yes | yes | no | no[6] | yes |
| Offset Ratio (1:X) | 1.5 | 1.5 | 1.5 | NA | NA | 1.3 |
| Required ERCs, lb/yr | 461,100 | 6,045 | 227,250 | 0 | 0 | 66,040 |
| ERCs in Possession, lb/yr | 522,400 | 266,000 | 0 | 0 | 0 | 77,498 |
| Inter-pollutant offset, lb/yr | – | -236,000 | 236,000 | – | – | – |
| ERCs Surplus/(Needed), lb/yr | 61,300 | 23,955 | 8,750 | – | – | 11,458 |
| **Additional Mitigation** | | | | | | |
| Required ERCs, lb/yr | 327,400 | 58,780 | 180,700 | 0 | 0 | 70,800 |
| ERCs in Possession, lb/yr | 522,400 | 266,000 | 0 | 0 | 0 | 77,498 |
| Inter-pollutant offset, lb/yr | – | -192,000 | 192,000 | – | – | – |
| ERCs Surplus/(Needed), lb/yr | 195,000 | 15,220 | 11,300 | – | – | 6,698 |

1 = Gross emissions include emissions from the exempt emergency generators and fire pumps; therefore, for SJVAPCD, less ERCs would be required.

2 = Ratio of 1:1 used to apply $SO_x$ certificates to $PM_{10}$ emissions

3 = Major Source of $PM_{2.5}$ is defined as 100TPY as of July 15, 2008

4 = Federal and SJVAPCD NSR offset trigger for $PM_{2.5}$ emissions is 100 TPY.

5 = Ratio of 1:1.3 used for VOCs, because source of VOC ERCs is within 15 miles of HECA project

6 = per Section 4.6.1 of DR2201, "Emission Offsets shall not be required for the following: Increases in carbon monoxide in attainment areas if the applicant demonstrates to the satisfaction of the APCO, that the Ambient Air Quality Standards are not violated in the areas to be affected, and such emissions will be consistent with Reasonable Further Progress, and will not cause or contribute to a violation of Ambient Air Quality Standards."

**Table E-10-2. ERCs Procured by HECA**

| Source | Address | Method of Reduction | ERC Certificate Number | Pollutant | lbs/yr |
|---|---|---|---|---|---|
| Big West of California, LLC | 6500 Refinery Ave, Bakersfield, CA Section: NE27, Township: 29S, Range: 27E | Shutdown of Catalytic Cracker, Fluid Cocker, and CO Boiler | S-3273-2 | $NO_X$ | 482,000 |
| | 6451 Rosedale Hwy, Area I, Bakersfield, CA Section: NE27, Township: 29S, Range: 27E | Shutdown of Tail Gas Incinerator, 2007027A | S-3275-5 | $SO_X$ | 168,000 |
| Aer Glan Energy LLC | 20807 Stockdale Hwy, Bakersfield, CA Section: NE06, Township: 30S, Range: 26E | Shutdown of Entire Stationary Source | S-3605-1 | VOC | 31,748 |
| | | | S-3557-1 | VOC | 45,750 |
| G.I.C. Financial Services, Inc. | 11535 E Mountain View Ave., Kingsburg, CA | Install Selective Catalytic Reduction, SCR, and Scrubber and convert from fuel oil to natural gas | C-1058-2 | $NO_X$ | 40,400 |
| | | | C-1058-5 | $SO_X$ | 98,000 |

# Appendix E-11

# Criteria Pollutant BACT Analysis

# BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS

# HYDROGEN ENERGY CALIFORNIA PROJECT
# KERN COUNTY, CALIFORNIA

*Prepared For:*

San Joaquin Valley Air Pollution Control District

California Energy Commission

U.S. Environmental Protection Agency Region IX

*Prepared on behalf of*

**Hydrogen Energy California LLC**

April 2012

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# 1.0 APPLICABLE REGULATIONS

Federal requirements pertaining to control of pollutants subject to PSD review (i.e., attainment pollutants) were promulgated by the U.S. Environmental Protection Agency (USEPA) in 40 Code of Federal Regulations (CFR) 42.21 (j). This regulation defines Best Available Control Technology (BACT) as emission limits "based on the maximum degree of reduction for each pollutant." BACT determinations are made on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs.

Federal requirements pertaining to control of non-attainment pollutants, or Lowest Achievable Emission Rate (LAER), were promulgated by USEPA under 40 CFR 51.165 (a). This regulation defines LAER as the emissions limit based on either (1) the most stringent emission rate contained in a State Implementation Plan (SIP), unless the [source] demonstrates the rate is not achievable; or (2) the most stringent emissions limitation that is achieved in practice. The federal LAER does not consider the cost impacts of control.

BACT must be applied to any new or modified source resulting in an emissions increase exceeding any San Joaquin Valley Air Pollution Control District (SJVAPCD) BACT threshold. SJVAPCD Rule 2201 requires HECA to apply BACT to any source that has an increase in emissions of oxides of nitrogen ($NO_X$), volatile organic compounds (VOC), sulfur dioxide ($SO_2$), carbon monoxide (CO), and particulate matter equal to or less than 10 microns in diameter ($PM_{10}$) (criteria pollutants) in excess of 2.0 pounds per highest day. BACT for the applicable pollutants was determined by reviewing the SJVAPCD BACT Guidelines Manual, the South Coast Air Quality Management District BACT Guidelines Manual, the most recent Compilation of California BACT Determinations, CAPCOA (2nd Ed., November 1993), and USEPA's BACT/LAER Clearinghouse.

This analysis provides a BACT review for the proposed HECA Project emission sources of $NO_X$, CO, VOC, $PM_{10}$ and $SO_2$.

The Combined Cycle Power Block will generate approximately 405 megawatts (MW) of gross power and will provide a nominal 300 MW of low-carbon baseload electricity to the grid during operations. The basis for the emissions-related analyses is annual average operation at a design capacity of approximately 405 MW of gross power. The Manufacturing Complex is designed for annual production of approximately 1 million tons of nitrogen-based product. The proposed Project as currently configured will involve the following major processes and emission units that require BACT review for the above-mentioned criteria pollutants:

- One hydrogen-rich fuel and/or natural gas–fired Combustion Turbine Generator (CTG) with Heat Recovery Steam Generator (HRSG) and one Steam Turbine-Generator (STG)
- One Multi-cell, Mechanical-draft Cooling Tower for the Combined-Cycle Power Block
- One Multi-cell, Mechanical-draft Cooling Tower for the Air Separation Unit
- One Multi-cell, Mechanical-draft Cooling Tower for the Gasification Block
- One Auxiliary Boiler
- Solid Feedstock Receiving and Handling System

- Gasification Block, including an Elevated Gasification Flare
- Coal Dryer
- Sulfur Recovery System (Tail Gas Thermal Oxidizer and two elevated flares with natural gas assist)
- Two Emergency, Diesel-Engine Generators
- One Diesel-Engine Fire-water Pump
- One carbon dioxide ($CO_2$) vent stack
- Ammonia Synthesis Unit preheater
- Urea Unit – Absorber Stacks and Pastillation Unit
- Nitric Acid Unit
- Ammonium Nitrate Unit
- Fugitive emissions

Section 2 of the CEC AFC Amendment provides a complete description of the Project indicating the layout of the major components within the site, and general discussion of the Project components.

## 2.0 BACT REVIEW PROCESS

BACT is defined in the PSD regulations as:

> *"... an emission limitation based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any proposed major stationary source ... which [is determined to be achievable], on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs" [40 CFR 52.21(b)(12)].*

In a December 1, 1987 memorandum from the USEPA Assistant Administrator for Air and Radiation, the agency provided guidance on the "top-down" methodology for determining BACT. The "top-down" process involves the identification of all applicable control technologies according to control effectiveness. Evaluation begins with the "top," or most stringent, control alternative. If the most stringent option is shown to be technically or economically infeasible, or if environmental impacts are severe enough to preclude its use, then it is eliminated from consideration, and the next most stringent control technology is similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by technical or economic considerations, energy impacts, or environmental impacts. The top control alternative that is not eliminated in this process becomes the proposed BACT basis.

This top-down BACT analysis process can be considered to contain five basic steps, described below (from the USEPA's Draft New Source Review Workshop Manual, 1990).[1]

Step 1. Identify all available control technologies with practical potential for application to the specific emission unit for the regulated pollutant under evaluation.

[1] "New Source Review Workshop Manual," DRAFT October 1990, USEPA Office of Air Quality Planning and Standards

Step 2. Eliminate all technically infeasible control technologies.

Step 3. Rank remaining control technologies by control effectiveness and tabulate a control hierarchy.

Step 4. Evaluate most effective controls and document results.

Step 5. Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

Formal use of these steps is not always necessary. However, the USEPA has consistently interpreted the statutory and regulatory BACT definitions as containing two core requirements, which USEPA believes must be met by any BACT determination, irrespective of whether it is conducted in a "top-down" manner. First, the BACT analysis must include consideration of the most stringent available technologies, i.e., those that provide the "maximum degree of emissions reduction."

Second, any decision to require a lesser degree of emissions reduction must be justified by an objective analysis of "energy, environmental, and economic impacts" contained in the record of the permit decisions.

Additionally, the minimum control efficiency to be considered in a BACT analysis must result in an emission rate no less stringent than the applicable New Source Performance Standard (NSPS) emission rate, if any NSPS standard for that pollutant is applicable to the source.

This BACT analysis was conducted in a manner consistent with this stepwise approach. Control options for potential reductions in criteria pollution emissions were identified for each source. These options were identified by researching the USEPA database known as the RACT/BACT/LAER/ Clearinghouse (RBLC), drawing upon previous environmental permitting experience for similar units and surveying available literature. Available controls that are judged to be technically feasible are further evaluated based on an analysis of economic, environmental, and energy impacts.

Assessing the technical feasibility of emission control alternatives is discussed in USEPA's draft "New Source Review Workshop Manual." Using terminology from this manual, if a control technology has been "demonstrated" successfully for the type of emission unit under review, then it would normally be considered technically feasible. For an undemonstrated technology, "availability" and "applicability" determine technical feasibility. An available technology is one that is commercially available, meaning that it has advanced through the following steps:

- Concept stage;
- Research and patenting;
- Bench-scale or laboratory testing;
- Pilot-scale testing;
- Licensing and commercial demonstration; and
- Commercial sales.

Suitability for consideration as a BACT measure involves not only commercial availability (as evidenced by past or expected near-term deployment on the same or similar type of emission unit), but also involves consideration of the physical and chemical characteristics of the gas stream to be controlled. A control method applicable to one emission unit may not be applicable to a similar unit, depending on differences in the gas streams' physical and chemical characteristics.

For this BACT analysis, the available control options were identified by querying the USEPA RBLC and by consulting available literature on control options for integrated gasification combined cycle (IGCC) and for nitrogen-based product sources. The analysis also involves review of currently permitted and operating IGCC and nitrogen-based products facilities.

## 3.0 PROJECT SOURCES SUBJECT TO BACT ANALYSIS

HECA will consist of several facility blocks/systems representing sources of regulated air pollutants that are addressed in this BACT analysis. These main "systems" are essentially the IGCC process, hydrogen production and power generation, and the Manufacturing Complex. To evaluate possible emission control technologies for the IGCC process, it is first important to understand the unique IGCC process and the supporting ancillary plant processes; additional descriptions of other permitted IGCC are provided in Section 5.0 for comparison. Section 6.0 describes the proposed BACT for each source. More detailed process descriptions for the various processes that make up the HECA Project are included in Chapter 2.0 the CEC AFC Amendment. The proposed BACT controls and associated emission rates for each emission unit are summarized in Table 3-1.

HECA includes a source unique to power generation facilities operating at this time – a CTG equipped to combust synthesis gas (syngas). It is important to emphasize that BACT for this source is based on the "best of class" in current diffusion combustor-based syngas fired gas turbine technology. The emissions profile contained in this application for this source is as good as or better than other syngas IGCC permitted to date, as discussed later in this section. However, the IGCC BACT level emissions should not be compared to the NGCC gas turbine technology using dry low-$NO_X$ burner technology emission levels.

**Table 3-1**
**Proposed BACT for Project**

| Pollutant | Technology | Emission Limit |
|---|---|---|
| **CTG/HRSG Combustion Turbine (excluding Startup/Shutdown conditions)** | | |
| $NO_X$ | Diluent Injection, Selective Catalytic Reduction (SCR), Limited operation on natural gas | 2.5 ppm $NO_X$ at 15% $O_2$ on hydrogen-rich fuel, 3-hour average |
| | | 4 ppm $NO_X$ at 15% $O_2$ on natural gas fuel, 3-hour average |
| CO | Good Combustion Practice (GCP), CO Catalyst, Limited operation on natural gas | 3 ppm CO at 15% $O_2$ on hydrogen-rich fuel, 3-hour average |
| | | 5 ppm CO at 15% $O_2$ on natural gas fuel, 3-hour average |

**Table 3-1**
**Proposed BACT for Project**

| Pollutant | Technology | Emission Limit |
|---|---|---|
| $PM/PM_{10}$ | GCP, Gas Cleanup, Gaseous Fuels, pipeline quality natural gas | 15 lb/hr on hydrogen-rich fuel and natural gas fuel |
| $SO_2$ | Hydrogen-rich Gas cleanup, pipeline quality natural gas | ≤ 2 ppmv total sulfur in hydrogen-rich syngas,<br>≤ 10 ppmv total sulfur in PSA off-gas |
| | | ≤ 0.75 grain/100 SCF (12.65 ppm for natural gas) |
| VOC | CO Catalyst, Limited operation on natural gas | 1 ppm VOC at 15% $O_2$ on hydrogen-rich fuel, 3-hour average |
| | | 2 ppm VOC at 15% $O_2$ on natural gas fuel, 3-hour average |
| $NH_3$ | SCR | 5 ppm $NH_3$ slip on hydrogen-rich fuel and natural gas fuel |
| Coal Dryer | | |
| $PM/PM_{10}$ | Baghouse | 0.001 grain/scf outlet dust loading |
| Cooling Towers | | |
| $PM/PM_{10}$ | High Efficiency Drift Eliminators, Total Dissolved Solids (TDS) limit in circulating water, and Good Operating Practice | 0.0005 % drift as percent of the circulating water |
| Auxiliary Boiler, Natural Gas 213 MMBTU/hr | | |
| $NO_X$ | Low-$NO_X$ burner and SCR | 5 ppm $NO_X$ at 3% $O_2$ |
| CO | GCP, annual tune-up | 50 ppmvd at 3% $O_2$ |
| $PM/PM_{10}$ | GCP, PUC grade natural gas fuel | 0.005 lb/MMBtu heat input |
| $SO_2$ | | 0.00285 lb/MMBtu (12.65 ppm for natural gas) |
| VOC | | 0.004 lb/MMBtu heat input |
| $NH_3$ | SCR | 5 ppm $NH_3$ slip natural gas fuel |
| Emergency Diesel Engines (2 Emergency Generators; 2,922 hp each) | | |
| $NO_X$ | Certified EPA Tier 4 diesel engine, combustion controls, restricted operating hours, Low Sulfur Diesel fuel | 0.5 g/bhp/hr |
| CO | | 2.6 g/bhp/hr |
| $PM/PM_{10}$ | | 0.07 g/bhp/hr |
| $SO_2$ | | Very Low Sulfur Diesel fuel (15 ppmw or less) |
| VOC | | 0.3 g/bhp/hr |

**Table 3-2**
**Proposed BACT for Project (Continued)**

| Pollutant | Technology | Emission Limit |
|---|---|---|
| Emergency Diesel Engine (Fire Pump; 565 hp) | | |
| $NO_X$ | Certified EPA Tier 4 diesel engine, combustion controls, restricted operating hours, Low Sulfur Diesel fuel | 1.5 g/bhp/hr |
| CO | | 2.60 g/bhp/hr |
| $PM/PM_{10}$ | | 0.015 g/bhp/hr |
| $SO_2$ | | Very Low Sulfur Diesel fuel (15 ppmw or less) |
| VOC | | 0.14 g/bhp/hr |

**Table 3-2**
**Proposed BACT for Project (Continued)**

| Pollutant | Technology | Emission Limit |
|---|---|---|
| Gasification Flare | | |
| $NO_X$, CO, $PM/PM_{10}$, $SO_2$ | GCP, gaseous fuel only, Gas cleanup/Limit on reduced sulfur in hydrogen-rich fuel | |
| VOC | GCP, gaseous fuel only, flare gas recovery system for non-emergency releases, VOC destruction of ≥ 98.5% | |
| Rectisol® Flare | | |
| $NO_X$, CO, $PM/PM_{10}$, $SO_2$ | GCP, gaseous fuel only, flare gas recovery system for non-emergency releases, gas cleanup/limit on reduced sulfur in syngas | |
| VOC | GCP, gaseous fuel only, flare gas recovery system for non-emergency releases, VOC destruction of ≥ 98.5% | |
| SRU Flare (Sulfur Recovery System) | | |
| $NO_X$, CO, $PM/PM_{10}$ | GCP, gaseous fuel only, flare gas recovery system for non-emergency releases | |
| $SO_2$ | Caustic Scrubber | |
| VOC | GCP, gaseous fuel only, flare gas recovery system for non-emergency releases, VOC destruction of ≥ 98.5% | |
| Thermal Oxidizer (Sulfur Recovery System) (excluding Startup/Shutdown conditions) | | |
| $NO_X$ | GCP | 0.24 lb/MMBtu |
| CO | | 0.20 lb/MMBtu |
| $PM/PM_{10}$ | | 0.0076 lb/MMBtu |
| $SO_2$ | GCP, Gas cleanup to ≤ 10 ppmw $H_2S$ | 2 lb/hr process vent gas |
| VOC | GCP | 0.0055 lb/MMBtu |
| $CO_2$ Vent | | |
| CO | Gas Cleanup, restricted operating hours | 1,000 ppmv |
| VOC | | 40 ppmv |
| $H_2S$ | Acid Gas Removal | 10 ppmv |
| Feedstock | | |
| $PM/PM_{10}$ | Dust Collector, adequate moisture to prevent visible emissions in excess of 5% opacity | 0.005 grain/scf outlet dust loading |
| Ammonia Plant Heater, Natural Gas 55 MMBtu/hr | | |
| $NO_X$ | Low-$NO_X$ burner, limited operation | 9 ppm $NO_X$ at 3% $O_2$ |
| CO | GCP, annual tune-up | 50 ppmvd at 3% $O_2$ |
| $PM/PM_{10}$ | GCP, PUC grade natural gas fuel | 0.005 lb/MMBtu heat input |
| $SO_2$ | | 0.00285 lb/MMBtu (12.65 ppm for natural gas) |
| VOC | | 0.004 lb/MMBtu heat input |
| Urea HP Absorber | | |
| $NH_3$ | Wet scrubber | 11.1 lb/hr |
| Urea LP Absorber | | |
| $NH_3$ | Wet scrubber | 2.0 lb/hr |
| Urea Pastillation | | |
| $PM/PM_{10}$ | Baghouse | 0.001 grain/dscf |
| Nitric Acid Plant | | |

**Table 3-2**
**Proposed BACT for Project (Continued)**

| Pollutant | Technology | Emission Limit |
|---|---|---|
| $NO_X$ | SCR | 0.2 lb/ton (15 ppmv in vent gas) |
| $NH_3$ | SCR | 5 ppm $NH_3$ slip |
| Ammonium Nitrate Plant | | |
| $PM/PM_{10}$ | Wet scrubber | 0.2 lb/hr |
| Fugitives | | |
| VOC | LDAR, leak detection for valves and connectors with VOC > 100 ppmv above background, and for pumps and compressor seals with VOC > 500 ppmv above background | Varies |

Source: HECA Project.

Notes:
BACT = best available control technology
CO = carbon monoxide
CPUC = California Public Utility Commission
CTG = combustion turbine generator
FGR = flue gas recirculation
GCP = good combustion practice
LDAR = leak detection and repair
MMBtu = million British thermal units
$NH_3$ = ammonia
$NO_X$ = nitrogen dioxide
$O_2$ = oxygen
$PM/PM_{10}$ = particulate matter/particulate matter less than 10 microns
ppm = parts per million
ppmvd = parts per million volumetric dry
SCF = standard cubic feet
SCR = selective catalytic reduction
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

## 4.0 CONSIDERATION OF ALTERNATIVE GENERATING TECHNOLOGY

This section addresses recent guidance relating to the need for consideration of alternative electrical generating technologies for the proposed Project, as part of the BACT analysis. Compared to pulverized coal (PC)-fired boilers and circulating fluidized bed (CFB) boilers, the proposed IGCC process is the very lowest emitting solid fuel-based electricity generating technology available, and selection of a completely different solid fuel-based generating technology would not result in lower emissions. Later portions of this BACT analysis address the specific controls that are proposed to minimize the emissions from the proposed IGCC process. In addition, Section 5.0 provides descriptions of other permitted IGCC facilities for more in-depth comparison.

The first step in a BACT determination process is to identify all available control technologies that could potentially be used to minimize the emissions of the source and pollutant under evaluation. The most common control technologies considered in a BACT analysis are add-on control measures and inherent process characteristics that minimize generation of pollutants, in addition to process or work practice modifications to improve the emissions performance of a proposed Project. These types of process modifications/measures, when applicable, are properly considered in a BACT analysis.

In contrast, consideration of alternatives that would involve completely “redefining the design” of the proposed process are not required to be considered (1990 Draft New Source Review Workshop Manual, Section IV.A.3). Alternative generating processes, such as natural-gas–fired combined-cycle plants, represent a completely different family of power generation plant designs from IGCC. Although there are certain types of components in common, such as cooling towers and steam-driven turbine generators, the technical basis for a gas-fired plant differs markedly from that of an IGCC facility.

Because CFB or PC boilers or a natural-gas–fired electrical generating plant would be a completely different process, and represent “redefining the design” compared to IGCC, it is reasonable to conclude that the USEPA would not require that the BACT analysis for HECA compare these different technologies. This point was reinforced in a December 13, 2005 letter from Stephen Page, Director of the USEPA’s OAQPS, to E3 Consulting, LLC regarding BACT requirements for proposed coal-fired power plant projects. In that letter, the USEPA clarified that a BACT analysis need not consider an alternative “which would wholly replace the proposed facility with a different type of facility.” Some specific cases regarding alternative design and project definitions are discussed below in Section 4.1. The decisions in these cases provide additional clarity for excluding alternative technologies that redefine the source from BACT procedures for this Project. Section 4.2 gives more details regarding the HECA source and purpose, providing further justification for excluding alternative technologies from this BACT analysis.

## 4.1 Case Studies for Alternative Technology Methodology and Applicability to HECA Project

Desert Rock Energy Company LLC proposed to build a 1,500 MW coal-fired electric generating facility in New Mexico. USEPA Region 9 issued a final PSD permit on July 31, 2008, which was appealed by four different parties. On September 24, 2009, the U.S. Environmental Appeals Board issued a remand, both granting the Region's request for a voluntary remand, as well as remanding for BACT review to consider IGCC technology as an alternative process/control technology. (*In re: Desert Rock Energy Company, LLC, PSD Appeal Nos. 08-03 et al. (September 24, 2009) ["Desert Rock."])*

The Desert Rock decision stated that "the Region abused its discretion in declining to consider IGCC as a potential control technology in step 1 of its BACT analysis for the facility. Although the Region has broad discretion in determining whether imposition of a control technology would "redefine the source," the Board concludes that, based on the administrative record for this case, the Region's analysis is inadequate for two reasons. First, the Region did not provide a rational explanation of why IGCC would redefine the source, especially when the applicant itself had indicated in its initial application that IGCC was a technology that could be considered for the facility (i.e., could satisfy its business purpose), thereby suggesting that IGCC would not redefine the source. Second, the Region failed to adequately explain its conclusion in light of previously issued federal permits at similar facilities in which IGCC *had* been considered as a BACT step 1 production process and had not been considered a "redefinition of the source."

The Desert Rock project's failure to consider IGCC as an alternate technology is not directly relevant to the HECA Project's BACT analysis, because HECA is already proposing an IGCC, and has in fact, proposed to go even further than a traditional IGCC. Traditional IGCCs burn syngas containing large quantities of both hydrogen and CO. In contrast, HECA is achieving similar or lower criteria emissions while significantly reducing greenhouse gas (GHG) emissions by the removal and sequestration of the carbon pre-combustion, and burning a hydrogen-rich syngas instead. [Note: GHG BACT is addressed in a separate GHG BACT document, and is only mentioned here as part of the alternative technology discussion.]

Nevertheless, the Desert Rock decision is instructive in that it provides a framework for determining if a particular technology "redefines the source". Specifically, the Board articulated the proper test to be used to answer that question. As the Board explained, the permit applicant initially "defines the proposed facility's end, object, aim, or purpose— that is the facility's basic design…." The inquiry, however, does not end there. The permit issuer should take a "hard look" at the applicant's determination in order to discern which design elements are inherent for the applicant's purpose and which design elements "may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility," while keeping in mind that BACT, in most cases, should not be applied to regulate the applicant's purpose or objective for the proposed facility."

In a sense, HECA is adhering to the Desert Rock decision by proposing an IGCC-based plant with coal and petcoke as feedstock, rather than a conventional coal boiler. In addition, the

Project goes even further than traditional IGCC, which burn the syngas containing both hydrogen and CO. HECA will remove the majority of the carbon (present in the syngas as CO or $CO_2$) and will fuel the combustion turbine with a hydrogen-rich syngas which drastically reduces $CO_2$ emissions.

USEPA issued similar guidance regarding what needs to be included in a BACT analysis in their December 15, 2009 response to objections raised by petitioners to the Cash Creek Generation LLC project in Kentucky, and objected to the permit issued by the Kentucky Department of Air Quality (KY DAQ) for a 770 MW IGCC plant proposed for Cash Creek, Kentucky (*In the Matter of Cash Creek Generation, LLC, Henderson, Kentucky*, Petition Nos. IV-2008-1 and IV-2008-2 ["*Cash Creek*"]). One of the reasons for objection was that KY DAQ did not adequately justify their lack of consideration of the use of natural gas as an alternative in the BACT analysis. USEPA pointed out that a BACT analysis should normally consider the use of "clean fuels" unless such an option is not "available" or would fundamentally redefine the design of the source. The USEPA maintained that KY DAQ did not provide sufficient justification and a reasoned basis as to why the use of natural gas would "redefine the source." In this decision, USEPA references and repeats the same analytical framework described above in the Desert Rock decision (i.e., evaluate proposed facility purpose and evaluate which design elements are inherent to that purpose).

The USEPA specifically stated that they were not indicating the proposed emission limits did not represent BACT, "only that the present permit record does not provide a sufficient rationale to demonstrate the adequacy of the BACT determinations for this facility."

This aspect of the Cash Creek situation is somewhat analogous to HECA's. In both cases, the applicant is proposing use of solid feedstocks and syngas fuels, and the USEPA has questioned the possible need to consider natural gas as an alternative. However, the USEPA very clearly states that its objection to the Cash Creek permit does not indicate that the use of natural gas is BACT. The USEPA states in the *Cash Creek* decision (emphasis added):

> "EPA's conclusion here… should in no way be interpreted as EPA expressing a policy preference for construction of natural-gas fired facilities over IGCC facilities to generate electricity. EPA supports the development and use of a broad range of technologies across the energy sector including those that will enable the sustainable use of coal. **The deployment of lGCC technology is one of the important technologies and a positive strategy to reduce emissions from coal-fired electricity generation. Technology that enables the United States to use its appreciable reserves of coal in an environmentally sustainable manner is critical to achieving the goals of the PSD program and maintaining compliance with the NAAQS by reducing conventional air pollutants**...This Order should not be interpreted to establish or imply an EPA position that PSD permitting authorities should conclude, under all circumstances, that BACT for a proposed electricity generating unit is firing such a unit with natural gas" (*Cash Creek*, pg. 9).

Another relevant Environmental Appeals Board (EAB) decision worth noting is *Prairie State* (*In re Prairie State Generating Company*, PSD Appeal No. 05-05 [August 24, 2006) "*Prairie State*]). EAB concluded in the *Prairie State* decision that the basic design of the proposed power plant at issue there was to generate electricity using solely coal originating from a coal mine at which the power plant was to be located (i.e., mine-mouth plant). Given this basic design, the EAB stated that requiring the applicant and the state permit agency to consider the use of *another source of coal*—specifically, low-sulfur western coal—in the BACT analysis for the plant would constitute redesigning the source.

This Prairie State decision shows that where there is a legitimate business purpose to using a particular fuel source, use of another cleaner fuel source is not necessarily required to be considered if the alternative fuel would be incompatible with the basic design and purpose of the proposed facility.

To summarize, in these recent USEPA decisions, the following analytical framework is provided to evaluate whether an option may be excluded from a BACT analysis because it redefines the proposed source:

- First, the permitting authority should determine from the particular record how the permit applicant defines the proposed facility's end, object, aim, or purpose (the "basic" or "fundamental" design of the facility).
- The next step is for the permitting authority to take a "hard look" at the applicant's purpose to discern which design elements are inherent for the applicant's purpose and which design elements may be changed to achieve pollutant emissions reductions without disrupting the applicant's basic business purpose for the proposed facility.
- As part of the latter step, the permitting authority should keep in mind that BACT, in most cases, should not be applied to regulate the applicant's purpose or objective for the proposed facility.

## 4.2 Purpose and Design of HECA as Applied to BACT Alternative Technology Methodologies

The purpose of the Project is not merely the generation of electricity. As identified in other areas of the application, the three key interrelated elements of the Project design and purpose can be summarized as follows:

- Use of solid carbon feedstocks (petcoke and/or coal) to produce low-emission electricity;
- Generation of hydrogen for low-carbon electricity and nitrogen-based products in an integrated Manufacturing Complex; and
- Capture of $CO_2$ for reduced GHG emissions and transporting $CO_2$ for use in enhanced oil recovery (EOR).

The design and purpose of the Project is outlined below and presented in detail in the AFC Amendment (2012).

The Project will gasify a 75 percent coal and 25 percent petroleum coke (petcoke) fuel blend to produce synthesis gas (syngas). Syngas produced via gasification will be purified to hydrogen-rich fuel, which will be used to generate low-carbon baseload electricity in a Combined Cycle Power Block, low-carbon nitrogen-based products in an integrated Manufacturing Complex, and carbon dioxide ($CO_2$) for use in enhanced oil recovery (EOR).

The products and power produced by the Project have a lower carbon footprint than similar products. This low-carbon footprint is accomplished by capturing more than 90 percent of the $CO_2$ in the syngas and transporting $CO_2$ for use in EOR, which results in simultaneous sequestration (storage) of the $CO_2$ in a secure geologic formation. $CO_2$ will be transported for use in EOR in the adjacent Elk Hills Oil Field (EHOF), which is owned and operated by Occidental of Elk Hills, Inc. (OEHI). As discussed below, the OEHI EOR project will be separately permitted by OEHI through the Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR). The EOR process results in sequestration (storage) of the $CO_2$.

Project GHG emissions (e.g., $CO_2$) will be reduced through carbon capture and $CO_2$ EOR resulting in simultaneous sequestration.

The Project is owned by SCS Energy California LLC, with the prime objective of producing hydrogen for low-carbon polygeneration.

In addition, the Project has been selected as part of the Clean Coal Power Initiative (CCPI), a cost-shared collaboration between the federal government and private industry to increase investment in low-emission coal technology by demonstrating advanced coal-based power generation technologies prior to commercial deployment.

DOE’s purpose, aim, and goal in supporting the Project, as stated on the above referenced website, is: “to accelerate the development of advanced coal technologies with carbon capture and storage at commercial-scale. These projects will help to enable commercial deployment to ensure the United States has clean, reliable, and affordable electricity and power.”

DOE’s relevant stated goals for this cost sharing program are to:

- make progress toward a target $CO_2$ capture efficiency of 90 percent;
- make progress toward a capture and sequestration goal of less than 10 percent increase in the cost of electricity for gasification systems; and
- capture and sequester or put to beneficial use an amount of $CO_2$ emissions in excess of the minimum of 300,000 tons per year required by Clean Coal Power Initiative.

This evaluation predominantly presents how a change to natural gas fuel would be considered “redefining the design of the source” in the context of the source’s “design” being its “purpose”. The next few paragraphs discuss the actual physical/engineering design of the source (i.e., equipment types, processes, etc.) that would require “redesigning” to accommodate a change to natural gas as the primary fuel or feedstock.

A production process is typically defined in terms of its physical and chemical unit operations used to produce the desired product from a specified set of raw materials. The specified raw materials of the IGCC process are solid carbon feedstocks such as petcoke and coal. Many of the unit operations and processes that have been designed for HECA are specific to the use of coal/ petcoke feedstocks, and to the removal of sulfur and $CO_2$ from the syngas, and the production of nitrogen-based products from the hydrogen-rich syngas. Use of natural gas as a feed stock would require substantial re-design of the facility due to these processes. These include:

- Solid fuel handling systems and baghouses
- Gasifier
- Sour shift/gas cooling
- Mercury removal
- Acid gas removal
- Sulfur Recovery Unit and Tail Gas Treating Unit
- SRU, Gasification and Rectisol® Flares
- Air Separation Unit
- $CO_2$ Absorption and Compression
- $CO_2$ Pipeline (3.4 miles)
- Nitrogen-based product from syngas.

In addition, the combustion turbine used in this Project has been specifically designed by Mitsubishi to fire hydrogen-rich fuel. While it is capable of firing natural gas, different turbines/ burners would be used if natural gas were the primary fuel.

Based on the criteria previously discussed, and the general stated purposes of the Project, the following paragraphs analyze the various Project elements with an emphasis on their necessity and inherent inclusion in the basic Project design/purpose.

As detailed previously, there are three key interrelated elements of the Project design and purpose. Each of these elements is critical to the objectives of the Project and the design of the source. These are legitimate business goals, and are important to the Project sponsors. They are not incidental, but rather essential Project preferences. These goals preclude the use of natural gas, or the construction of a natural-gas combined cycle power plant as an alternative. Further discussion of these points is provided in the following paragraphs.

Coal and petcoke, a by-product of petroleum refining, are the raw materials integral to the process. They are historically cheaper (per British thermal unit) and more widely available in the United States than natural gas. The purpose of the Project is to use these traditional solid raw materials/fuels, which are readily-available, and demonstrate the generation of clean, low-carbon electricity and nitrogen based products. Although the electricity generation is an important revenue stream that helps support the economic justification for the Project, the goals of the Project will clearly not be achieved if the electricity is generated by the use of natural gas or other non-solid fuel. Likewise the use of natural gas would not qualify for funding or meet the objectives of DOE's Clean Coal Power Initiative.

Second, the Project intends to generate hydrogen for the production of electricity and nitrogen-based products. Hydrogen is one of the cleanest, purest fuels that can be combusted to generate electricity, especially in regards to GHG emissions. However, hydrogen use for this purpose has not yet been demonstrated in a large-scale application. This Project is revolutionary in the advancement of clean fuel production and electricity generation, as well as reduction of GHGs through low-carbon fuels. The Project will take the revolutionary step of producing clean gaseous hydrogen-rich fuel from some of the most abundant solid fuel resources in the U.S.: petcoke and coal. This hydrogen-rich fuel will be used for both the generation of electricity and production of nitrogen-based products. The production of hydrogen is a key element of the Project.

Third, the Project will demonstrate the capture of over 90 percent of the carbon from the fuel, prior to combustion in the turbines or use in the Manufacturing Complex. The simple combustion of natural gas for electricity generation would not achieve this goal. Likewise, the "gasification" of natural gas would be superfluous. The power generation portion of the Project, which uses syngas with the majority of the carbon removed prior to combustion, results in $CO_2$ emissions of approximately 400 pounds per megawatt hour (lb/MWh). This is less than half of the $CO_2$ emissions from a typical natural gas-fired simple cycle combustion turbine of 1,100 lb/MWh and easily complies with U.S. and California's stringent GHG emissions performance standard (EPS) for electricity generation of 1,000 and 1,100 lb/MWh, respectively. The $CO_2$ that is captured from the syngas will be used for sequestration and EOR in the Elk Hills Oil Field in San Joaquin Valley, California. This sequestration step is significant as a demonstration for the DOE funding, as well as integral to the financial objectives of the Project. The use of EOR to recover local petroleum reserves increases the United States' energy independence.

For all the above reasons, it is clear that the use of natural gas as the primary fuel to the combustion turbine, as the feedstock to the gasification process or raw material for production of nitrogen-based products would not achieve the inherent business purposes of the Project. Hydrogen generated from solid fuels with advanced pollution controls has great promise as a clean source of electricity and nitrogen based products. However, it has not yet been used or demonstrated in large scale application. The Project is an important first step in the advancement of clean fuel production and electricity generation, as well as reduction of GHGs through the use of low-carbon fuels. It is vital to the Project's goals, and to the DOE Clean Coal Project demonstration, that solid petcoke/coal feeds be used to demonstrate that these abundant resources can be used in an environmentally-sensitive manner to generate low-carbon electricity and capture and sequester carbon dioxide to reduce impacts of GHGs, along with the production of nitrogen-based products from a low carbon fuel. The use of natural gas would simply not fulfill these business, project and national energy program purposes and would constitute a substantial redesign of the source.

## 5.0 OTHER PERMITTED IGCC PROJECTS

The available control options were identified by querying the RBLC database and by consulting available literature on control options for IGCC. Applications and/or permits from a number of other IGCC facilities that have completed the New Source Review process were also reviewed to provide additional reference material for this BACT analysis. A brief summary of the other recently permitted IGCC plants in the United States and their emissions limits is presented in this section. Recently permitted IGCC facilities that will be used for comparison in this BACT analysis are:

- Duke Energy, Edwardsport Generating Station
- Christian County Generation (formerly ERORA Group), Taylorville Energy Center
- ERORA Group, Cash Creek Generation Station
- Hyperion Energy Center
- Mississippi Power Company, Kemper IGCC Facility
- Summit Power TCEP, IGCC Power Plant

The air permits, BACT analyses, and additional literature were reviewed for each of these recently permitted IGCC facilities. Each facility is discussed briefly below. The facilities that were subject to BACT determinations are listed as such.

**Duke Energy, Edwardsport Generating Station:** Duke Energy Indiana, owner of Edwardsport Generating Station, obtained approval, via Indiana Department of Environmental Management Significant Modification Title V Permit, to install an IGCC facility in Knox County, Indiana. The Title V Significant Modification Permit was issued in January 2008. The Edwardsport Generating Station is expected to start commercial operation in 2012. The 630 MW (net) IGCC plant will replace four older, less efficient generating units capable of generating approximately 160 MW at the Edwardsport site. The Edwardsport Generating Station is expected to use coal as feedstock, and SCR as add-on control to minimize $NO_X$ emissions from the plant. The SCR system is being installed on a trial basis to investigate technical feasibility for effective operation in recognition of technical uncertainties posed by $SO_2$ residuals, ammonia slip, and potential inorganic precipitants. The SCR system is not required to demonstrate compliance with federal or state statutes.

***Christian County Generation – Taylorville Energy Center:*** Christian County Generation LLC is developing the Taylorville Energy Center, a 630 MW IGCC facility to be located in Christian County, southern Illinois. Taylorville Energy Center obtained a draft Illinois Environmental Protection Agency air permit. Final public comments were due December 31, 2011; a final permit has not yet been issued. Commercial operation is expected to start in 2014. Taylorville Energy Center proposed to use Siemens gasification technology and local coals (Illinois coal) as the feedstock. The Taylorville Energy Center will use a Rectisol® acid gas removal (AGR) system, for syngas cleanup followed by a Methanation Unit in the gasification process to produce Substitute Natural Gas (SNG), which has virtually the same composition as natural gas. Since the SNG is essentially the same as natural gas, the combustion turbine is designed to operate on natural gas. BACT for $NO_X$ will be dry low-$NO_X$ (DLN) burners and SCR.

***ERORA Group – Cash Creek Generation Station****:* The ERORA Group is developing the Cash Creek Generation Station IGCC facility, to be located near Owensboro, Henderson County, Kentucky. Cash Creek Generation Station obtained a final Kentucky DAQ air permit in January 2008 and is expected to start commercial operation in 2012. The 630 MW IGCC proposes to use GE Energy gasification technology and local coals (Kentucky coal) as the feedstock. Cash Creek Generation Station will use Selexol® AGR systems, as well as SCR. Because the proposed facility site is in an ozone attainment area, SCR is not required for BACT purposes. ERORA is using SCR to minimize $NO_X$ emissions from the plant, but not as BACT. This will allow them to minimize the cost to acquire $NO_X$ allowances from the market. ERORA notes that in order to increase the chance that the SCR system will work in this unproven application on coal-derived syngas, higher sulfur removal, by using Selexol® instead of methyldiethanol-amine (MDEA), will be required.

***Hyperion Energy Center:*** The South Dakota Department of Environmental and Natural Resources issued a PSD permit for the Hyperion Energy Facility on August 20, 2009, and a revised PSD permit in September 2011. The facility will consist of a greenfield petroleum refinery and an IGCC plant, to be located in Union County, South Dakota. The IGCC plant will use petroleum coke as primary feedstock, and is designed to provide the refinery with up to 450 million cubic feet per day of hydrogen, 200 MW of electricity, and 2.4 million pounds of steam per hour. The application did not specify the type of combustion turbine to be used.

The co-located refinery will not be able to make enough petroleum coke to supply the IGCC, so additional fuel will be imported to make up the energy shortfall. Hyperion was permitted for two mutually exclusive configurations for the power plant. The first configuration is termed the "maximum coke design case," and will use imported solid fuels (coke and/or coal) to meet the energy needs. In this configuration, the combustion turbines will be fired with syngas, and the heat recovery steam generators will be fired with both syngas and tail gas from the plant's pressure swing absorber (PSA) process (which is part of its process for generating hydrogen for use by the refinery processes) and ultra-low sulfur distillate as a backup fuel.

The second configuration is termed the "natural gas design case." In this configuration the turbines will be fired with natural gas as the primary fuel and ultra-low sulfur distillate as a backup fuel. The heat recovery steam generators will be fired with natural gas and PSA tail gas. This configuration (using no syngas fuel in the turbine) is fundamentally different than HECA's proposed turbine operation. Therefore, we have not used this configuration in our comparison, but instead focused our comparison on the Hyperion "maximum coke design case," which is more similar to HECA's.

For $SO_2$ and particulate, the permitted Hyperion IGCC BACT control technology is syngas sulfur cleanup by physical absorption (Rectisol®). For $NO_X$ the use of low-$NO_X$ duct burners, diluent injection, and SCR was determined to be BACT for the maximum coke design case. For CO and VOCs, the use of oxidation catalyst and good combustion practice was selected as BACT. These are the same control technologies proposed as BACT by HECA. It should be noted that some of the pollutant limits for this facility are based on long-term (24-hour and 365-day) rolling averages.

***Mississippi Power Company, Kemper IGCC Facility:*** The Mississippi Department of Environmental Quality issued a final PSD permit for the Kemper IGCC Facility on March 9, 2010. Commercial operation is expected to start in 2014. The facility will be located in Kemper County, Mississippi. The primary fuel for the proposed facility will be syngas derived from lignite coal. Natural gas will be used as a secondary fuel. The facility will use Siemens 5000F turbines, and generate a nominal 582 net MW of electric power.

For $NO_X$, BACT was determined to be the use of good combustion and operating practices for a diffusion flame combustion turbine when using syngas. BACT when using natural gas was determined to be the use of steam or water injection in conjunction with the use of SCR. (Note: SCR was not required when firing syngas because of the project's use of lignite coal and an oxygen-blown gasifier. When using syngas, the permit allows ammonia to not be added to the SCR, allowing the exhaust gas to pass through the system without forming ammonium sulfates.) For CO and VOC, the use of good combustion practice was selected as BACT. (Note: oxidation catalyst was not required.) For $SO_2$, use of the Selexol® AGR system was determined to be BACT. For particulate, BACT was determined to be the use of clean fuels and good combustion practices. The Kemper permit does not require as stringent emissions controls as those proposed by HECA.

***Summit Texas Clean Energy, LLC (Summit) TCEP, IGCC Power Plant:*** The Texas Commission on Environmental Quality issued a final PSD permit for Summit's Texas Clean Energy Project (TCEP) IGCC Facility on December 28, 2010. Commercial operation is expected to start in 2015. The facility will be located in Odessa, Ector County, Texas. The primary fuel for the proposed facility will be syngas derived from coal. Natural gas will be used as a secondary fuel. The facility will use Siemens gasifiers fueling a single Siemens 5000F turbine and one steam turbine, and will generate a nominal 400 net MW of electric power.

For $NO_X$, combustion control diluent injection and SCR was determined to be BACT. When firing on syngas, diluent injection will provide combustion control; when firing on natural gas, steam injection will provide combustion control. For CO and VOC, the use of good combustion practice was selected as BACT. For $SO_2$, use of the clean, low sulfur fuel was determined to be BACT. For particulate, BACT was determined to be the use of clean fuels and good combustion practices. It should be noted that some of the $NO_X$ limits for this facility (for both syngas and natural gas) are based on 30-day rolling averages.

## 6.0 SOURCE-SPECIFIC BACT ANALYSIS

The following BACT analysis evaluates control technologies applicable to each of the criteria pollutants that would be emitted from the HECA Project to determine appropriate BACT emission limits. This BACT analysis is based on the current state of IGCC and nitrogen-based product production technology, energy and environmental factors, current expected economics, energy, and technical feasibility.

## 6.1 CTG/HRSG BACT Analysis

The following is the BACT analysis for the proposed combustion turbine. The proposed combustion turbine will be a Mitsubishi Heavy Industries (MHI) 501 GAC® model turbine with a gross capacity of approximately 405 MW. The MHI 501 GAC® is a new turbine model designed to optimally use hydrogen-rich fuel and natural gas as a backup fuel, and includes changes to the fuel system, combustion system, and hot gas path. The use of hydrogen-rich fuel requires the use of a diffusion-type combustor, because the high concentration of hydrogen precludes the use of DLN combustor technology.

The air permits, BACT analyses, and additional literature for each of the recently permitted IGCC facilities discussed in the last section were reviewed. Table 6-1 summarizes the criteria pollutant emission levels permitted for the combustion turbine units at each facility. This table also shows the proposed BACT limits for the HECA Project as a comparison.

### 6.1.1 Nitrogen Oxides BACT Analysis for the CTG/HRSG

The criteria pollutant $NO_X$ is primarily formed in combustion processes via the reaction of elemental nitrogen and oxygen in the combustion air (thermal $NO_X$), and the oxidation of nitrogen contained in the fuel (fuel $NO_X$). The hydrogen-rich fuel produced in the Project contains negligible amounts of fuel-bound nitrogen; therefore, it is expected that essentially all $NO_X$ emissions from the CTG/HRSG will originate as thermal $NO_X$.

The rate of formation of thermal $NO_X$ in a combustion turbine is a function of residence time, oxygen radicals, and peak flame temperature. Front-end $NO_X$ control techniques are aimed at controlling one or more of these variables during combustion. Examples include dry low-$NO_X$ combustors, flue gas recirculation, and diluent injection (steam, water, or nitrogen). These technologies are considered to be commercially available pollution prevention techniques. It is necessary to recognize the fundamental differences between natural-gas-fired and hydrogen-rich fuel-fired combustion turbines in evaluating these techniques. Compared to natural gas and substitute natural gas (SNG), hydrogen-rich fuel has a much higher hydrogen content (natural gas is often over 90 percent methane), and a much lower heating value (about 250 Btu/scf for hydrogen-rich fuel vs. 1,000 Btu/scf for natural gas). HECA will be fired primarily on hydrogen-rich fuel. The other power plants used for comparison in this analysis are fired on syngas. Plants firing SNG will be discussed, but are not comparable to HECA.

#### *1. Identify Control Technologies*

The following $NO_X$ control technologies were evaluated for the proposed CTG/HRSG:

*Combustion Process Controls*

- Dry Low-$NO_X$ Burner
- Diluent Injection

*Post-Combustion Controls*

- SCONO$_X$™
- Selective Non-Catalytic Reduction (SNCR)
- Selective Catalytic Reduction (SCR)

**Table 6-1**
**Permitted Criteria Pollutant BACT Limits for Combined-Cycle Combustion Turbine**

| Facility | HECA | Cash Creek Generation Station | Edwardsport Generating Station | Taylorville Energy Center | Hyperion Energy Center | Kemper County IGCC Project | Summit TCEP |
|---|---|---|---|---|---|---|---|
| **Location** | Kern County, CA | Henderson County, KY | Knox County, IN | Christian County, IL | Union County, SD | Kemper County, MS | Ector County, TX |
| **Permit Date** | Not Yet Permitted | January 2008 | June 2007 | Public Comment Period on Draft PSD Permit Ended December 31, 2011 | September 2011 | March 2010 | December 2010 |
| **Fuel** | Hydrogen-based syngas<br>-----<br>Natural Gas backup | Coal-derived Syngas<br>-----<br>Natural Gas backup | Coal-derived Syngas<br>-----<br>Natural Gas backup | Substitute Natural Gas (SNG) and Natural Gas | Petroleum coke-derived Syngas with PSA Tail gas<br>*or*<br>Natural Gas with PSA Tail gas[a]<br>-----<br>Ultra Low Sulfur Distillate (ULSD) backup | Lignite coal-derived Syngas<br>-----<br>Natural Gas backup | Coal-derived Syngas<br>-----<br>Natural Gas backup |
| **MW (net)** | 405 | 630 | 630 | 630 (net) | 280[b] | 582 | 400 |
| **Turbine** | MHI 501 GAC® | GE 7FB | GE 7FB | Siemens MHI 501GAC® CT | Not Specified | Siemens 5000F | Siemens 5000F |
| **$NO_X$** | 2.5 ppmc (0.011 lb/MMBtu) on hydrogen-rich fuel, 3-hr rolling average;<br>4.0 ppmc (0.015 lb/MMBtu) on Natural Gas, 3-hr rolling average | 5 ppmc (0.0331 lb/MMBtu) on Syngas;<br>0.0246 lb/MMBtu on Natural Gas | 0.027 lb/MMBtu on Syngas;<br>0.018 lb/MMBtu on Natural Gas | 2.0 ppmc on SNG or Natural Gas | 3.0 ppmc (0.018 lb/MMBtu) on Syngas/PSA Tailgas;<br>2.0 ppmc (0.012 lb/MMBtu) on Natural Gas/PSA Tailgas;<br>6.0 ppmc on ULSD | 0.061 lb/MMBtu on Syngas (LHV);<br>0.015 lb/MMBtu on Natural Gas (LHV) | 15 ppmc on Syngas or Natural Gas, 1-hr average;<br>3.5 ppmc (0.014 lb/MMBtu) on Syngas, 30-day rolling average;<br>2.5 ppmc (0.009 lb/MMBtu) on Natural Gas, 30-day rolling average |
| **$SO_2$** | ≤ 2 ppmv in undiluted hydrogen-rich fuel; and<br>≤ 10 ppmv in PSA off-gas (0.0002 lb/MMBtu);<br>0.75 grains/100 scf of total sulfur on Natural Gas (0.002 lb/MMBtu) | 3.8 ppmc (0.0158 lb/MMBtu) on Syngas;<br>0.0006 lb/MMBtu on Natural Gas | 0.0138 lb/MMBtu on Syngas;<br>0.0006 lb/MMBtu on Natural Gas | 0.25 grains/100 scf sulfur in SNG or Natural Gas | 1.0 ppmv sulfur in Syngas, 0.5 ppmv in PSA Tail gas (0.0005 lb/MMBtu on Syngas/PSA Tail gas);<br>9 ppmv sulfur in Natural Gas;<br>15.0 ppmw sulfur in ULSD (0.0015 lb/MMBtu) | 0.004 lb/MMBtu on Syngas;<br>1.9 lb/hr on Natural Gas | 10 ppmv sulfur in Syngas (0.006 lb/MMBtu);<br>2 grains/100 dscf in Natural Gas (0.006 lb/MMBtu) |
| **CO** | 3 ppmc (0.008 lb/MMBtu) on hydrogen-rich fuel;<br>5 ppmc (0.011 lb/MMBtu) on Natural Gas | 0.0485 lb/MMBtu on Syngas;<br>0.0449 lb/MMBtu on Natural Gas | 0.0441 lb/MMBtu on Syngas;<br>0.0421 lb/MMBtu on Natural Gas | 4.3 ppmc on SNG or Natural Gas | 3.0 ppmv on Syngas/PSA Tailgas/ULSD;<br>3.0 ppmv on Natural Gas/PSA Tailgas/ULSD | 0.031 lb/MMBtu on Syngas (LHV);<br>0.063 lb/MMBtu on Natural Gas (LHV) | 10 ppmc (0.02 lb/MMBtu) on Syngas;<br>10 ppmc (0.02 lb/MMBtu) on Natural Gas |
| **$PM_{10}$** | 15 lb/hr (0.008 lb/MMBtu) on hydrogen-rich fuel or Natural Gas | 76 lb/hr[c] on Syngas;<br>57 lb/hr[c] on Natural Gas | 63 lb/hr[c] on Syngas;<br>29 lb/hr[c] on Natural Gas | 0.0065 lb/MMBtu on SNG or Natural Gas | 36.9 lb/hr (0.022 lb/MMBtu) on Syngas/PSA Tailgas;<br>18.4 lb/hr (0.011 lb/MMBtu) on Natural Gas/PSA Tailgas;<br>36.9 lb/hr (0.022 lb/MMBtu) on ULSD | 36 lb/hr[c] on Syngas;<br>0.01 lb/MMBtu on Natural Gas (LHV) | 0.008 lb/MMBtu on Syngas or Natural Gas |
| **VOC** | 1 ppmc (0.0015 lb/MMBtu) on hydrogen-rich fuel;<br>2 ppmc (0.003 lb/MMBtu) on Natural Gas | NA | 0.0016 lb/MMBtu on Syngas;<br>0.0016 lb/MMBtu on Natural Gas | 0.0013 lb/MMBtu on SNG or Natural Gas | 0.0017 lb/MMBtu on Syngas or Natural Gas | 0.005 lb/MMBtu on Syngas (LHV);<br>0.008 lb/MMBtu on Natural Gas (LHV) | 1 ppmc (0.0012 lb/MMBtu) on Syngas;<br>1 ppmc (0.0012 lb/MMBtu) on Natural Gas |

Notes:

[a] Hyperion turbines are designed to operate in one of 2 configurations. Option 1 is a turbine designed to burn petcoke-derived syngas with PSA tail gas fired only in the duct burner. Option 2 is a natural gas-fired turbine with PSA tail gas fired only in the duct burner. These two options are mutually exclusive turbine configuration, one or the other will be selected, not a combination of the two.
[b] Hyperion gas turbines are not defined in permit, except for a fuel input rate of 1,677 MMBtu/hr (each turbine). The MW size for each of these is prorated from the HECA turbine (405 MW and approximately 2,400 MMBtu/hr (HHV)), for an individual turbine size of 280 MW.
[c] $PM_{10}$ lb/hr limits have been prorated to HECA-sized turbine in MW for comparison purposes. This is only done in cases where no other limits (such as lb/MMBtu) are provided.

dscf = dry standard cubic foot
HHV = higher heating value
lb/hr = pounds per hour
lb/MMBtu = pounds per million British thermal units
LHV = lower heating value
MW = megawatt
ppmc = parts per million by volume, dry basis, corrected to 15 percent $O_2$
ppmv = parts per million by volume
scf = standard cubic foot

## 2. *Evaluate Technical Feasibilities*

- Dry Low-$NO_X$ Combustor

DLN combustor technology has been successfully demonstrated to reduce thermal $NO_X$ formation from natural-gas combustion turbines. This is done by designing the combustors to control both the stoichiometry and temperature of combustion by tuning the fuel and air locally within each individual combustor's flame envelope. Combustor design includes features that regulate the aerodynamic distribution and mixing of the fuel and air. A lean, pre-mixed combustor design mixes the fuel and air prior to combustion. This results in a homogeneous air/fuel mixture, which minimizes localized fuel-rich pockets that produce elevated combustion temperatures and higher $NO_X$ emissions. A lean fuel-to-air ratio approaching the lean flammability limit is maintained, and the excess air serves as a heat sink to lower the combustion temperature, which in turn lowers thermal $NO_X$ formation. A pilot flame is used to maintain combustion stability in this fuel-lean environment.

Hydrogen-rich fuel differs from natural gas in heating value, gas composition, and flammability characteristics. Available DLN combustor technologies are designed for natural gas (methane-based) fuels and will not operate on the hydrogen-rich fuel (CO-based) used by an IGCC combustion turbine. DLN combustors are not technically feasible for this application due to the potential for explosion hazard in the combustion section due primarily to the high hydrogen content of the fuel. No manufacturer currently makes DLN combustors that can be used for a combustion turbine fueled by syngas or other fuels containing significant hydrogen. Thus, DLN combustor is not a technically feasible control option for this unit. [Note that the Hyperion Energy Center has DLN for $NO_X$ BACT for their natural gas design case only. This technology is not combined with the diffusion burner technology (and diluent injection) for the Syngas design case. Therefore, the use of DLN at Hyperion is not comparable to the HECA facility.]

The more recently constructed natural gas combustion turbines use the latest technology dry low nitrogen oxide (DLN) combustors, which are typically guaranteed to achieve 9 to 15 ppm $NO_X$ in the turbine exhaust gas when operating with natural gas. The MHI combustion turbine proposed for the HECA Project must use a diffusion combustor, because a DLN or other low-$NO_X$ combustor has not yet been developed for hydrogen-rich fuel, due to its high flame front speed and broad range of combustibility. During periods when hydrogen-rich fuel is unavailable and during start up/shut downs, the HECA Project will fire natural gas for very limited periods as a backup fuel. The natural gas must be fired through the same diffusion burner because the MHI turbine does not have the option of a separate natural gas DLN combustor. Thus, the use of DLN combustor is not a technically feasible control option for this unit.

- Diluent Injection

Higher peak flame temperature during combustion may increase thermodynamic efficiency, but it also increases the formation of thermal $NO_X$. The injection of an inert diluent such as atomized water, steam, or nitrogen into the high-temperature region of a combustor flame serves to inhibit thermal $NO_X$ formation by reducing the peak flame temperature.

For the Project's CTG/HRSG, nitrogen is used as a diluent that reduces thermal $NO_X$ produced when hydrogen-rich gas is combusted. Steam is used as a diluent when natural gas is combusted. This method effectively lowers the fuel heat content, and consequently, the combustion temperature, thereby reducing $NO_X$ emissions.

[redacted] The higher emission rate from combustion of natural gas is caused by the difference in combustion characteristics of natural gas compared to the hydrogen-rich fuel.

A secondary benefit of diluent injection is that it will increase the mass flow of the exhaust. Therefore, the power output per unit of fuel input also increases.

Diluent injection represents an inherently lower-emitting process for IGCC units, and is a technically feasible control technology. Diluent injection (steam for natural gas and nitrogen for hydrogen-rich fuel) is proposed as the baseline case for the CGT/HRSG combustion turbine $NO_X$ BACT analysis. This $NO_X$ control technology and emission level has also been determined as BACT for all other recent IGCC permits. This $NO_X$ diluent injection control technology has been commercially demonstrated on syngas turbines.

- $SCONO_X$™

The $SCONO_X$™ system is an add-on control device that reduces emissions of multiple pollutants. $SCONO_X$™ uses a single catalyst for the reduction of CO, VOC, and $NO_X$, which are converted to $CO_2$, water ($H_2O$), and nitrogen ($N_2$).

All installations of the technology have been on small natural gas facilities, and have experienced performance issues. The fact that $SCONO_X$™ has not been applied to large-scale natural gas combustion turbines creates concerns regarding the timing, feasibility, and cost-effectiveness of necessary design improvements. $SCONO_X$™ has also not been applied to syngas (or hydrogen-rich fuel).

In evaluating technical feasibility for large IGCC projects, the additional concerns are:

– $SCONO_X$™ uses a series of dampers to re-route air streams to regenerate the catalyst. The HECA Project is significantly larger than the facilities where $SCONO_X$™ has been used. This would require a significant redesign of the damper system, which raises feasibility concerns regarding reliable mechanical operation of the larger and more numerous dampers that would be required for application to the HECA CTG/HRSG.

– SCONO$_X$™ would not be expected to achieve lower guaranteed NO$_X$ levels than SCR, and, for reasons described above, it has even greater feasibility concerns with respect to application on IGCC turbines than those for SCR.

For the above reasons, SCONO$_X$™ is considered technically infeasible for this unit.

- Selective Non-Catalytic Reduction

Selective non-catalytic reduction is a post-combustion NO$_X$ control technology in which a reagent ($NH_3$ or urea) is injected into the exhaust gases to react chemically with NO$_X$ to form elemental nitrogen and water without the use of a catalyst. The success of this process in reducing NO$_X$ emissions is highly dependent on the ability to achieve uniform mixing of the reagent into the flue gas, which must occur within a narrow flue gas temperature zone (typically from 1,700 to 2,000 degrees Fahrenheit [°F]).

The consequences of operating outside the optimum temperature range are severe. Above the upper end of the temperature range, the reagent will be converted to NO$_X$. Below the lower end of the temperature range, the reagent will not react with the NO$_X$ resulting in very high $NH_3$ slip concentrations ($NH_3$ discharge from the stack).

This technology is occasionally used in conventional fired heaters or boilers upstream of any HRSG or heat recovery unit. SNCR has never been applied in IGCC service, primarily because there are no flue gas locations within the combustion turbine or upstream of the HRSG with the optimal requisite temperature and residence time characteristics to facilitate the SNCR flue gas reactions. Therefore, SNCR is not technically feasible for this unit.

- Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) is a technology that achieves post-combustion reduction of NO$_X$ from flue gas within a catalytic reactor. The SCR process involves the injection of $NH_3$ into the exhaust gas stream upstream of a specialized catalyst module to promote the conversion of NO$_X$ to molecular nitrogen. SCR is a common control technology for use on natural gas–fired combustion turbines.

In the SCR process, $NH_3$, usually diluted with air or steam, is injected through a grid system into the exhaust gas upstream of the catalyst bed. On the catalyst surface, the $NH_3$ reacts with NO$_X$ to form molecular nitrogen and water. The basic reactions are:

$$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$$

$$8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O$$

The Project selected SCR and diluent injection technology to control NO$_X$ emissions from the CTG/HRSG unit. The SCR system reduces nitrogen oxide emissions from the HRSG stack gases by up to about 92 percent when firing hydrogen-rich fuel. Anhydrous ammonia is injected into the stack gases upstream of a catalytic system that converts nitrogen oxide and ammonia to nitrogen and water.

It is anticipated that this combination of control processes will achieve a $NO_X$ emission limit of 2.5 ppmvd at 15 percent oxygen, based on a 3-hour rolling average, when firing hydrogen-rich fuel, or 4 ppmvd at 15 percent oxygen, based on a 3-hour rolling average, when firing natural gas.

The HECA Project has been designed to use steam injection and SCR for $NO_X$ control when in natural gas service. A comparison with other recent IGCCs using SCR indicate that 4 ppm is an appropriate emission stack concentration for natural gas operation using a diffusion burner. (Note that the Hyperion Project's BACT limit for $NO_X$ on natural gas is slightly lower than this, but uses DLN technology that is not available with syngas-fired turbines. Also, the Summit Project, when combusting natural gas, has a significantly higher short-term $NO_X$ limit of 15 ppm, but a slightly lower long-term [30-day] rolling average limit; this is not comparable to the short-term limit proposed for HECA.) To provide the high level of confidence necessary to meet a 4 ppm permit limit, the HECA Project will plan to achieve very high conversion efficiency in the SCR. Therefore, the HECA LLC believes that the proposed 4 ppm $NO_X$ level is an appropriate BACT level for the HECA Project when burning natural gas and is consistent with other recently permitted IGCCs.

These emission limitations for both hydrogen-rich fuel and natural gas represent a removal efficiency that is better than the approved emissions for recently permitted IGCC units. HRSG vendors confirm the feasibility of achieving these $NO_X$ levels.

### *3. Rank Control Technologies*

Among the control technologies considered in the previous subsection, only one was determined to be both technically feasible and commercially demonstrated at a cost level acceptable as a BACT option. Specifically, the feasible option is diluent injection upstream of the combustion zone.

Although there is no commercial demonstration of SCR performance for an IGCC plant using coal or petcoke feedstock, SCR technology has been proposed as emission limits for many recently permitted IGCC projects; therefore, SCR is determined to be technically feasible. The HECA HRSG vendor confirm that the SCR catalyst will be able to achieve combined $NO_X$ reduction to 2.5 ppmvd at 15 percent oxygen, based on a 3-hour rolling average, when firing hydrogen-rich fuel, and 4 ppmvd at 15 percent oxygen, based on a 3-hour rolling average, when firing natural gas.

### *4. Evaluate Control Options*

The next step in a BACT analysis is to evaluate the feasible control technology. Based on the evaluation in the previous step, the only feasible technologies suitable for establishment of BACT limits are diluent injection and SCR. The principal environmental consideration with respect to implementation of SCR is that, while it will reduce $NO_X$ emissions, it will add $NH_3$ emissions associated with use of $NH_3$ as the reagent chemical. A portion of the unreacted $NH_3$ passes through the catalyst and is emitted from the stack. This is called ammonia slip, and the magnitude of these emissions depends on the catalyst activity and the degree of $NO_X$ control desired. For the Project, the concentration of ammonia slip is limited to 5 ppmvd at 15 percent oxygen.

Table 6-2 shows the typical $NO_X$ BACT determination (when firing hydrogen-rich fuel and natural gas, respectively) and control technology for other recently permitted IGCC projects, in comparison with HECA's proposed $NO_X$ BACT for the CTG/HRSG.

As shown in Table 6-2, the BACT limitation for $NO_X$ emissions from HECA CTG/HRSG is more stringent than the historic BACT determination for other recently permitted IGCC projects.

NSPS 40 CFR 60 Subpart Da is considered as the BACT "floor" for this source category. As shown above, the BACT emission limit proposed for HECA is significantly lower than the applicable NSPS Subpart Da limit of 0.5 lb/MMBtu heat input for gaseous fuel. The proposed $NO_X$ reduction technology is also more stringent than the NSPS Subparts Da recommended minimum reduction efficiency of 25 percent.

#### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As has been explained, for this application of hydrogen-rich fuel-fired combustion turbine within an IGCC facility, diluent injection in the combustion turbine and SCR installation as post-combustion $NO_X$ control are the appropriate control techniques for setting BACT-based emission limits. The BACT selection described above is strongly supported by recent precedents for similar IGCC projects.

The proposed BACT limits based on this technology are 2.5 ppmvd $NO_X$ at 15 percent $O_2$ for hydrogen-rich–fuel firing, and 4 ppmvd $NO_X$ at 15 percent $O_2$ for natural-gas firing.

### 6.1.2 Carbon Monoxide BACT Analysis for the CTG/HRSG

CO is a product of incomplete combustion. Control of CO is typically accomplished by providing adequate fuel residence time and high temperature in the combustion zone to ensure complete combustion. However, these same control factors can increase $NO_X$ emissions. Conversely, lower $NO_X$ emission rates achieved through flame temperature control (by diluent injection) can increase CO emissions for natural gas and un-shifted syngas. Thus, a compromise must be established whereby the flame temperature reduction is set to achieve the lowest $NO_X$ emission rate possible while keeping CO emissions to an acceptable level. However, CO emissions are inherently low for hydrogen-rich fuels that contain very little reduced carbon and are less affected by the conventional trade-off between CO and $NO_X$.

**Table 6-2**
**$NO_X$ BACT Emission Limit Comparison**

| Facility | State | MW | Turbine | $NO_X$ BACT Technology | Emission Limit on Syngas | | Emission Limit on Natural Gas | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ppmc | lb/MMBtu | ppmc | lb/MMBtu |
| HECA | CA | 405 | MHI 501 GAC® | SCR | 2.5 | 0.011 | 4 | 0.015 |
| Cash Creek Generation Station | KY | 630 | GE 7FB | SCR | 5 | 0.0331 | -- | 0.0246 |
| Edwardsport Generating Station | IN | 630 | GE 7FB | SCR operated in trial mode | -- | 0.027[a] | -- | 0.018[a] |
| Taylorville Energy Center | IL | 630 (net) | Siemens MHI 501GAC® CT; SNG fuel | DLN[b], SCR (SNG and natural gas) | 2[b] | -- | 2 | -- |
| Hyperion Energy Center | SD | 280 | Not specified | Diluent Injection and SCR (syngas option)<br>DLN and SCR (natural gas option)[c], | 3[d] | 0.018 | 2[e] | 0.012 |
| Kemper County IGCC Project | MS | 582 | Siemens 5000F | GCP and diffusion flame combustion (syngas); Steam/ Water Inject and SCR (natural gas) | -- | 0.061 | -- | 0.015 |
| Summit TCEP | TX | 400 | Siemens 5000F | Diluent Injection and SCR | 15[f]<br>3.5[g] | 0.014[g] | 15[f]<br>2.5[g] | 0.009[g] |

Notes:

[a] Calculated from mass emissions rate of 57 lb/hr on hydrogen-rich fuel and 38 lb/hr on natural gas.

[b] DLN technology is feasible for substitute natural gas (SNG) – fired turbine. Emission limits are for SNG firing only.

[c] For the syngas Option 1, diluent injection and SCR are proposed. DLN control will only be included if Option 2 is chosen, which is a natural gas-fired turbine with PSA tail gas fired only in the duct burner. These two options are mutually exclusive turbine configuration, one or the other will be selected, not a combination of the two.

[d] The DLN technology is not applied for this limit, as the technology is not feasible for a syngas-fired turbine.

[e] Emission limit for separate natural gas turbine option using DLN and SCR (see footnote c).

[f] Emission limit based on 1-hour averaging time.

[g] Emission limit based on 30-day averaging time.

DLN = dry low-$NO_X$ burners
GCP = good combustion practice
MMBtu = million British thermal units
MW = megawatt
ppmc = parts per million by volume, dry basis, corrected to 15 percent $O_2$
SCR = selective catalytic reduction

### 1. Identify Control Technologies

The following CO control technologies were evaluated for the proposed CTG/HRSG:

*Combustion Process Controls*

- Good Combustion Practices (GCPs)

*Post-Combustion Controls*

- $SCONO_X$™
- Oxidation Catalyst

### 2. Evaluate Technical Feasibilities

*Good Combustion Practices*

Good combustion practices include the use of operational and design elements that optimize the amount and distribution of excess air in the combustion zone to ensure optimum complete combustion. [redacted]

This technology has been determined to be BACT for CO emissions in other operational or recently permitted IGCC projects.

- $SCONO_X$™

  The $SCONO_X$ system was evaluated in the $NO_X$ BACT analysis, and determined to be not technically feasible for this unit.

- Oxidation Catalysts

  Catalytic oxidation is a post-combustion control technology that uses a catalyst to oxidize CO into $CO_2$. Other operational or recently permitted IGCC projects determined GCPs as the only feasible BACT for CO emissions, with the exception of the Hyperion Energy that is proposing use of an oxidation catalyst to reduce CO emissions to 3 ppm. HECA anticipates CO conversions greater than 90 percent are attainable across the CO catalyst, thus HECA proposed CO emission limits of 3.0 ppmvd at 15 percent $O_2$ while firing hydrogen-rich fuel, and 5.0 ppmvd CO at 15 percent $O_2$ while firing natural gas.

### 3. Rank Control Technologies

Oxidation catalyst is the only technically feasible CO control technology identified in addition to Good Combustion Practices.

### 4. Evaluate Control Options

GCP is considered the baseline and only feasible and commercially demonstrated CO control technology for IGCC combustion turbines. GCP has been selected as BACT for other recent IGCC permits. The Hyperion Energy Center is the only IGCC project to propose use of oxidation catalysts to control CO. In comparison to other operational or recently permitted IGCC projects, this emission limitation represents a removal efficiency that is lower than the emission achieved in practice at currently operating IGCC turbines, and the lowest proposed emission limits for proposed syngas-fired units, including other proposed IGCC turbines.

Table 6-3 shows the typical CO BACT determination (when firing hydrogen-rich fuel and natural gas) and control technology for other recently permitted IGCC projects, in comparison with HECA's proposed CO BACT for the CTG/HRSG.

**Table 6-3**
**CO BACT Emission Limit Comparison**

| Facility | State | MW | Turbine | CO BACT Technology | Emission Limit on Syngas | | Emission Limit on Natural Gas | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ppmc | lb/MMBtu | ppmc | lb/MMBtu |
| HECA | CA | 405 | MHI 501 GAC® | Oxidation catalyst and GCP | 3 | 0.008 | 5 | 0.011 |
| Cash Creek Generation Station | KY | 630 | GE 7FB | GCP | -- | 0.0485 | -- | 0.0449 |
| Edwardsport Generating Station | IN | 630 | GE 7FB | GCP | -- | 0.0441[a] | -- | 0.0421[a] |
| Taylorville Energy Center | IL | 630 (net) | Siemens MHI 501GAC® CT; SNG fuel | GCP | 4.3[b] | -- | 4.3 | -- |
| Hyperion Energy Center | SD | 280 | Not specified | Oxidation catalyst and GCP | 3 | -- | 3[c] | -- |
| Kemper County IGCC Project | MS | 582 | Siemens 5000F | GCP | -- | 0.031 | -- | 0.063 |
| Summit TCEP | TX | 400 | Siemens 5000F | GCP | 10 | 0.02 | 10 | 0.02 |

Notes:
[a] Calculated from mass emissions rate of 93 lb/hr on hydrogen-rich fuel and 88.7 lb/hr on natural gas.
[b] Emission limit for substitute natural gas (SNG) – fired turbine; turbines are set up for natural-gas type of firing only.
[c] Emission limit for separate natural gas turbine option set up with CO catalyst and GCP specifically for natural gas use. The natural gas turbine option is a mutually exclusive turbine configuration from the syngas Option 1, only one turbine configuration will be selected, not a combination of the two.

GCP = good combustion practice
lb/MMBtu = pound per million British thermal units
MW = megawatt
ppmc = parts per million by volume, dry basis, corrected to 15 percent $O_2$.

As shown in Table 6-3, the BACT limitation for CO emissions from HECA CTG/HRSG is more stringent than most of the historic BACT determination for other recently permitted IGCC units. This emission limitation represents a removal efficiency that is better than the emission achieved in practice at currently operating IGCC turbines, and equals the lowest proposed emission limits for recently permitted IGCC turbines. The proposed CO emission limit for backup natural gas firing is lower than other similarly operated units. It is slightly higher than the limits proposed for Taylorville and Hyperion; turbines at both of these facilities are designed specifically for natural gas firing as the primary fuel, not as a backup, as is the case for HECA.

#### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As explained, GCPs and oxidation catalyst are the appropriate control technique for setting BACT-based emission limits.

HECA proposed the CO BACT-based limit of 3.0 ppmvd at 15 percent $O_2$ while firing hydrogen-rich fuel, and 5.0 ppmvd CO at 15 percent $O_2$ while firing natural gas during non-start-up operation, using GCPs and an oxidation catalyst.

### 6.1.3 Particulate Matter Emissions BACT Analysis for the CTG/HRSG

Particulate matter emissions from gas-fired combustion sources consist of inert contaminants in gaseous fuel, sulfates from fuel sulfur, ammonia compounds for the SCR reagent, dust drawn in from the ambient air that passes through the combustion turbine inlet air filters, and particles of carbon and hydrocarbons resulting from incomplete combustion. Low ash content and high combustion efficiency exhibit correspondingly low particulate matter emissions for hydrogen-rich fuel.

#### *1. Identify Control Technologies*

The following particulate matter control technologies were evaluated for the proposed CTG/HRSG:

*Pre-Combustion Controls*

- Gas Cleanup (for hydrogen-rich fuel)

*Combustion Process Controls*

- Good Combustion Practices

*Post-Combustion Controls*

- Baghouse
- Electrostatic Precipitation

### *2. Evaluate Technical Feasibilities*

In a typical solid fuel combustion process, fuel particulate matter is removed by post-combustion processes such as fabric filters or electrostatic precipitators. However, in an IGCC plant, particulate matter could damage the turbine, so particulate matter is removed prior to combustion. Post-combustion controls, such as electrostatic precipitators (ESPs) or baghouses, have never been applied to commercial combustion turbines burning gaseous fuels. Therefore, the use of ESPs and baghouses are considered technically infeasible control technology.

In the absence of add-on controls, the most effective control method demonstrated for gas-fired combustion turbines is the use of low-ash fuel, such as natural gas or hydrogen-rich fuel and GCPs. Therefore, it is necessary to use pre-combustion controls such as particulate removal as an integral part of the gasification process, in addition to GCPs.

The use of clean hydrogen-rich fuel and good combustion control is proposed as BACT for PM/ $PM_{10}$ control in the proposed HECA CTG/HRSG. These operational controls will limit filterable plus condensable PM/$PM_{10}$ emissions to 15 lb/hr when operating on hydrogen-rich fuel or natural gas.

### *3. Rank Control Technologies*

The use of clean fuels with low potential particulate emissions from optimum gas cleanup processes and GCPs were identified as the only technically feasible particulate emissions control technologies applicable to the proposed combustion turbines.

### *4. Evaluate Control Options*

The USEPA has indicated that particulate matter control devices are not typically installed on combustion turbines and that the cost of installing a particulate matter control device is prohibitive. When the NSPS for Stationary Gas Turbines (40 CFR 60 Subpart GG) was promulgated in 1979, the USEPA acknowledged, "Particulate emissions from stationary gas turbines are minimal." Similarly, the recently revised Subpart GG NSPS (2004) did not impose a particulate emission standard. Therefore, performance standards for particulate matter control of stationary gas turbines have not been proposed or promulgated at a federal level.

Table 6-4 shows the typical PM BACT determination (when firing hydrogen-rich fuel and natural gas) and control technology for other recently permitted IGCC projects, in comparison with HECA's proposed PM BACT for the CTG/HRSG.

Based on the evaluation in the previous step, GCPs and optimum gas cleanup are considered as technically feasible PM/$PM_{10}$ control technologies that are suitable for establishment of BACT limits. As shown in Table 6-4, HECA emission limitation represents a removal efficiency that is cleaner in comparison to other operational or recently permitted IGCC units. Therefore, the BACT limitation for PM emissions from HECA CTG/HRSG is more stringent than the historic BACT determination for other recently permitted IGCC units.

**Table 6-4**
**PM BACT Emission Limit Comparison**

| Facility | State | MW | Turbine | $PM_{10}$ BACT Technology | Emission Limit on Syngas | Emission Limit on Natural Gas |
|---|---|---|---|---|---|---|
| | | | | | lb/hr | lb/hr |
| HECA | CA | 405 | MHI 501 GAC® | Gas Cleanup and GCP | 15 (0.008 lb/ MMBtu) | 15 (0.008 lb/ MMBtu) |
| Cash Creek Generation Station | KY | 630 | GE 7FB | Gas Cleanup and GCP | 76[a] | 57[a] |
| Edwardsport Generating Station | IN | 630 | GE 7FB | Gas Cleanup and GCP | 63[a] | 29 [a] |
| Taylorville Energy Center | IL | 630 (net) | Siemens MHI 501GAC® CT; SNG fuel | GCP | 0.0065 lb/ MMBtu[b] | 0.0065 lb/ MMBtu |
| Hyperion Energy Center | SD | 280 | Not specified | AGR, Rectisol® | 36.9 (0.022 lb/ MMBtu) | 18.4 (0.011 lb/ MMBtu)[c] |
| Kemper County IGCC Project | MS | 582 | Siemens 5000F | Clean fuels and GCP | 36[a] | 0.01 lb/MMBtu |
| Summit TCEP | TX | 400 | Siemens 5000F | Clean fuels and GCP | 0.008 lb/MMBtu | 0.008 lb/ MMBtu |

Notes:

[a] Emission limits have been prorated to HECA-sized turbine in MW for comparison purposes. This is only done in cases where no other limits (such as lb/MMBtu) are provided.
[b] Emission limit using substitute natural gas (SNG); turbines are set up for natural-gas type firing only.
[c] Emission limit for separate natural gas turbine option specifically for natural gas use.

AGR = acid gas removal
lb/MMBtu = pound per million British thermal unit
MW = megawatt
$PM_{10}$ = particulate matter 10 microns in diameter or less

NSPS 40 CFR 60 Subpart Da is considered as the BACT "floor" for this source category. The BACT emission limits proposed in Table 6-4 are equivalent to 0.006 lb/MMBtu on hydrogen-rich fuel, and 0.006 lb/MMBtu on natural gas. These emission limits are significantly lower than the applicable NSPS Subpart Da limit of 0.03 lb/MMBtu heat input derived from the combustion of solid, liquid, or gaseous fuel.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As explained, GCPs and optimum gas cleanup are the appropriate control technique for setting BACT-based emission limits. The use of optimum gas cleanup to produce clean fuels with low potential particulate emissions and GCPs were selected as LAER for particulate emissions from the proposed combustion turbines. The following emission limit resulting from the implementation of these technologies is proposed for each combustion turbine.

HECA proposed the PM BACT-based limit of 15 lb/hr while firing hydrogen-rich fuel or natural gas, during non-start-up operation, using GCPs and optimum gas cleanup.

## 6.1.4 Sulfur Dioxide and Sulfuric Acid Mist BACT Analysis for the CTG/HRSG

Sulfur dioxide emissions from any combustion process are largely defined by the sulfur content of the fuel being combusted and the rate of the fuel usage. The combustion of hydrogen-rich fuel in the combustion turbines creates primarily $SO_2$ and small amounts of sulfite ($SO_3$) by the oxidation of the fuel sulfur. The $SO_3$ can react with the moisture in the exhaust to form sulfuric acid mist, or $H_2SO_4$. Emissions of these sulfur species can be controlled, either by limiting the sulfur content of the fuel (pre-combustion control), or by scrubbing the $SO_2$ from the exhaust gas (post-combustion control).

### *1. Identify Control Technologies*

The following sulfur dioxide and sulfuric acid mist control technologies were evaluated for the proposed CTG/HRSG when operating on hydrogen-rich fuel:

*Pre-Combustion Controls*

- Chemical Absorption Acid Gas Removal (AGR), e.g., methyldiethanol-amine (MDEA)
- Physical Absorption Acid Gas Removal, e.g., Selexol®, Rectisol®

*Post-Combustion Controls*

- Flue Gas Desulfurization

The sulfur dioxide BACT for the proposed CTG/HRSG when operating on natural gas is PUC-grade natural gas fuel with less than 0.75 grain/100 scf sulfur content.

### *2. Evaluate Technical Feasibilities*

- Acid Gas Removal

  In the gasification process, sulfur in the petcoke or coal feedstock converts primarily to hydrogen sulfide ($H_2S$). Solvent-based acid gas cleanup is commonly used for “gas sweetening” processes in petroleum refinery fuel gas or tail gas treating units, where $H_2S$ in the process gas is removed before use as a fuel. The removed $H_2S$ is recovered either as elemental sulfur in a Sulfur Recovery Unit (e.g., using a Claus process).

In a chemical absorption process, acid gases in the sour syngas are removed by chemical reactions with a solvent that is subsequently separated from the gas and regenerated. The chemical absorption occurs in amine-based systems that use solvents such as MDEA. Amine solvents chemically bond with the $H_2S$. The $H_2S$ can be easily liberated with low-level heat in a stripper to regenerate the solvent. However, amine-based systems such as MDEA are not effective at removing COS and have not demonstrated the deep total sulfur removal levels required by the Project.

Lower levels of sulfur removal are possible using physical absorption AGR systems. Physical absorption methods, including Selexol® and Rectisol®, use solvents that dissolve acid gases under pressure. Selexol® or Rectisol® are normally applied when low syngas sulfur levels are required for SCR. Solubility of an acid gas is proportional to its partial pressure and is independent of the concentrations of other dissolved gases in the solvent. Consequently, increased operating pressure in an absorption column facilitates separation and removal of an acid gas like $H_2S$. The dissolved acid gas can then be removed from the solvent, which is regenerated by depressurization in a stripper.

To selectively remove $H_2S$ and $CO_2$, two absorption and regeneration columns or two-stage process are required. In general, $H_2S$ is selectively removed in the first column by a lean solvent that has been deeply stripped with steam, while $CO_2$ is removed from the now $H_2S$-free gas in the second absorber. The second-stage solvent can be regenerated if very deep $CO_2$ removal is required. If only bulk $CO_2$ removal is required, then the flashed gas containing the bulk of the CO, can be vented, and the second regenerator duty can be substantially lowered or totally eliminated.

- Flue Gas Desulfurization

Flue gas desulfurization (FGD) is a post-combustion $SO_2$ control technology that reacts an alkaline with $SO_2$ in the exhaust gas. Typical FGD processes operate by contacting the exhaust gas downstream of the combustion zone with an alkaline slurry or solution that absorbs and subsequently reacts with the acidic $SO_2$. FGD technologies may be wet, semi-dry, or dry, based on the state of the reagent as it is injected or pumped into the absorber vessel. Also, the reagent may be regenerable (where it is treated and reused) or non-regenerable (all waste streams are de-watered and either discarded or sold). Wet, calcium-based processes that use lime (CaO) or limestone ($CaCO_3$) as the alkaline reagent are the most common FGD systems in PC unit applications. After the exhaust gas has been scrubbed, it is passed through a mist eliminator and discharged through a stack.

Flue gas desulfurization systems are commonly employed in conventional PC plants, where the concentration of oxidized sulfur species in the exhaust is relatively high. If properly designed and operated, FGD technology can reliably achieve more than 95 percent sulfur removal. However, FGD cannot provide as high a level of control as the pre-combustion AGR systems. In addition, FGD has the environmental drawbacks of substantial water usage and the need to dispose of a solid byproduct (the scrubber sludge). The solid by-product requires the installation of a significant number of ancillary support systems to accommodate treatment, handling, and disposal. Given these disadvantages and the fact that FGD could not achieve the high removal efficiencies associated with AGR, even though FGD is not technically infeasible, it is not considered to be a reasonable technical option for IGCC. Therefore FGD will not be considered further in this BACT analysis

### *3. Rank Control Technologies*

Both chemical and physical absorption methods for AGR are considered feasible for an IGCC, and can achieve control of the sulfur in syngas up to 99 percent or better. Both of these systems are further considered in the BACT analysis.

### *4. Evaluate Control Options*

Physical absorption AGR systems (including Selexol® and Rectisol®) are considered as feasible sulfur dioxide and sulfuric acid mist control technology for the proposed CTG/HRSG turbine. Selexol® has been selected as BACT for several of the recent IGCC permits. Rectisol® was selected for Taylorville Energy Center and the Hyperion Energy Project and has also been widely used in gasification projects in the chemical industry where both deep sulfur removal and $CO_2$ removal are required. Both Rectisol® and Selexol® are considered viable alternatives to MDEA. However, the Project selected Rectisol® because there are more units operating at similar capacities and similar conditions to those required for the Project, making Rectisol® the more proven alternative.

Table 6-5 shows the typical $SO_2$ BACT determination (when firing hydrogen-rich fuel and natural gas, respectively) and control technology for other recently permitted IGCC projects, in comparison with HECA's proposed $SO_2$ BACT for the CTG/HRSG.

As shown in Table 6-5, the BACT limitation for $SO_2$ emissions from HECA CTG/HRSG when firing hydrogen-rich fuel is similar to the historic BACT determination for other recently permitted IGCC units. This emission limitation represents a removal efficiency that is better than the emission achieved in practice at currently operating IGCC units, and similar to the proposed emission limits compared to recently permitted IGCC units.

NSPS 40 CFR 60 Subpart Da is considered as the BACT "floor" for this source category. The proposed $SO_2$ emission limits are significantly lower than the applicable NSPS Subpart Da limit of 180 nanograms per joule (1.4 lb/MWh) or 95 percent reduction on a 30-day rolling average.

When firing natural gas, $SO_2$ emission from CTG/HRSG is slightly higher than other recently permitted IGCC units. The $SO_2$ BACT for the proposed CTG/HRSG when operating on natural gas is PUC-grade natural gas fuel with less than 0.75 grain/100 scf sulfur content.

**Table 6-5**
**$SO_2$ BACT Emission Limit Comparison**

| Facility | State | MW | Turbine | $SO_2$ BACT Technology | Emission Limit on Syngas | | Emission Limit on Natural Gas | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ppm | lb/MMBtu | ppm | lb/MMBtu |
| HECA | CA | 405 | MHI 501 GAC® | AGR, Rectisol® | ≤ 2 ppm Sulfur in undiluted Hydrogen-rich fuel<br>≤ 10 ppm Sulfur in PSA off-gas | 0.0002 | 0.75 grains/ 100 scf | 0.002 |
| Cash Creek Generation Station | KY | 630 | GE 7FB | AGR, Selexol® | 3.8[a] | 0.0158 | | 0.0006 |
| Edwardsport Generating Station | IN | 630 | GE 7FB | AGR, Selexol® | | 0.0138[b] | | 0.0006[b] |
| Taylorville Energy Center | IL | 630 (net) | Siemens MHI 501GAC® CT; SNG fuel | AGR, Rectisol® | 0.25 grains/ 100 scf in SNG | -- | 0.25 grains/ 100 scf | -- |
| Hyperion Energy Center | SD | 280 | Not specified | AGR, Rectisol® | 1 ppmv Sulfur in syngas[c];<br>0.5 ppmv in PSA off-gas | 0.0005[c] | 9 ppmv | -- |
| Kemper County IGCC Project | MS | 582 | Siemens 5000F | AGR, Selexol® | -- | 0.004 | | 1.9 lb/hr |
| Summit TCEP | TX | 400 | Siemens 5000F | Low Sulfur fuel | 10 ppmv Sulfur in Syngas | 0.006 | 2 grains/ 100 dscf | 0.006 |

Notes:
[a] Parts per million by volume, dry basis, corrected to 15 percent $O_2$.
[b] Calculated from mass emissions rate of 2.9 lb/hr on hydrogen-rich fuel and 1.30 lb/hr on natural gas.
[c] Emission limit based on 24-hr rolling average.

AGR = acid gas removal
dscf = dry standard cubic foot
lb/MMBtu = pounds per million British thermal units
MW = megawatt
ppm = parts per million
ppmv = parts per million by volume
scf = standard cubic foot
SNG = substitute natural gas

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. HECA selected Rectisol® as syngas cleanup control technology to remove sulfur dioxide from the hydrogen-rich fuel stream entering the CTG/HRSG. The reduction efficiency of Rectisol® is above the NSPS floor requirement, and the overall performance of this technology is more stringent than the historic BACT determination for other recently permitted IGCC units. The following emission limit resulting from the implementation of these technologies is proposed for each combustion turbine.

HECA proposed the $SO_2$ BACT-based limit of ≤ 2 ppmv sulfur in undiluted hydrogen-rich syngas, ≤ 10 ppmv sulfur in PSA off-gas using an AGR system (Rectisol®) and ≤0.75 grains/ 100 scf of natural gas sulfur content using PUC-grade natural gas. These levels will meet the SJVAPCD BACT guideline 7.2.6 for sulfur recovery plants.

## 6.1.5 Volatile Organic Compounds BACT Analysis for the CTG/HRSG

VOCs are a product of incomplete combustion of the organic components in the hydrogen-rich fuel. Hydrogen-rich fuel contains very low concentrations of VOC; therefore, emissions of VOC are inherently very low. Reduction of VOC emissions is accomplished by providing adequate fuel residence time and a high temperature in the combustion zone to ensure complete combustion. A survey of the RBLC database indicated that good combustion control and burning clean gas fuel are the VOC control technologies primarily determined to be BACT. The advantage of IGCC technology is the fact that the combustion turbine operates on hydrogen-rich fuel, which contains a very low organic content, and yields very low levels of uncombusted VOC emissions.

### *1. Identify Control Technologies*

The following VOC control technologies were evaluated for the proposed CTG/HRSG:

*Combustion Process Controls*

- Good Combustion Practices

*Post-Combustion Controls*

- $SCONO_X$™
- Oxidation Catalyst

### *2. Evaluate Technical Feasibilities*

- Good Combustion Practices

  GCPs include the use of operational and design elements that optimize the amount and distribution of excess air in the combustion zone to ensure optimum complete combustion.

This technology has been determined to be BACT for VOC emissions in other operational or recently permitted IGCC projects.

- $SCONO_X$™

  The $SCONO_X$ system was evaluated in the $NO_X$ BACT analysis, and determined to be not technically feasible for this unit.

- Oxidation Catalysts

  Catalytic oxidation is a post-combustion control technology that uses a catalyst to oxidize VOC. The catalyst beds that functions to reduce CO emissions can also be effective in reducing VOC emissions. Such systems typically achieve a maximum VOC removal efficiency of up to 50 percent, while providing control for CO.

  Other operational or recently permitted IGCC projects determined GCPs as the only feasible BACT for VOC emissions, with the exception of the Hyperion Energy that is proposing use of an oxidation catalyst to reduce VOC emissions. The turbine exhaust will achieve VOC emission levels of 1.0 ppmvd VOC (at 15 percent oxygen) when firing hydrogen-rich fuel, and 2.0 ppmvd VOC (at 15 percent oxygen) when operating on natural gas.

### *3. Rank Control Technologies*

Oxidation catalyst is the only technically feasible VOC control technology identified in addition to GCPs.

### *4. Evaluate Control Options*

GCPs are considered the baseline and the only commercially demonstrated VOC control technology for IGCC combustion turbines. GCP has been selected as BACT for all other recent IGCC permits, with the exception of the Hyperion Energy, that is proposing use of an oxidation catalyst. In comparison to other operational or recently permitted IGCC projects, this emission limitation represents a removal efficiency that is lower than the emissions achieved in practice at currently operating IGCC units, and the lowest proposed emission limits for proposed turbines combusting syngas.

Table 6-6 shows the typical VOC BACT determination (when firing hydrogen-rich fuel and natural gas, respectively) and control technology for other recently permitted IGCC projects, in comparison with HECA's proposed VOC BACT for the CTG/HRSG.

As shown in Table 6-6, the BACT limitation for VOC emissions from HECA CTG/HRSG is comparable to the historic BACT determination for other recently permitted IGCC turbines when firing syngas. This emission limitation represents a removal efficiency that is as good as the emissions proposed in recently permitted syngas turbines.

**Table 6-6**
**VOC BACT Emission Limit Comparison**

| Facility | State | MW | Turbine | VOC BACT Technology | Emission Limit on Syngas | | Emission Limit on Natural Gas | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ppmc | lb/MMBtu | ppmc | lb/MMBtu |
| HECA | CA | 405 | MHI 501 GAC® | Oxidation catalyst and GCP | 1 | 0.0015 | 2 | 0.003 |
| Cash Creek Generation Station | KY | 630 | GE 7FB | GCP | -- | N/A | -- | N/A |
| Edwardsport Generating Station | IN | 630 | GE 7FB | GCP | -- | 0.0016[a] | -- | 0.0016[a] |
| Taylorville Energy Center | IL | 630 (net) | Siemens MHI 501GAC® CT; SNG fuel | GCP | -- | 0.0013[b] | -- | 0.0013 |
| Hyperion Energy Center | SD | 280 | Not specified | Oxidation catalyst and GCP | -- | 0.0017 | -- | 0.0017[c] |
| Kemper County IGCC Project | MS | 582 | Siemens 5000F | GCP | -- | 0.005 | -- | 0.008 |
| Summit TCEP | TX | 400 | Siemens 5000F | GCP | 1 | 0.0012 | 1 | 0.0012 |

Notes:
[a] Calculated from mass emissions rate of 3.3 lb/hr on hydrogen-rich fuel and natural gas.
[b] Emission limit using substitute natural gas (SNG); turbines are set up for natural-gas type of firing only.
[c] Emission limit for separate natural gas turbine option set up with CO catalyst and GCP specifically for natural gas use. The natural gas turbine option is a mutually exclusive turbine configuration from the syngas Option 1, only one turbine configuration will be selected, not a combination of the two.

GCP = good combustion practice
lb/MMBtu = pound per million British thermal units
MW = megawatt
ppmc = parts per million by volume, dry basis, corrected to 15 percent $O_2$.
VOC = volatile organic compound

The proposed VOC emission limit for backup natural gas firing is comparable to other similarly operated units, although it is slightly higher than the limits proposed for Taylorville and Hyperion; turbines at both of these facilities are designed specifically for natural gas firing as the primary fuel, not as a backup, as is the case for HECA. The Summit Project, when combusting natural gas, has a slightly lower long-term average limit than HECA is proposing, although this is not comparable to the short-term limit proposed for HECA.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As explained, GCPs and oxidation catalyst are the appropriate control technique for setting BACT-based emission limits.

HECA proposes the VOC BACT-based limit of 1.0 ppmvd at 15 percent $O_2$ while firing hydrogen-rich fuel, and 2.0 ppmvd VOC at 15 percent $O_2$ while firing natural gas during non-start-up operation, using GCPs and oxidation catalyst.

## 6.1.6 Startup and Shutdown BACT Analysis for the CTG/HRSG

The proposed turbine is a MHI 501 GAC® model turbine with a gross capacity of approximately 405 MW, operating in a combined cycle mode and discharging its exhaust gases through a HRSG. The MHI 501 GAC® turbine is a new turbine model designed for optimum performance on both hydrogen-rich fuel and natural gas and includes changes to the fuel system, combustion system and hot gas path to accommodate this combination of fuels.

According to the turbine manufacturer, the emissions of all criteria pollutants except $SO_2$ and $PM_{10}$ will be slightly higher during turbine start up. This is in part due to lower control effectiveness of the SCR and Oxidation Catalyst control systems until the exhaust gases reach optimal operating temperatures. This is also due to the slightly lower combustion efficiency of gas turbines at low loads, particularly during cold starts. Consequently, the most effective consideration for minimizing emissions due to start up and shutdown events is to minimize the frequency and duration of these events.

HECA is being designed and permitted as a base-load electrical generating facility. In keeping with this mode of operation, frequent start ups and shut downs of the combustion turbine and HRSG will not be required. In contrast, a NGCC plant may frequently be turned off during periods of low demand (e.g., overnight). The time required for gasifier start up does not allow overnight shut downs (and would also result in some flaring during each event). The Project proposed maximum annual start-up and shut-down duration of 314 hours per year for the entire facility and 123 hours per year for the CTG/HRSG. This limit would allow 2 starts per year for HECA, as compared to a typical NGCC plant that may be allowed up to 250 starts per year.

The estimated annual criteria pollutant emissions for the CTG/HRSG operating scenario, including start-up/shut-down emissions and maximum permitted natural gas backup operation, are presented below in Table 6-7.

**Table 6-7**
**Maximum Annual Emissions from the CTG/HRSG**

| Pollutant | Startup and Shutdown Emissions (ton/yr) | CTG/HRSG Emissions Hydrogen-Rich Fuel (tons/yr) | CTG/HRSG Emissions Natural Gas (tons/yr) | Maximum Total CTG/HRSG Emissions (tons/yr) |
|---|---|---|---|---|
| $NO_X$ | 4.3 | 99.6 | 5.7 | 109.7 |
| CO | 15.7 | 72.8 | 4.4 | 92.9 |
| VOC | 0.5 | 13.9 | 1.0 | 15.3 |
| $PM_{10}$ | 0.8 | 51.3 | 2.5 | 54.6 |
| $SO_2$ | 0.1 | 16.2 | 0.8 | 17.1 |
| $NH_3$ | 0.0 | 73.6 | 2.6 | 76.3 |

The start-up and shut-down emissions basis included in the above annual emissions estimate are based on the 2 start ups and 2 shut downs per year. The emissions from these events represent a very small percentage of the overall Project emissions. For example, $NO_X$ emissions from start up and shut down of this base-load turbine would be approximately 4 percent of the total annual turbine emissions. VOC, PM, and $SO_2$ emissions vary from approximately 1 to 3 percent of the annual turbine emissions. CO emissions are somewhat larger, but still represent less than 20 percent of the annual emissions. This sharply contrasts with single-cycle peaking turbine permits, where start-up emissions can represent the majority of a facility's permitted emissions for certain pollutants.

The following sections provide a stepwise evaluation of control technologies considered for BACT for the proposed CTG/HRSG.

### *1. Identify Control Technologies*

A review of the RBLC database for large combustion turbines in the last 10 years identified only a few combustion turbine entries that specifically discuss start-up or shut-down emissions. Only two of these entries listed the emissions control method determined to represent BACT for start-up emissions, as shown below.

| | |
|---|---|
| RBLC ID: | LA-0224 |
| +Corporate/Company Name: | SOUTHWEST ELECTRIC POWER COMPANY (SWEPCO) |
| +Facility Name: | ARSENAL HILL POWER PLANT |
| Facility State: | LA |
| **+Control Method Description:** | **COMPLETE EVENTS AS QUICKLY AS POSSIBLE ACCORDING TO MANUFACTURE'S RECOMMENDED PROCEDURES** |

| | |
|---|---|
| RBLC ID: | IN-0115 |
| +Corporate/Company Name: | MIRANT SUGAR CREEK, LLC |
| +Facility Name: | MIRANT SUGAR CREEK, LLC |
| Facility State: | IN |
| **+Control Method Description:** | **DRY LOW-NOX BURNERS, GOOD COMBUSTION PRACTICES, NATURAL GAS.** |

None of the combustion turbines with start-up and shut-down entries in the RBLC are in IGCC service. Nevertheless, their identified start-up and shut-down BACT listings are helpful references for possible emission control ideas.

Because precedents established in the permits of similar projects can be relevant in determining BACT, the permits for several recent IGCC projects were also reviewed. The following three examples summarize the relevant control strategies identified in other IGCC permits.

***Hyperion Energy Center IGCC* –** Requirement for startup and shutdowns as referenced from this PSD permit are as follows; "…the owner or operator shall use good work and maintenance practices and manufacturers' recommendations to minimize emissions during, and the frequency and duration of, startup, shutdown, and malfunction events for those units and pollutants that are not using a continuous emissions monitoring system to demonstrate compliance. The owner or operator shall develop and implement a startup, shutdown, and malfunction plan…."

***Duke Edwardsport IGCC* –** "Emissions from startups and shutdowns of the power block of the IGCC plant shall not exceed the established annual and 24-hour average limits determined on a monthly basis, using the appropriate emission factors and number of specific startup and shutdown events per month."

***Cash Creek IGCC* –** "…at all times, including periods of startup, shutdown and malfunction, owners and operators shall, to the extent practicable, maintain and operate any affected facility including associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions. Determination of whether acceptable operating and maintenance procedures are being used will be based on information available to the Division which may include, but is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the source."

Based on the above review, and also including the "fast-start" and "opflex" technologies mentioned by USEPA, the following start-up/shut-down (SU/SD) control technologies were evaluated for the proposed CTG/HRSG:

*Combustion Process Controls*

1) Fast Start and OpFlex Technology

2) Several aspects of Good Air Pollution Control Work Practices (i.e., Complete events as quickly as possible following manufactures recommendation and or Startup, Shutdown or Malfunction Plans)

## 2. Evaluate Technical Feasibilities

*Fast Start and OpFlex Technology*

The proposed combustion turbine, the MHI 501 GAC®, is designed to run as a combined-cycle turbine specifically for IGCC applications. The "fast start" or "opflex" technologies are technologies that suppliers such as GE offer for their combustion turbines. The technology consists of specialized control software that allows a slightly more rapid start up and slightly lower turndown level on turbines. The concept is to bring the CTG into emissions compliance quicker during the start-up of a NGCC. This approach minimizes the higher emission rates associated with lower load operation, while providing adequate temperature control of the steam entering the steam turbine generator (STG). Plants that are currently using this system or are slated to employee it use DLN combustion technology. Furthermore, these facilities are generally in peaking service, where there are numerous hot and cold starts per year.

The GE OpFlex(TM) system has limited field operating experience in NGCC facilities and no experience in a facility designed to operate on hydrogen fuel. The differences between NGCC and hydrogen fueled IGCC facilities are substantial. Although the GE OpFlex(TM) is an innovative technology that has been successfully applied for NGCC operation, it has not been proven for application in a hydrogen fueled facility like HECA. For this reason, and because the HECA Project is a base-loaded facility with start-up emissions that are a relatively small portion of the total CTG/HRSG emissions, additional BACT for start up and shut down should not be required.

*Good Air Pollution Control Work Practices*

Good air pollution control work practices are feasible for the Project. The proposed CTG for the HECA Project is designed to minimize the frequency and duration of start-up and shut-down events by using the following work practices, operating controls, and design elements:

- Baseload Power Generation Project (inherent design feature)
- Use of fuel dilution, SCR and CO catalyst systems during start up and shut down when operating conditions are amenable to their effective use.
- Follow manufacturer's recommendations to minimize the duration and emissions during start up.

The Project will be operated as a base-load power generating unit. Unlike peak-load generation, base-load power generation entails continuous operation and power generation during all seasons that is normally interrupted only for maintenance or unexpected outages. The applicant is proposing a maximum of only two start ups annually to allow for repairs and/or maintenance activities. In contrast, a peak-load plant may operate only several hours per day (during periods of peak electrical demand).

Another operating control/design element of the Project that inherently minimizes the emissions associated with start-up and shut-down events from the CTG/HRSG is the use of fuel dilution, SCR and CO catalyst systems. The primary purpose of these emissions controls is to control emissions during operations. However, they will provide some benefit during start up and shut down as well. For example, the SCR and CO catalyst systems will be in the direct path of the exhaust flow throughout the start-up and shut-down processes. As described in the permit application, the oxidation catalyst will be in service and functioning to provide emissions control as soon as the CTG/HRSG operating temperature rises to a sufficient level. Meaningful control of CO emissions by the oxidation catalyst should begin as the temperature approaches about 400 ºF. The SCR catalyst system will be in the exhaust gas flow path throughout start ups, but will become effective for $NO_X$ control when both the temperature is sufficient (about 450 to 500 ºF) to activate the ammonia injection system. Injection of ammonia prematurely will cause excessive ammonia slip. HECA plans to begin injection of ammonia as soon as the exhaust gas operating conditions are amenable to its effective use, following manufacturers' recommendations.

In addition to the above aspects, HECA will follow manufacturers' recommendations and good work practices to minimize the numbers and durations of start ups and shut downs and, hence the emissions associated with non-routine operation.

### *3. Rank Control Technologies*

Among the potentially available controls, the only feasible and commercially demonstrated control technology for IGCC combustion turbines start up and shutdown is the use of good air pollution control practices to minimize emissions during start up and shutdown.

### *4. Evaluate Control Options*

The only feasible and commercially demonstrated control technology for IGCC combustion turbines start up and shut down is the use of good air pollution control practices to minimize emissions during start up and shut down.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps and review of determinations for turbine start ups and shut downs of other IGCC projects. As a result of these considerations, BACT for the HECA Project's turbine start-up and shut-down emissions is proposed as follows:

1. HECA shall operate the CTG/HRSG using good work practices and following manufacturers' recommendations to minimize emissions during, and the duration of, start-up and shut-down events.

2. CTG/HRSG exhaust will be routed through the SCR system and the oxidation catalyst system at all times including periods of start up and shut down. Ammonia

shall be added to the SCR system when operating conditions are amenable to its effective use.

3. HECA shall monitor and maintain records of each start-up and shut-down event including the duration of the event.

4. HECA shall include the emissions during periods of start up and shut down, along with routine emissions, in determining compliance with the long-term annual emission rates which were used in the permit modeling demonstration.

## 6.2 Coal Dryer BACT Analysis

The MHI gasifier is a completely enclosed process with only one emission point: the coal dryer. This system uses dry feed in an oxygen-blown gasifier to generate the raw syngas. This syngas is further treated in the downstream units to produce the hydrogen used for the combined cycle unit fuel as well as feed for the Manufacturing Complex. This technology has no start-up emissions directly from the gasifier. Waste gases from gasifier warming, start up, and shut down are routed to the one of the flares for safe disposal (which are discussed in later sections of this analysis).

The coal (feedstock) dryer removes moisture from the solid feed to ensure proper grinding and injection into the gasifier. The coal dryer is the only emission point associated with the gasifier system. The heat source for the dryer is a slipstream of HRSG fluegas. This slipstream is obtained just downstream of the catalytic emission controls (SCR and CO catalysts described above) and is ducted to the coal dryer adjacent to the gasifier. The coal dryer is a totally enclosed vessel that contacts the hot flue gas with the coal/petcoke feed material as it enters the grinder. After drying the solid feed, the flue gas is routed to the coal dryer vent stack. The vented gas will contain the moisture removed from the feed, the residual emissions from the HRSG emission controls, and particulate fines entrained from the solid feed. Baghouse fabric filtration will be provided on this vent stream to reduce the particulate emissions to less than 0.001 grain/dscf.

Because the HRSG fluegas has already undergone emission controls for $NO_X$, CO and VOC, only BACT for PM is reviewed, as emissions of PM are primarily due to the particulate fines entrained from the solid feed in the flue gas, as a consequence of the direct-contact drying process. Even though it is expected that most of these entrained particles are larger than $PM_{10}$, the controls discussed below apply to $PM_{10}$ and $PM_{2.5}$ as well. An RBLC search for coal dryers identified three units; two of these have baghouses as BACT and one has a fabric filter (essentially the same technology as a baghouse). Baghouses (fabric filtration) are considered to be the only applicable control technology for $PM/PM_{10}$ from coal dryers. The BACT limits cited for the three units range from 0.01 to 0.015 gr/dscf for filterable PM. The baghouse selected for the HECA coal dryer is designed to limit PM emissions to 0.001 gr/dscf. Therefore, HECA proposes this baghouse efficiency as the BACT for the coal dryer vent.

## 6.3 Cooling Towers Particulate Emissions BACT Analysis

There will be three cooling towers proposed for the Project:  two cooling towers, the process cooling tower and the Air Separation Unit (ASU) cooling tower, are associated with the gasification process and Manufacturing Complex, and the third cooling tower, the power block cooling tower, is used by the power block.  Compared to similar sized combined cycle power plants, the power block cooling duty is somewhat greater due to the heat integration with gasification resulting in the generation of additional steam for power production in the steam turbine and therefore requires additional cooling to condense this steam from the gasification block.  Each tower has a separate cooling water basin, pumps, and piping system, and operates independently.  The cooling water will circulate through a mechanical draft-cooling tower that uses electric motor-driven fans to move the air into contact with the flow of the cooling water. The heat removed in the condenser will be discharged by heating the air, and through evaporation of some of the cooling water.

The power block cooling tower is designed for an approximate capacity of 95,500 gallons per minute (gpm) of water, the process cooling tower design circulation rate is 162,582 gpm, and the ASU cooling tower design circulation rate is 44,876 gpm.

All cooling towers are supplied with high-efficiency drift eliminators designed to reduce the maximum drift; that is, the fine mist of water droplets entrained in the warm air leaving the cooling tower, to less than 0.0005 percent of the circulating water flow.  Circulating water could range in total dissolved solids (TDS) depending on makeup-water quality and tower operation. Therefore, $PM_{10}$ emissions would vary proportionately.

For cooling water makeup uses, HECA will use local brackish groundwater that has been determined by the local water district to be impaired and not suitable for agricultural or drinking use without extensive treatment because of its high TDS content.  These impaired groundwater sources are found in various locations within the BVWSD Buttonwillow Service Area. According to the BVWSD, the impaired groundwater is considered objectionable by local agricultural users because it is unsuitable for good crop yield or crop diversification.  As such, this water currently poses a negative impact on agriculture.  Elevated TDS in groundwater has prompted the BVWSD to develop the Brackish Groundwater Remediation Project.  This program includes extraction of groundwater in elevated TDS areas.  HECA's use of this poor quality groundwater for the proposed Project's process water needs will remove significant TDS from the groundwater aquifer and is consistent with the BVWSD groundwater remediation plan. The maximum cycled-up cooling water TDS for the process and power block cooling tower will be 9,000 ppmw and 2,000 ppmw for the ASU cooling tower.[2]

Wet (evaporative) cooling towers emit aqueous aerosol "drift" particles that evaporate to leave crystallized solid particles that are considered $PM_{10}$ emissions.  The proposed control technology for $PM_{10}$ is high-efficiency drift eliminators to capture drift aerosols upstream of the vent point.

[2] The cooling equipment in the ASU requires significantly lower dissolved solids in the circulating water than the rest of the plant.

### *1. Identify Control Technologies*

The following particulate matter control technologies were evaluated for the proposed cooling towers:

*Potential Cooling Tower Control Technology*

- Air Cooled Condenser (ACC) Technology
- Drift Elimination System with limited TDS level

### *2. Evaluate Technical Feasibilities*

- Air Cooled Condenser Technology

Although most power plants and other industrial processes are cooled by use of non-contact cooling water, some use air cooling systems which directly reject heat to the air. Air cooled plants employ high-flow forced draft fans to blow air across a system of finned tubes in the condenser through which the steam (or process fluid needing cooling) passes. The heat from the process is simply transferred to the ambient air directly.

The major benefit of air cooled systems is that they reduce a power plant's water usage (versus a water-cooled plant which has evaporative losses). Consequently, they are commonly considered for projects located in areas without adequate water supplies. In the case of HECA, there is a plentiful supply of suitable water available. Likewise, to a very small degree, they can avoid particulate emissions from the wet cooling tower. However, a major disadvantage of air cooled systems is that they consume a lot of power because of the large fans required. In a hot climate, the ambient air temperature (i.e., 40ºC) can severely limit the cooling potential compared with wet/evaporative cooling systems which would benefit from a cooler wet bulb temperature (i.e., 20ºC) which defines the potential for a wet system. In a power plant application, this results in a loss of efficiency (decreased power output), which increases plant costs and results in greater emissions of GHGs and criteria pollutants per kilowatt-hour from the power generator.

Additionally, air is not a particularly efficient heat transfer medium. Therefore, air cooled systems require a much larger cooling plant which is mechanically more complex. A 2009 U.S. DOE study stated that air cooled systems are three to four times more expensive than a recirculating wet cooling system.

- Drift Elimination System with limited TDS level

High-efficiency drift eliminators and limits on TDS concentrations in the circulating water are the techniques that set the basis for cooling tower BACT emission limits. The efficiency of drift eliminator designs is characterized by the percentage of the circulating water flow rate that is lost to drift. The drift eliminators to be used on the proposed cooling tower will be designed such that the drift rate is less than 0.0005 percent of the circulating water.

There is no $PM_{10}$ BACT guideline for mechanical draft cooling towers in the SJVAPCD. However, the use of high-efficiency drift-eliminating media to de-entrain aerosol droplets from the air flow exiting the wetted-media tower is a commercially proven technique to reduce $PM_{10}$ emissions. Compared to "conventional" drift eliminators, advanced drift eliminators reduce the $PM_{10}$ emission rate by more than 90 percent.

In addition to the use of high-efficiency drift eliminators, management of the tower water balance to control the concentration of dissolved solids in the cooling water can also reduce particulate emissions. Dissolved solids accumulate in the cooling water due to increasing concentrations of dissolved solids in the make-up water as the circulating water evaporates; and secondarily, to the addition of anti-corrosion, anti-biocide additives.

### *3. Rank Control Technologies*

For the control of PM from the cooling towers the following technologies in order of emission control effectiveness are:

- Air Cooled Condenser Technology
- Drift Elimination System with limited TDS level

### *4. Evaluate Control Options*

- Air Cooled Condenser Technology

*Cost effectiveness analysis*

A cost effectiveness analysis was conducted for the previous configuration of the HECA Project to determine if ACC would be cost effect to control PM emissions. The study examined the power cooling tower, although the operational capacity of this cooling tower has changed, the relative cost per ton of controlled PM is expected to remain similar. Below is the previous discussion.

The Water Minimization Study conducted by Fluor engineers and documented in Appendix X of the AFC (May 2009) provides a comparison of the performance and cost impact of using an ACC versus a water cooled condenser (WCC) for the power block of the Project. The performance and cost effectiveness analyses for an ACC system were conducted on the power block for the Project because this system represented the majority of the cooling load compared to the rest of the Project. The cost-effectiveness based on the increased capital costs/capital recovery for using an ACC system for the other cooling loads proposed in the Project would be comparable to those for the power block.

The HECA Water Minimization Study considered the total installed capital cost of an ACC system compared to the proposed WCC system for the steam turbine generator power block. Using the WCC as a "Base Case," the additional installed capital cost required for an ACC is estimated at approximately $37 million dollars.

The Cost-Effectiveness of using an ACC system can be calculating by dividing the total annualized cost by the amount of particulate matter emission reduction achieved using this type of system. Total annualized cost is calculated by annualizing the capital cost (capital recovery) and including other direct annual costs (labor, maintenance, utilities) and other indirect annual costs (property taxes, insurance, administrative charges, and overhead). However, to conservatively illustrate the poor cost-effectiveness for using an ACC to control particulate matter for the power block, the following calculation includes only the capital recovery component in the total annualized cost. Assuming a 7 percent interest and 20-year life the Capital Recovery Factor (CRF) is 0.0944. This results in a total annualized cost of $3.5 million dollars per year. The total particulate matter emissions from the power block cooling tower were estimated to be 16.4 tons per year. This results in a cost-effectiveness of greater than $213,900/ton of PM controlled based solely on the capital recovery costs, using techniques from the USEPA Cost Control Manual (USEPA, 2002). This cost would be even higher if the increased energy needs of the ACC were included (as discussed below). HECA believes that this high cost per ton of PM for using an ACC is cost prohibitive for the Project.

The “power output” of the steam turbine generator is partially dependent on the temperature of the coolant delivered to the surface condenser. The use of an ACC design will have warmer coolant temperature (ambient air) versus a water cooled design. Consequently, an ACC results in a slightly lower steam turbine generator output. Additionally, the electricity usage for running the fans for an air cooled system is higher than needed for a WCC. Compared to a WCC design, this decreased power output and increase parasitic power consumption would decrease the net electrical generation of an ACC design for the power block by approximately 8.4 MW. This increased electrical consumption/decreased output significantly would increase the annual operating costs for the air cooled system. Even conservatively valued at 8 cents per kilowatt hour, this is equivalent to an additional annual electrical cost of $5.6 million dollars per year. This cost alone is significantly higher than the annualized capital recovery cost shown above. If this cost was included with the above capital recovery component of annualized cost, it would confirm the high cost per ton of PM controlled to use ACC, and further support that an ACC system is cost prohibitive for the Project.

Due to the decreased performance of the steam turbine generator coupled with the cost-prohibitive economic analysis described above results in the ACC system being rejected as an economically feasible control technology for particulate matter emissions from the Project.

- Drift Elimination System with limited TDS level

The highest control efficiency to reduce the $PM_{10}$ emission from the proposed cooling towers involves the instillation of drift eliminators and adoption of TDS limit for the circulating water. Development of increasingly effective de-entrainment structures has resulted in equipment vendors’ claims that a cooling tower may be specified to achieve drift release no higher than 0.0005 percent of the circulating water rate for the HECA Project. This level of reduction has been approved in other recently permitted IGCC projects.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps.

Process cooling with an ACC system was rejected as an economically feasible control technology for particulate matter emissions from the Project. Thus, a drift elimination system is selected as BACT for the proposed cooling towers. The proposed cooling tower will be designed with a high-efficiency drift elimination system to minimize potential drift and particulate emissions, achieving a maximum drift of 0.0005 percent of the circulating water. This measure, along with a limit on the circulating water TDS, is considered to be the BACT option for particulate emissions from the cooling towers.

## 6.4 Auxiliary Boiler BACT Analysis

The auxiliary boiler will provide steam to facilitate CTG start up, and for other industrial purposes. The auxiliary boiler will be designed to burn pipeline-quality natural gas at the design maximum fuel flow rate of 213 MMBtu/hr (HHV). During operation, the auxiliary boiler may be kept in warm standby (steam sparged, no firing) or cold standby (no firing), and will not have emissions. The boiler will produce a maximum of about 150,000 pounds per hour of steam.

Pollutant emissions from natural gas boiler units include $NO_X$, $PM_{10}$, CO, $SO_2$, and VOCs. The auxiliary boiler emissions are based on 2,190 hours of operation per year. The applicant is proposing proper boiler design and operation, low-$NO_X$ combustors with Flue Gas Recirculation (FGR), Selective Catalytic Reduction (SCR) and use of natural gas to be the BACT for the auxiliary boiler. This emission limitation is proposed to meet the SJVAPCD BACT Guidelines for greater than 20.0 MMBtu/hr natural-gas–fired boiler (base-loaded or with small load swings).

### *1. Identify Control Technologies*

The following criteria pollutant emissions control technologies were evaluated for the proposed auxiliary boilers:

*Potential Auxiliary Boiler Control Technology*

*For $NO_X$ emission controls*

- Low-$NO_X$ combustor
- Low-$NO_X$ combustor with Flue Gas Recirculation
- Selective Catalytic Reduction
- Selective Non-Catalytic Reduction

*For CO emission controls*

- Good Combustion Practices
- CO Oxidation Catalysts

### 6.4.1 Nitrogen Oxides BACT Analysis for the Auxiliary Boiler

*2. Evaluate Technical Feasibilities*

- Low-$NO_X$ Combustors

  Low-$NO_X$ combustors reduce thermal $NO_X$ formation by regulating the distribution and mixing of fuel and air to control the stoichiometry and temperature of combustion. Historically, low-$NO_X$ combustors have been selected as BACT for natural-gas–fired auxiliary boilers. Therefore, low-$NO_X$ combustor technology is technically feasible for the proposed auxiliary boiler.

- Low-$NO_X$ Combustors with Flue Gas Recirculation

  FGR reduces boiler $NO_X$ emissions by recirculating a portion of the flue gas into the main combustion chamber. The increase in gas flow within the combustion chamber reduces the peak combustion temperature and oxygen in the combustion air/flue gas mixture, thereby reducing the formation of thermal $NO_X$. The application of FGR is typically in combination with low-$NO_X$ combustor technology and has been selected as BACT for some auxiliary boiler processes. Therefore, FGR is considered technically feasible for the proposed auxiliary boiler.

- Selective Catalytic Reduction

  SCR is a technology that achieves post-combustion reduction of $NO_X$ from flue gas within a catalytic reactor. The SCR process involves the injection of $NH_3$ into the exhaust gas stream upstream of a specialized catalyst module to promote the conversion of $NO_X$ to molecular nitrogen. SCR technology has been most commonly applied to pulverized coal–generating units and to natural gas–fired combustion turbines.

- Selective Non-Catalytic Reduction

  Selective non-catalytic reduction is a post-combustion $NO_X$ control technology in which a reagent ($NH_3$ or urea) is injected into the exhaust gases to react chemically with $NO_X$ to form elemental nitrogen and water without the use of a catalyst. The success of this process in reducing $NO_X$ emissions is highly dependent on the ability to achieve uniform mixing of the reagent into the flue gas, which must occur within a narrow flue gas temperature zone (typically from 1,700°F to 2,000°F).

  The consequences of operating outside the optimum temperature range are severe. Above the upper end of the temperature range, the reagent will be converted to $NO_X$. Below the lower end of the temperature range, the reagent will not react with the $NO_{X,}$ resulting in very high $NH_3$ slip concentrations ($NH_3$ discharge from the stack).

  Although there are expected to be technical difficulties with SNCR, due to the lack of flue gas locations within the process with the optimal requisite temperature and residence time characteristics to facilitate the SNCR flue gas reactions, the RBLC shows SNCR applied in only two boiler units greater than 100 MMBtu/hr. The control cited in both of these examples is 60 percent.

### *3. Rank Control Technologies*

The RBLC examples for low-$NO_X$ combustors combined with either FGR or SCR give efficiencies of up to 95 percent with FGR and efficiencies of up to 97 percent with SCR. Both of these technologies have reported control efficiencies that are significantly greater than that for SNCR. Low-$NO_X$ combustors and SCR have recently been selected as BACT for other projects, and report slightly greater control than low-$NO_X$ combustors with FGR. The expected emission rate for the HECA auxiliary boiler operating with low-$NO_X$ combustors and FGR is 9 ppm $NO_X$ at 3 percent $O_2$, while the expected emission rate with low-$NO_X$ combustors and SCR is 5 ppm $NO_X$ at 3 percent $O_2$.

### *4. Select Control Technology*

Low-$NO_X$ combustor technology and flue gas recirculation have historically been selected as BACT for natural-gas–fired auxiliary boilers. These technologies are commonly used in combination to reduce $NO_X$ emissions in other recently permitted IGCC projects. However, the HECA auxiliary boiler is expected to have more $NO_X$ control by using SCR instead of FGR, as mentioned above. Therefore, the proposed auxiliary boiler will be designed with a Low-$NO_X$ combustor technology and SCR, achieving a maximum $NO_X$ emission concentration of 5 ppm $NO_X$ at 3 percent $O_2$ on natural gas fuel.

## 6.4.2 Carbon Monoxide BACT Analysis for the Auxiliary Boiler

An inadequate degree of fuel mixing, lack of available oxygen, or low temperatures in the combustion zone are common causes of incomplete combustion that results in CO emissions. Fuel quality and good combustion practices can limit CO emissions. Good combustion practice has commonly been determined as BACT for natural gas–fired auxiliary boilers. Post-combustion control technologies using catalytic reduction have also been employed in some processes to reduce CO and VOC emissions.

### *2. Evaluate Technical Feasibilities*

*Good Combustion Practices*

GCPs include the use of operational and design elements that optimize the amount and distribution of excess air in the combustion zone to ensure complete combustion. Good combustion practice has historically been determined as BACT for CO and VOC emissions from auxiliary boilers, and is a technically feasible control strategy for the proposed auxiliary boiler.

*Oxidation Catalyst*

Catalytic oxidation is a post-combustion control technology that uses a catalyst to oxidize CO and VOC into $CO_2$ or $H_2O$. The technology has most commonly been applied to natural gas–fired combustion turbines. No examples were identified where oxidation catalyst technology has been applied to an auxiliary boiler. Because of the low potential CO and VOC emission without an oxidation catalyst and the limited use of the proposed auxiliary boiler, the use of catalytic oxidation technology is determined to be infeasible.

#### *3. Rank Control Technologies*

Good combustion practice is the only feasible control strategy identified, and has historically been selected as BACT for CO emissions from the auxiliary boiler.

#### *4. Select Control Technology*

The use of good combustion practices has been selected as BACT for potential CO emission from the proposed auxiliary boiler. Boiler vendor information indicates that a CO worst-case hourly emission for the proposed auxiliary boiler is 50 ppmvd at 3 percent $O_2$.

### 6.4.3 Particulate Emissions, Sulfur Oxides, Volatile Organic Compounds BACT Analysis for the Auxiliary Boiler

For these pollutants, the commercially available control measures that are identified in the most stringent BACT determinations are use of low-sulfur, PUC natural gas, and GCP. Based on SJVAPCD BACT Guidelines for > 20.0 MMBtu/hr Natural Gas–Fired Boiler (base-loaded or with small load swings), add-on controls were not implemented to achieve BACT limits for these pollutants.

Boiler vendor information indicates that the worst-case hourly emissions for this unit with these technologies would be 0.00285 lb $SO_2$/MMBtu; 0.004 lb VOC/MMBtu; and 0.005 lb $PM_{10}$/MMBtu. These rates, or corresponding lb/hour emission rates, are proposed as BACT limits for the auxiliary boiler emission unit.

## 6.5 Diesel Engines BACT Analysis

The Project will include two 2,922 HP standby diesel generators and one 556 HP, standby firewater pump. HECA proposed to apply the SJVAPCD BACT Guidelines for Emergency Diesel I.C. Engine = or > 400 hp as the BACT for the standby diesel generator engines, and SJVAPCD BACT Guidelines for Emergency Diesel I.C. Engine Driving a Fire Pump as the BACT for the standby firewater pump engine. The BACT emission limits will be achieved by the following control effort.

- Low Sulfur Fuel Selection

  The diesel engines will exclusively combust ultra-low sulfur diesel fuel. $SO_2$ emissions were estimated using ultra-low sulfur diesel fuel containing 15 ppm sulfur.

- Clean Combustion Process Selection

  The engines will meet USEPA interim Tier 4 emissions standards.

  Standby diesel generator engine: 0.3 g/bhp-hr NMHC; 0.5 g/bhp-hr $NO_X$; 2.6 g/bhp-hr CO; 0.07 g/bhp-hr PM

  Standby firewater pump engine: 0.14 g/bhp-hr NMHC; 1.5 g/bhp-hr $NO_X$; 2.6 g/bhp-hr CO; 0.015 g/bhp-hr PM

- Restricted Operating Hours

  The standby diesel generators will operate less than 50 hours per year per engine for non-emergency purposes such as: routine testing, maintenance, and inspection purposes. The fire pump will operate than less than 100 hours per year per engine for non-emergency purposes.

### 6.5.1 BACT Analysis for the Standby Diesel Generators

The achieved-in-practice or contained in the SIP BACT guideline for $NO_X$ is certified emissions of 6.9 g/bhp-hr or less. The proposed control of using engines that meet USEPA interim Tier 4 emissions standards for 2011 and newer model equipment will meet this BACT limit with 0.5 g/bhp-hr $NO_X$. Although it is technically feasible to install add-on $NO_X$ control, this option is cost prohibitive due to the emergency nature of the engine operations.

The achieved-in-practice or contained in the SIP BACT guideline for CO is 2.0 g/bhp-hr. The vendor emission factor for the diesel engines guaranteed 0.29 g/bhp-hr of CO emission. This emission limit is substantially below the required BACT limit. Although it is feasible to install a CO oxidation catalyst to further reduce CO emissions from the engines, the cost for oxidation catalyst for CO control will be prohibitive, given the low number of routine operating hours per year of the engines.

The achieved-in-practice or contained in the SIP BACT guideline for $PM_{10}$ is 0.1 gram/bhp-hr (if TBACT is triggered) or 0.4 g/bhp-hr (if TBACT is not triggered). The proposed control of using engines that meet USEPA interim Tier 4 emissions standards will meet this BACT limit with 0.07 g/bhp-hr PM.

The achieved-in-practice or contained in the SIP BACT guideline for sulfur oxides is low-sulfur diesel fuel (500 ppmw sulfur or less) or Very Low-Sulfur Diesel fuel (15 ppmw sulfur or less). The standby diesel generator engines will exclusively combust ultra-low sulfur diesel fuel. $SO_2$ emissions were estimated using ultra-low sulfur diesel fuel containing 15 ppm sulfur.

There is no numerical emission limit achieved in practice or contained in the SIP BACT guideline for VOC. The proposed control of using engines that meet USEPA interim Tier 4 emissions standards for 2011 and newer model equipment proposed a BACT limit with 0.3 g/bhp-hr VOC for this unit.

### 6.5.2 BACT Analysis for the Firewater Pump Diesel Engine

The achieved-in-practice or contained in the SIP BACT guideline for $NO_X$ is certified emissions of 6.9 g/bhp-hr or less. The proposed control of using engines that meet USEPA interim Tier 4 emissions standards will meet this BACT limit with 1.5 g/bhp-hr $NO_X$. Although it is technically feasible to install add-on $NO_X$ control, this option is cost prohibitive due to the emergency nature of the fire/water pump engine operations.

There is no numerical emission limit achieved in practice or contained in the SIP BACT guideline for CO. The proposed control of using engines that meet USEPA interim Tier 4 emissions standards proposed a BACT limit with 2.6 g/bhp-hr CO for this unit. Although it is feasible to install a CO oxidation catalyst to further reduce CO emissions from the engines, the cost for an oxidation catalyst for CO control will be prohibitive, given the low number of routine operating hours per year of the fire water pump.

The achieved-in-practice or contained in the SIP BACT guideline for $PM_{10}$ is 0.1 grams/bhp-hr (if TBACT is triggered) or 0.4 grams/bhp-hr (if TBACT is not triggered). The proposed control of using engines that meet USEPA interim Tier 4 emissions standards will meet this BACT limit with 0.015 g/bhp-hr PM.

The achieved-in-practice or contained in the SIP BACT guideline for sulfur oxides is low-sulfur diesel fuel (500 ppmw sulfur or less) or ultra-low sulfur diesel fuel (15 ppmw sulfur or less). The firewater-pump diesel engine will exclusively combust ultra-low sulfur diesel fuel. $SO_2$ emissions were estimated using ultra-low sulfur diesel fuel containing 15 ppm sulfur.

No numerical emission limit is achieved in practice or contained in the SIP BACT guideline for VOC. The proposed control of using engines that meet USEPA interim Tier 4 emissions standards for 2011 and newer model equipment proposed a BACT limit with 0.14 g/bhp-hr VOC for this unit.

## 6.6 Gasification Flare BACT Analysis

The gasification block will be provided with a relief system and associated gasification flare to safely dispose of gasifier streams during start up, shut down, and unplanned upsets or emergency events, syngas during AGR start up, hydrogen-rich gas during short-term emergency combustion turbine outages, or other various streams within the Project during other unplanned upsets or equipment failures. Syngas sent to the flare during normal planned flaring events is filtered, water-scrubbed and further treated in the AGR Unit to remove regulated contaminants prior to flaring.

Two flare-control technologies were evaluated for the proposed facility: an elevated flare, and an enclosed ground flare. Elevated flare technology uses a stack to vent combustible process gases to a combustor located at the top, resulting in an open flame at the stack discharge. Elevated flares provide for greater dispersion of heat and combustion products than ground flares. Elevated flares are the most common technology used by refinery, steel, and chemical industries, and are used by operational and recently permitted IGCC projects.

Compared to an elevated flare, an enclosed ground flare offers better CO destruction. However, enclosed ground flares pose potentially decreased dispersion of combustion gases and increased reliability concerns and have never been installed on any IGCC plants and so are considered unproven technology in this application with an associated risk. Elevated flares are used extensively with IGCC applications and therefore, the gasification block will be designed with an elevated flare to safely dispose of gasifier start-up gases, hydrogen-rich fuel during AGR start up, hydrogen-rich gas during short-term emergency combustion turbine outages, or other various streams within the Project during other unplanned upsets or equipment failures.

The flare, when in operation, will emit criteria pollutants that are products of combustion. However, the chemical compositions of the predominant gaseous fuels that would be flared; i.e., syngas and natural gas, result in low emissions of $PM_{10}$, $SO_2$, and VOC. For the syngas case, there is very little unoxidized carbon in the fuel, which limits the formation of particulate matter during combustion even below the rate for natural gas. Formation of $SO_2$ is limited by not intentionally flaring untreated syngas and the inherently low sulfur content of treated syngas and pipeline natural gas.

### *1. Identify Control Technologies*

The following control technologies were evaluated for the proposed gasification flare:

- Clean pilot fuel (Natural gas) and Good Combustion Practices
- Low-$NO_X$ Combustor
- Add-On Controls
- Limited Operation

### *2. Evaluate Technical Feasibilities*

- Clean pilot fuel (Natural Gas) and Good Combustion Practices

  A certain level of flame temperature control can be exercised for the gasification flare by implementing fuel/air ratio control. Flare BACT options that have been achieved in practice in California (e.g., CAPCOA BACT Clearinghouse) indicate a natural gas pilot and “proper burner management and monitoring” are used to control the emissions of CO, VOCs and $NO_X$.

- Low-$NO_X$ Combustor

  Low-$NO_X$ combustor and ultralow-$NO_X$ combustor technology alter air-to-fuel ratio in the combustion zone by staging the introduction of the air to promote a "lean-premixed" flame. This results in lower combustion temperatures and reduced $NO_X$ formation. Such designs are not available for elevated flares that do not have a confined combustion zone, which would allow staged introduction of fuel and air streams. Therefore, this control technology is not feasible for the proposed gasification flare.

- Add-On Controls

  The gasification block flare is not a candidate for add-on abatement systems. It is generally recognized in the chemical process industries that adoption of add-on control can impede the ability of a flare to respond to unexpected upset conditions. Therefore, this control technology is not feasible for the proposed gasification flare.

- Limited Operations

  The gasification flare planned operation will be limited to gasifier start ups and shut downs, which occurs at most twice a year.

For plant safety, the flare must provide a "fail-safe" that is available regardless of the functioning of pollution control devices.

### *3. Rank Control Technologies*

The use of natural gas as pilot fuel, good combustion practices and limited operation were identified as the only technically feasible criteria pollutant emissions control technologies applicable to the proposed gasification flare.

### *4. Evaluate Control Options*

As determined in the last section, the use of natural gas as pilot fuel, good combustion practices and limited operation are the only feasible control strategy identified. Based on review of SJVAPCD BACT guideline, there is no BACT determination source category for flare that supports the gasification process.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As has been explained, use of natural gas as pilot fuel, good combustion practices and limited operation are selected as BACT for the proposed gasification flare. The measure, along with natural gas pilot and processes flare gas for non-emergency operation are considered to be the best available control option for criteria pollutant emissions from the gasification flare. The proposed criteria pollutant emissions for the gasification flare are summarized in Table 6-8.

**Table 6-8**
**Gasification Flare Total Criteria Pollutant Emissions**

| Pollutant | Emissions | | |
|---|---|---|---|
| | Pilot (ton/yr) | Start-Up/ Shut-Down (ton/yr) | Total (ton/yr) |
| $NO_X$ | 0.263 | 2.91 | 3.17 |
| CO | 0.175 | 18.28 | 18.46 |
| VOC | 0.003 | 0.01 | 0.01 |
| $SO_2$ | 0.004 | 0.02 | 0.02 |
| $PM_{10}$ | 0.007 | 0.03 | 0.03 |

Notes:
CO = carbon monoxide
$NO_X$ = oxides of nitrogen
$PM_{10}$ = particulate matter 10 microns in diameter or less
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

## 6.7 Sulfur Recovery System BACT Analysis

The sulfur recovery system is designed to process acid gas streams from the AGR system and IGCC process into an elemental sulfur product. Sulfur is removed from the processing facility through a sulfur complex which consists of a Claus unit (thermal stage) plus catalytic converters otherwise known as the SRU. The SRU is a totally enclosed process with no discharges. The tail gas stream from the SRU is composed mostly of carbon dioxide, water vapor, and sulfur vapor with trace amounts of $H_2S$ and $SO_2$. The tail gas is routed to the Tail Gas Treating Unit (TGTU) where the tail gas is catalytically hydrogenated, compressed, and completely recycled to the Shift Unit.

The proposed sulfur process facility consists of one 100 percent SRU, and one TGTU. HECA proposed the integral use of two elevated flares, a caustic scrubber, and a thermal oxidizer as control devices to provide for the safe and efficient destruction of combustible gas streams. These control devices are primarily used intermittently during short-term periods of start up, shut down, and malfunction operations.

### *1. Identify Control Technologies*

The following control technologies were evaluated for the proposed Sulfur Recovery System:

- Thermal Oxidizer
- Flare
- Caustic Scrubber
- Limited Operation

### *2. Evaluate Control Technologies*

- Thermal Oxidizer

  In the thermal oxidizer, the TGTU tail gas and other oxidizing streams are subjected to a high temperature and a sufficient residence time to cause an essentially complete destruction of reduced sulfur compounds such as $H_2S$. The thermal oxidizer uses natural gas to reach the necessary operating temperature for optimal thermal destruction. The thermal oxidizer also controls emissions from various systems during operations, including the sulfur pit vent. A continuous natural gas pilot will be in service on both controls. The flare and thermal oxidizer are the only control technologies identified that are capable of controlling the variable potential gas streams associated with the sulfur recovery process and the start up, shut down, and malfunction of the integrated IGCC systems.

Good thermal oxidizer design includes optimization of parameters that maintain efficiency, such as temperature, residence time, and the mixing of gas streams in the combustion zone. The proposed thermal oxidizer will use natural gas for preheating and to facilitate the combustion of process gases in the thermal oxidizer. Implementation of these elements into the design and operation of the thermal oxidizer, in combination with the use of a natural-gas pilot flame, will support a thermal oxidizer control technology that minimizes incomplete combustion, which directly correlates to potential criteria pollutant emissions.

- Flare

Emissions from the IGCC gas cleanup process cannot be directed to certain control systems and/or the combustion turbines during start-up and shut-down operations, or during operational malfunctions. Directly venting these emissions could result in very high concentrations of $SO_2$, CO, VOCs, $NO_X$, and/or $H_2SO_4$ being released. In this case, two elevated flares are selected to accommodate the variability inherent in these operations: Sulfur Recovery Unit Flare, and Rectisol® Flare.

The SRU Flare will be used to safely dispose of gas streams containing sulfur during start up and shut down, and gas streams containing sulfur during unplanned upsets or emergency events. Acid gas derived from the AGR, gasification unit, and Sour Water Stripper overhead is normally routed to the SRU for recovery as elemental sulfur. During cold plant start up of the gasifiers, AGR, and Shift units, these acid-gas streams will be diverted to the SRU Flare Header for a short time. To reduce the emissions of sulfur compounds to the environment during SRU or TGTU shutdown, the acid gas is routed to the Emergency Caustic Scrubber, where the sulfur compounds are absorbed with caustic solution. After scrubbing, the gas is then routed to the elevated SRU Flare Stack. It is expected that a maximum of 40 hours per year of flaring for this purpose would be required by this flare.

The Rectisol® flare may be used for off-specification carbon dioxide during gasifier start-up or shut-down events. It is expected that a maximum of 40 hours per year of flaring for this purpose would be required by this flare.

Enclosed ground flares have the potential to minimize flame appearance and provide a setting for monitoring post-combustion gas streams. However, they have not been proven for the proposed facility because of reliability concerns.

Elevated flares are used extensively with IGCC applications and therefore, are considered proven technology. The SRU will be designed with an elevated flare.

- Caustic Scrubber

  During cold plant start up of the gasification block, acid-gas streams will be diverted to a caustic scrubber prior to being directed to the elevated flare for a short time. The caustic scrubber removes $H_2S$ from the acid gas stream with an anticipated scrubbing efficiency of at least 99.6 percent sulfur removal.

### *3. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. As discussed, the use of flares, thermal oxidizer, and caustic scrubber are the proposed technologies designed to control criteria pollutant emissions from the sulfur recovery system, in addition to an efficient IGCC process design. These technologies complement one another, and may operate in combination with each other. In addition, limited planned operation of each will control emissions.

Including the proposed control system to provide for the safe and efficient destruction of combustible sulfur-rich acid-gas streams, the emissions from the sulfur recovery system are categorized into three emission sources of tail gas thermal oxidizer, SRU flare and Rectisol® flare (elevated flares with natural gas assist). Each emission source has its own emission control measure to reduce its criteria pollutant emissions. The proposed criteria pollutant emissions for the sulfur recovery system are summarized in Table 6-9. HECA has selected all of the control technologies that were evaluated for the Sulfur Recovery System, and proposes these as BACT for the Project.

**Table 6-9**
**Sulfur Recovery System Emissions**

| Pollutant | Thermal Oxidizer Emissions (lb/MMBtu, HHV) | SRU Flare Emissions | | | Rectisol® Flare Emissions | | |
|---|---|---|---|---|---|---|---|
| | | Pilot (ton/yr) | Start-Up/ Shut-Down (ton/yr) | Total (ton/yr) | Pilot (ton/yr) | Start-Up/ Shut-Down (ton/yr) | Total (ton/yr) |
| $NO_X$ | 0.24 | 0.158 | 0.09 | 0.24 | 0.158 | 1.03 | 1.19 |
| CO | 0.2 | 0.105 | 0.06 | 0.16 | 0.105 | 0.69 | 0.79 |
| VOC | 0.006 | 0.002 | 0.00 | 0.00 | 0.002 | 0.01 | 0.01 |
| $SO_2$ | See Below | 0.003 | 0.37 | 0.37 | 0.003 | 0.30 | 0.30 |
| $PM_{10}$ | 0.008 | 0.004 | 0.00 | 0.01 | 0.004 | 0.03 | 0.03 |

Assume an allowance of 2 lb/hr $SO_2$ emission to account for sulfur in the various vent streams, plus fuel.

Notes:

CO = carbon monoxide
$NO_X$ = oxides of nitrogen
$PM_{10}$ = particulate matter 10 microns in diameter or less
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

## 6.8 $CO_2$ Vent BACT Analysis

The Project will produce electricity while substantially reducing GHG emissions by capturing $CO_2$. At least 90 percent of the carbon in the raw syngas will be captured in a high-purity carbon dioxide stream during steady-state operation. The high-purity $CO_2$ will be compressed and transported by pipeline to the EHOF for injection into deep underground hydrocarbon reservoirs for $CO_2$ EOR.

A $CO_2$ vent stack will allow for infrequent venting of produced $CO_2$ from the AGR and TGTU when the $CO_2$ injection system is unavailable, unable to export, or other upset condition. The $CO_2$ vent will enable HECA to operate, rather than be disabled, by brief periods of gasifier shutdown and subsequent gasifier restart. The $CO_2$ vent exhaust stream will be nearly all $CO_2$, with small amounts of CO, VOC, and $H_2S$.

Due to the infrequent nature of the venting event, the option of using add-on control technology is cost prohibitive for this emission point. In order to reduce the impact of this infrequent venting event, good engineering practice stack height, limited venting duration, and vent gas concentration limits are selected as BACT for this source.

HECA proposed a maximum of 504 hours of venting duration for this unit. The pollutant concentrations in the vent gas are limited to 1,000 ppm for CO, 40 ppm for VOCs, and 10 ppm for $H_2S$ to reduce the overall impact of the venting event.

### *Good Engineering Practice Stack Height*

The USEPA provides specific guidance for determining the Good Engineering Practice (GEP) stack height and for determining whether building downwash will occur in the *Guidance for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations*). GEP is defined as “the height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, and wakes that may be created by the source itself, nearby structures, or nearby terrain obstacles.”

The GEP definition is based on the observed phenomenon of atmospheric flow in the immediate vicinity of a structure. It identifies the minimum stack height at which significant adverse aerodynamics (downwash) are avoided. The USEPA GEP stack height regulations specify that the GEP stack height is calculated in the following manner:

$$H_{GEP} = H_B + 1.5L$$

where:

$H_B$ = the height of adjacent or nearby structures; and

L = the lesser dimension (height or projected width) of the adjacent or nearby structures.

The regulations also specify that the creditable stack height for modeling purposes is either the GEP stack height as calculated, or a *de minimis* height of 65 meters.

A 260-foot stack height was chosen to satisfy HECA's inherently safe design practices to minimize ground-level $CO_2$ concentrations in the event of a $CO_2$ vent under very low wind speeds.

## 6.9 Material Handling System BACT Analysis

Particulate matter emissions are associated with the material handling of with the feedstock (petcoke and coal), and dry product (urea and gasification solids). The conveyance and preparation processes related to the feedstock and products have a potential to emit particulate matter. The following is the BACT analysis for the proposed material handling system at HECA.

### 6.9.1 Particulate Matter BACT Analysis for the Material Handling System

Because the feedstock preparation processes will be within an enclosed conveyor system, a forced air dust collection system is the most appropriate and common control technology for particulate matter emission control from the emission points. The material handling system will consist of the following activities, all with associated baghouses:

- Truck/Train feedstock unloading
- Petcoke/coal crushing building and transfer towers
- Urea transfer towers
- Urea unloading buildings
- Gasification solids transfer tower and load-out

HECA selected dust collection systems consisting of baghouses as BACT to control particulate emissions from the aforementioned emission points. The baghouses associated with the material handling at HECA will have a maximum dust collector PM emission rate based on expected supplier guarantee of 0.001 grain/scf outlet dust loading.

A dust collection system using baghouses has been proposed as BACT in other operating and recently permitted IGCC projects. The proposed emission limitation represents a removal efficiency that is comparable or lower with the emissions achieved in practice at currently operating IGCC units, and the lowest recently permitted IGCC units.

## 6.10 Manufacturing Complex BACT Analysis

The BACT analysis for the Manufacturing Complex is broken down by emission units. Nitrogen-based product production at HECA consists of: an ammonia synthesis unit, where the only emission source is an ammonia plant start-up heater (combustion emissions); a urea unit (scrubber emissions); a urea pastillation unit (particulate matter emissions); and a Urea Ammonium Nitrate (UAN) Unit, consisting of a nitric acid unit and an ammonium nitrate unit as emission sources. BACT for the material handling processes for the Manufacturing Complex are addressed in Section 6.9. The RBLC was examined for similar sources. Most of the facilities listed in the RBLC are different from the HECA Manufacturing Complex; however, there are many similar components. Thus many of the proposed BACT levels are not compared to those from existing facilities unless similar source units had process operations (such as unit inputs and outputs) that were comparable to HECA.

### 6.10.1 Ammonia Synthesis Unit

The high-purity hydrogen stream, from the Pressure Swing Adsorption (PSA) Unit, and nitrogen, from the ASU, are combined in an exothermic ammonia synthesis reaction that takes place at high temperature and high pressure across an iron-based catalyst. There is a large degree of heat integration within the Ammonia Synthesis Unit, and the substantial heat of reaction is recovered and used to generate steam. Cold liquid ammonia is stored in a tank at atmospheric pressure.

There are no normal operating emissions from the ammonia synthesis unit. However, a start-up heater (natural gas-fired) is used to heat the catalyst during a cold start of the unit. A 55 MMBtu/hr natural gas–fired start-up heater is provided in the ammonia synthesis unit to raise the catalyst-bed temperatures during initial plant commissioning or during start up after a long period of plant shutdown.

The annual heat input for this heater is not expected to exceed 7,700 MMBtu (HHV), which is equivalent to approximately 140 hours of operation at full capacity.

The heater will use a low-$NO_X$ burner to control emissions to 9 ppm. The heater will only combust natural gas, therefore the potential for $SO_2$, VOC, and PM emissions is minimized. Good combustion practices will optimize the performance of the heater, thereby minimizing the emissions of CO. The proposed BACT emission rates for the ammonia synthesis start-up heater are presented in Table 6-10. Therefore, BACT for the heater was determined to be a low-$NO_X$ burner, GCP, natural gas fuel, and restricted operating hours.

**Table 6-10**
**Ammonia Synthesis Startup Heater Emissions**

| Pollutant | Emission Limit |
|---|---|
| $NO_X$ | 0.011 lb/MMBtu, HHV – 9 ppmvd (3% $O_2$) |
| CO | 0.037 lb/MMBtu, HHV – 50 ppmvd (3% $O_2$) |
| $PM_{10}$ | 0.005 lb/MMBtu, HHV |
| $SO_2$ | 0.002 lb/MMBtu, HHV (12.65 ppm) |
| VOC | 0.004 lb/MMBtu, HHV |

Notes:
CO = carbon monoxide
$NO_X$ = oxides of nitrogen
$PM_{10}$ = particulate matter 10 microns in diameter or less
$SO_2$ = sulfur dioxide
VOC = volatile organic compound

### 6.10.2 Urea Unit – High and Low Pressure Absorbers

The purified and compressed carbon dioxide and the liquid ammonia are reacted in the Urea Unit to create a concentrated urea solution, which is pumped to the Urea Pastillation Unit. Lower-concentration urea solution is produced as a feedstock to the urea ammonia nitrate (UAN) Solution Plant. Vacuum evaporator/separator systems are used to produce the required urea solutions.

The off-gases from the urea synthesis process, consisting of inerts present in the $CO_2$ feed, process air and unreacted ammonia are cleaned before being vented in the high-pressure (HP) scrubber, which operates at an elevated pressure. The off-gases are scrubbed first with process water, and second with clean cold water. In this way, nearly all of the ammonia is scrubbed from the gas.

Low pressure off-gases are cleaned in the low-pressure (LP) scrubber, which operates at close to atmospheric pressure. Here, the off-gas is scrubbed with clean cold water to reduce the ammonia content in the vent.

The only emissions associated with the HP and LP Absorbers are ammonia, which are reduced by the wet scrubbers. HECA proposes BACT for the HP and LP Absorbers to be wet scrubbers.

### 6.10.3 Urea Unit- Pastillation

The pastillation process is used to convert the urea melt into high-quality pastilles. This process is enclosed with a hood, passed through a baghouse then vented. Limited ammonia and urea dust, which is classified as $PM_{10}$, are emitted from this source.

The only BACT level grain loading provided was 0.0960 gr/dscf. The RBLC shows no listings for ammonia emissions or control.

The vent from the urea pastillation building is treated with a baghouse filter in order to reduce the particulate loading in the atmospheric vent. The HECA granulation process PM/$PM_{10}$ emissions are expected to have a grain loading of 0.001 gr/dscf with use of a baghouse, and is therefore considered BACT.

HECA proposes BACT for the Urea Pastillation Unit to be a baghouse with a grain loading of 0.001 gr/dscf.

### 6.10.4 Nitric Acid Unit

Nitric acid production is a three-step process consisting of ammonia oxidation, nitric oxide (NO) oxidation and absorption. Tail gas from the absorber column will be cleaned before being discharged by catalytic decomposition and reduction of both nitrous oxide ($N_2O$) and $NO_X$.

## *1. Identify Control Technologies*

The following $NO_X$ control technologies were evaluated for the proposed Nitric Acid Unit:

- Extended Absorption with Selective Non-Catalytic Reduction (SNCR)
- Selective Catalytic Reduction (SCR)

## *2. Evaluate Technical Feasibilities*

- Extended Absorption with Selective Non-Catalytic Reduction

  Extended absorption reduces $NO_X$ emissions by increasing absorption efficiency and is achieved by either installing a single large tower, extending the height of an existing absorption tower, or by adding a second tower in series with the existing tower.

  Selective non-catalytic reduction is a $NO_X$ control technology in which a reagent ($NH_3$ or urea) is injected into the flue gases to react chemically with $NO_X$ to form elemental nitrogen and water without the use of a catalyst. The success of this process in reducing $NO_X$ emissions is highly dependent on the ability to achieve uniform mixing of the reagent into the flue gas, which must occur within a narrow flue gas temperature zone (typically from 1,700°F to 2,000°F). The consequences of operating outside the optimum temperature range are severe. Above the upper end of the temperature range, the reagent will be converted to $NO_X$. Below the lower end of the temperature range, the reagent will not react with the $NO_{X,}$ resulting in very high $NH_3$ slip concentrations ($NH_3$ discharge from the stack).

  Although there are expected to be technical difficulties with Extended Absorption with SNCR, due to the lack of flue gas locations within the process with the optimal requisite temperature and residence time characteristics to facilitate the SNCR flue gas reactions and the need for larger or additional absorption towers, the RBLC shows Extended Absorption with SNCR was applied at one nitric acid plant. The control cited was 1.6 lb/ton of nitric acid produced.

- Selective Catalytic Reduction

  SCR is a technology that achieves reduction of $NO_X$ from flue gas within a catalytic reactor. The SCR process involves the injection of $NH_3$ into the exhaust gas stream upstream of a specialized catalyst module to promote the conversion of $NO_X$ to molecular nitrogen.

  A RBLC review identified that SCR technology has been applied to a number of nitric acid plants lowering $NO_X$ emissions as low as 0.524 lb/ton of nitric acid produced.

## *3. Rank Control Technologies*

The RBLC review provided examples of $NO_X$ control with SCR and Extended Absorption with SNCR, neither is identified as providing more control of $NO_X$.

### *4. Evaluate Control Options*

The next step in a BACT analysis is to evaluate the feasible control technology. Based on the evaluation in the previous step, the technology with the maximum control is SCR.

The $N_2O$ emissions are treated in a tertiary reduction system, based on its location at the end of the tail gas heat recovery system. Primary and secondary reduction occurs in the nitric acid unit equipment without any catalysis simply by the high process temperature. In the tertiary reduction, a reducing catalyst that uses high temperature rather than a reducing agent, converts 95 percent of the remaining $N_2O$ emission to molecular nitrogen ($N_2$) and nitric oxide (NO). The $NO_X$ emissions (including the NO formed in the $N_2O$ converter) are then reduced in one or more selective catalytic reduction (SCR) units, with injected ammonia as a reducing agent, as is typical for $NO_X$ control in flue gas systems. Total $NO_X$ emissions from this unit will not exceed 0.2 lb/ton of dry nitric acid or 15 ppmv $NO_X$.

This is far below the NSPS of 3 lb/ton, the proposed NSPS of 0.50 lb/ton, and also well below other limits cited in the RBLC, which range from 0.52 to 3.0 lb/ton, using NSCR or SCR. The levels of control vary for each of these control types; neither is identified as providing more control of $NO_X$. Injection of hydrogen peroxide is also listed as BACT for one source, with a $NO_X$ limit of 0.6 lb/ton $HNO_3$. Because the expected $NO_X$ emission level for the HECA nitric acid unit is well below these values, it is considered that BACT is the application of SCR for control of $NO_X$ emissions from the nitric acid unit.

Only one source in the RBLC noted a limit for $NH_3$ emissions due to ammonia slip. This source had a BACT limit of 10 ppmv. The HECA nitric acid plant will have an emission limit of 5 ppm for $NH_3$ due to slip from the SCR unit and proposes this as the BACT level.

### *5. Select Control Technology*

The final step in the top-down BACT analysis process is to select BACT based on the results of the previous steps. For the nitric acid unit at HECA, SCR to control $NO_X$ emission limits is considered BACT. HECA proposes the SCR to control $NO_X$ on the nitric acid unit to 0.2 lb/ton of dry nitric acid and an emission limit of 5 ppm for $NH_3$ due to slip from the SCR unit.

## 6.10.5 Ammonium Nitrate Unit

The ammonia and nitric acid are the feedstocks to the ammonium nitrate unit, which makes the ammonium nitrate solution. The ammonium nitrate unit vent stream contains water vapor and residual ammonium nitrate solution mist that is not removed by the demisting system. If this vent stream with mist is emitted directly, the mist droplets would evaporate and result in PM emissions. These particulate emissions are substantially reduced by routing the vent stream to a water scrubbing system before discharge. This vent scrubber condenses the vapor into condensate which then absorbs the previously entrained mist droplets. The condensate stream is either recycled to the neutralizer or mixed with cooling tower blowdown for treatment and disposal. For this plant, a near total condensing vent scrubbing system will be used and the scrubber vent particulate emissions will be less than 0.2 lb/hr. Review of the RBLC for ammonium nitrate plants show wet scrubber use in all systems.

HECA proposes BACT for the ammonium nitrate unit to be a wet scrubber with $PM/PM_{10}$ emissions limited to 0.2 lb/hr.

## 6.11 Fugitive Emissions BACT Analysis

Fugitive emissions of VOC, CO, $NH_3$, $H_2S$, and trace HAPs and GHGs may occur in some areas of the facility due to leaking process equipment. Fugitive emissions are associated with the Gasification Block and the Manufacturing Complex. A leak detection and repair (LDAR) program will be implemented in select process areas to maximize emission reductions. LDAR is the primary established method for controlling fugitive emissions from various pieces of equipment, such as valves and seals, and is considered BACT. As determined by SJVAPCD, LDAR will be employed at a minimum to valves and connectors at HECA where VOC > 100 ppmv above background, and to pumps and compressor seals at HECA where VOC > 500 ppmv above background. HECA intends to apply LDAR to additional process areas beyond the SJVAPCD recommendation.

HECA proposes LDAR on select process areas as BACT to control fugitive emissions.

# 7.0 REFERENCES

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# Appendix E-12

# Operational Transportation Emissions for Alternative 2

## Summary of Offsite Transportation Emissions — Emissions Summary

*Hydrogen Energy California LLC*
*HECA Project*

*4/18/2012*

| Area | Attainment Status | Emission Source | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|---|
| | | | Annual Emission Rates (tons/yr) | | | | | |
| SJVAPCD (San Joaquin Valley) | Ozone Nonattainment - Extreme<br>PM2.5 Nonattainment | Offsite Train | 10.91 | 39.99 | 0.73 | 0.71 | 0.66 | 2.30 |
| | | Offsite Truck | 22.37 | 19.56 | 5.37 | 1.62 | 0.14 | 1.65 |
| | | Offsite Workers Commuting | 4.17 | 0.48 | 1.05 | 0.28 | 0.01 | 0.13 |
| | | Onsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Onsite Truck | 1.42 | 2.76 | 0.28 | 0.09 | 0.01 | 0.41 |
| | | **Total Emission (ton/yr)** | **38.86** | **62.79** | **7.43** | **2.70** | **0.82** | **4.50** |
| | | **Conformity De minimis (ton/yr)** | **100** | **10** | **NA** | **100** | **NA** | **10** |
| | | **Less than De minimis?** | **Yes** | **No** | **Yes** | **Yes** | **Yes** | **Yes** |
| SCAQMD (South Coast) | Ozone Nonattainment - Extreme<br>PM10 Nonattainment - Serious<br>PM2.5 Nonattainment<br>CO Nonattainment - Serious | Offsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Offsite Truck | 7.96 | 6.96 | 1.91 | 0.58 | 0.05 | 0.59 |
| | | **Total Emission (ton/yr)** | **7.96** | **6.96** | **1.91** | **0.58** | **0.05** | **0.59** |
| | | **Conformity De minimis (ton/yr)** | **100** | **10** | **70** | **100** | **NA** | **10** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| EKAPCD (East Kern County) | Ozone Nonattainment (Former Subpart 1)<br>PM10 Nonattainment - Serious | Offsite Train | 9.66 | 35.42 | 0.64 | 0.62 | 0.58 | 2.03 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **9.66** | **35.42** | **0.64** | **0.62** | **0.58** | **2.03** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **70** | **NA** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| MDAQMD (Mojave Desert) | Ozone Nonattainment - Moderate (San Bernardino County): approximately 75% of the total distance across of MDAQMD<br>PM10 Nonattainment - Moderate (San Bernardino County) | Offsite Train | 23.37 | 64.27 | 1.56 | 1.51 | 1.41 | 3.69 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **23.37** | **64.27** | **1.56** | **1.51** | **1.41** | **3.69** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **100** | **NA** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Sacramento Metro | Ozone Nonattainment - Serious<br>PM10 Nonattainment - Moderate (Sacramento County)<br>PM2.5 Nonattainment | Offsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **50** | **100** | **100** | **NA** | **50** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Yuba City-Marysville | Ozone Nonattainment - Former Subpart 1 (Sutter County)<br>PM2.5 Nonattainment | Offsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **NA** | **100** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| Chico | Ozone Nonattainment - Former Subpart 1 (Sutter County)<br>PM2.5 Nonattainment | Offsite Train | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| | | **Conformity De minimis (ton/yr)** | **NA** | **100** | **NA** | **100** | **NA** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

| Area | Attainment Status | Emission Source | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|---|
| | | | **Annual Emission Rates (tons/yr)** | | | | | |
| Arizona | Ozone Nonattainment (Former Subpart 1) (Maricopa Co, Pinal Co) PM10 Nonattainment (Moderate or Serious) (10 counties) PM2.5 Nonattainment (Santa Cruz and Pinal Counties) SO2 Nonattainment (Pinal county) CO Nonattainment (Phoenix and Tucson, AZ. Maricopa and Pima Counties) | Offsite Train | 31.16 | 57.13 | 3.78 | 0.20 | 1.88 | 3.28 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **31.16** | **57.13** | **3.78** | **0.20** | **1.88** | **3.28** |
| | | **Conformity De minimis (ton/yr)** | **100** | **100** | **70** | **100** | **100** | **100** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| New Mexico | PM10 Nonattainment - Moderate (Dona Ana County) CO Nonattainment - Moderate (Bernalillo County) | Offsite Train | 24.15 | 88.56 | 1.61 | 1.56 | 1.46 | 5.09 |
| | | Offsite Truck | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | | **Total Emission (ton/yr)** | **24.15** | **88.56** | **1.61** | **1.56** | **1.46** | **5.09** |
| | | **Conformity De minimis (ton/yr)** | **100** | **NA** | **100** | **NA** | **NA** | **NA** |
| | | **Less than De minimis?** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |

Notes:
Onsite worker travel and associated emissions are negligible
SJVAPCD - Carbon Monoxide - Not Classified (Bakersfield, CA, Kern County)
MDAQMD - PM2.5 Unclassified/Attainment (Federal), PM2.5 Non-attainment (State)
MDAQMD - Approximately 75% of the train route (distance) within MDAQMD is ozone nonattainment area while all MDAQMD is PM10 nonattainment area.

**Annual Number of Train Cars (incoming/outgoing)**

| | Coal Cars (incoming) | Liquid Sulfur Cars (outgoing) | Gasification Cars (outgoing) | Ammonia Cars (outgoing) | Urea Cars (outgoing) | UAN Cars (outgoing) | Maximum Total Trains per period |
|---|---|---|---|---|---|---|---|
| Annual average number of train cars | 13034 | 0 | 0 | 0 | 0 | 0 | 13034 |

| | | Line-Haul Engine for Product Trains | | | | |
|---|---|---|---|---|---|---|
| | Line-Haul Engine for Coal Train | Liquid Sulfur | Gasification | Ammonia | Urea | UAN |
| ton-mile/gallon | 480 | 480 | 480 | 480 | 480 | 480 |
| Train car capacity (ton) | 117 | 100 | 100 | 117 | 117 | 117 |
| Unloaded train car weight (ton) | 25 | 25 | 25 | 25 | 25 | 25 |

480 ton-mile/gallon is based on 2009 *class I rail freight fuel consumption and travel* data (Association of American Railroads, *Railroad Facts*)

| | Coal Trains | | | Liquid Sulfur Product Train | | | Gasification Solid Product Train | | |
|---|---|---|---|---|---|---|---|---|---|
| Area | Miles traveled per Train (mile/engine) - One Way * | Coal Train (ton-miles/year) - Round Trip | Fuel Use for Coal Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip |
| SJVAPCD | 70 | 152,369,658 | 317,426 | 0 | 0 | 0 | 0 | 0 | 0 |
| EKAPCD | 62 | 134,955,983 | 281,148 | | 0 | 0 | 0 | 0 | 0 |
| MDAQMD (PM10 nonattainment and total distance) | 150 | 326,506,410 | 680,198 | | 0 | 0 | 0 | 0 | 0 |
| MDAQMD (Ozone nonattainment) | 113 | 244,879,808 | 510,148 | | 0 | 0 | | 0 | 0 |
| Arizona (PM10 nonattainment and total distance) | 364 | 792,322,222 | 1,650,613 | | 0 | 0 | | 0 | 0 |
| Arizona (PM2.5 nonattainment) | 20 | 43,534,188 | 90,693 | | 0 | 0 | | 0 | 0 |
| Arizona (Ozone nonattainment) | 100 | 217,670,940 | 453,465 | | 0 | 0 | | 0 | 0 |
| Arizona (SO2 and CO nonattainment) | 200 | 435,341,880 | 906,930 | | 0 | 0 | | 0 | 0 |
| New Mexico | 155 | 337,389,957 | 702,871 | | 0 | 0 | | 0 | 0 |

* Since exact route of coal train was not determined yet, It was assumed that the coal train would travel across the maximum distance of the nonattainment area for all pollutants in Arizona.

| | Ammonia Product Train | | | Urea Product Train | | | UAN Product Train | | |
|---|---|---|---|---|---|---|---|---|---|
| Area | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip | Miles traveled per Train (mile/engine) - One Way | Product Train (ton-miles/year) - Round Trip | Fuel Use for Product Train (gal/year) - Round Trip |
| SJVAPCD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sacramento Metro | | 0 | 0 | 80 | 0 | 0 | | 0 | 0 |
| Yuba City-Marysville | | 0 | 0 | 50 | 0 | 0 | | 0 | 0 |
| Chico | | 0 | 0 | 50 | 0 | 0 | | 0 | 0 |
| Other Area in California and Oregon/Washington | | 0 | 0 | -180 | 0 | 0 | | 0 | 0 |

| | Line-Haul Emission Factors | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| | Tier 3 Emission Factor (g/bhp-hr) | 1.50 | 5.50 | 0.10 | 0.10 | 0.09 | 0.32 |
| | Tier 3 Emission Factor (g/gal) | 31.20 | 114.40 | 2.08 | 2.02 | 1.88 | 6.57 |

**Annual Emission Rates Using ton-mile/gallon factor**

| Area | | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|
| | | Annual Emission Rates (tons/year) all trains | | | | | |
| SJVAPCD (San Joaquin Valley), CA | Line-haul coal engines | 10.91 | 39.99 | 0.73 | 0.71 | 0.66 | 2.30 |
| | Line-haul liquid sulfur product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Line-haul gasification product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Line-haul ammonia product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Line-haul urea product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Line-haul UAN product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **10.91** | **39.99** | **0.73** | **0.71** | **0.66** | **2.30** |
| EKAPCD (East Kern County), CA | Line-haul coal engines | 9.66 | 35.42 | 0.64 | 0.62 | 0.58 | 2.03 |
| | Line-haul gasification product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **9.66** | **35.42** | **0.64** | **0.62** | **0.58** | **2.03** |
| MDAQMD (Mojave Desert), CA | Line-haul coal engines | 23.37 | 64.27 | 1.56 | 1.51 | 1.41 | 3.69 |
| | Line-haul gasification product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **23.37** | **64.27** | **1.56** | **1.51** | **1.41** | **3.69** |
| Sacramento Metro, CA | Line-haul urea product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Yuba City-Marysville, CA | Line-haul urea product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Chico, CA | Line-haul urea product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Other Area in California and Oregon/Washington | Line-haul urea product engines | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total Trains (ton/yr)** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Arizona | Line-haul coal engines | 31.16 | 57.13 | 3.78 | 0.20 | 1.88 | 3.28 |
| | **Total Trains (ton/yr)** | **31.16** | **57.13** | **3.78** | **0.20** | **1.88** | **3.28** |
| New Mexico | Line-haul coal engines | 24.15 | 88.56 | 1.61 | 1.56 | 1.46 | 5.09 |
| | **Total Trains (ton/yr)** | **24.15** | **88.56** | **1.61** | **1.56** | **1.46** | **5.09** |

**Emission Factors**

**40 CFR Part 1033**

**Table 1 to §1033.101—Line-Haul Locomotive Emission Standards**

| Year of original manufacture | Tier of standards | Standards (g/bhp-hr) | | | |
|---|---|---|---|---|---|
| | | CO | $NO_X$ | PM | HC |
| 1973–1992 | Tier 0 | 5 | 8 | 0.22 | 1 |
| 1993–2004 | Tier 1 | 2.2 | 7.4 | 0.22 | 0.55 |
| 2005–2011 | Tier 2 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2012–2014 | Tier 3 | 1.5 | 5.5 | 0.10 | 0.3 |
| 2015 or later | Tier 4 | 1.5 | 1.3 | 0.03 | 0.14 |

Reference: 40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards

| Emission Factors For all Locomotives | | | |
|---|---|---|---|
| SOx (3) | $CO_2$ | $CH_4$ (4) | $N_2O$ (4) |
| g/gal | g/gal | g/gal | g/gal |
| 1.88 | 10217 | 0.80 | 0.26 |

| Locomotive Application | Conversion Factor (bhp-hr/gal) |
|---|---|
| Large Line-haul & Passenger | 20.8 |
| Small Line-haul | 18.2 |
| Switching | 15.2 |

Note:

(1) EPA's Technical Highlights: Emission Factors for Locomotives, 2009 (http://www.epa.gov/nonroad/locomotv/420f09025.pdf).

(2) Line-haul engine emissions of CO, Nox, PM, and HC are based on EPA Tier 3.

(3) Based on 300 ppm sulfur diesel fuel.

(4) $CH_4$ and $N_2O$ factors are derived from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Stationary Combustion by Sector and Fuel Type).

VOC emissions can be assumed to be equal to 1.053 times the HC emissions

(5) $PM_{2.5}$ Fraction of $PM_{10}$, = 0.97

(6) No off-site switching or idling was assumed for train transportation.

## Summary of Truck Emissions - HECA

4/18/2012

**Calculations for Trucks Operation Modeling**

| Data Supplied By Client | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Coke Trucks (Max @ 50 or 60 mph)** | **Coal Trucks (Max @ 50 or 60 mph)** | **Liquid Sulfur Product Trucks (Max @ 50 or 60 mph)** | **Gasification Product Trucks (Max @ 50 or 60 mph)** | **Ammonia Product Trucks (Max @ 50 or 60 mph)** | **Urea Product Trucks (Max @ 50 or 60 mph)** | **UAN Sulfur Product Trucks (Max @ 50 or 60 mph)** | **Equipment and Miscellaneous Trucks (Max @ 50 or 60 mph)** |
| | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** |
| Distance traveled per truck in SJVAPCD (mi) | 104 | 26.5 | 104 | 160 | 80 | 80 | 80 | 80 |
| Distance traveled per truck in SCAQMD (mi) | 176 | 0 | 180 | 0 | 0 | 0 | 0 | 0 |
| **Maximum number of trucks or loads:** | | | | | | | | |
| Annual average trucks or loads | 15,200 | 61,000 | 1,320 | 11,200 | 6,680 | 11,200 | 18,560 | 1,818 |

No off-site idling was assumed for truck transportation.
Distance traveled per truck is based on round-trip.

**EMFAC2007 Emission Factors + Fugitive Dust (g/mi) For Truck Model year 2010, Scenario year 2015**

| **Pollutant** | **Coke Trucks (Max @ 50 or 60 mph)** | **Coal Trucks (Max @ 50 or 60 mph)** | **Liquid Sulfur Product Trucks (Max @ 50 or 60 mph)** | **Gasification Product Trucks (Max @ 50 or 60 mph)** | **Ammonia Product Trucks (Max @ 50 or 60 mph)** | **Urea Product Trucks (Max @ 50 or 60 mph)** | **UAN Sulfur Product Trucks (Max @ 50 or 60 mph)** | **Equipment and Miscelleneous Trucks (Max @ 50 or 60 mph)** |
|---|---|---|---|---|---|---|---|---|
| | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** | **Running Emissions (g/mile/trk)** |
| CO | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 | 2.48 |
| NOx | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 | 2.17 |
| ROG | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| SOx | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| PM10 * | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| PM2.5 * | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
The maximum emission factor from either truck speed at 50 mph or 60 mph was used.
Most California highways have speed limits of 60 or 70 mph and large trucks travel more slowly than the speed limit.

**Annual Emission Rates for AERMOD (ton/yr) all truck**

| **Pollutant** | **Coke Trucks (Max @ 50 or 60 mph)** | **Coal Trucks (Max @ 50 or 60 mph)** | **Liquid Sulfur Product Trucks (Max @ 50 or 60** | **Gasification Product Trucks (Max @ 50 or 60 mph)** | **Ammonia Product Trucks (Max @ 50 or 60 mph)** | **Urea Product Trucks (Max @ 50 or 60 mph)** | **UAN Sulfur Product Trucks (Max @ 50 or 60 mph)** | **Equipment and Miscelleneous Trucks (Max** | **Total Truck Emission Rates (tons/yr)** |
|---|---|---|---|---|---|---|---|---|---|
| | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | **Running Emissions** | |
| **SJVAPCD (San Joaquin Valley)** | | | | | | | | | |
| CO | 4.32 | 4.42 | 0.38 | 4.90 | 1.46 | 2.45 | 4.06 | 0.40 | **22.37** |
| NOx | 3.78 | 3.86 | 0.33 | 4.28 | 1.28 | 2.14 | 3.55 | 0.35 | **19.56** |
| ROG | 0.32 | 0.33 | 0.03 | 0.36 | 0.11 | 0.18 | 0.30 | 0.03 | **1.65** |
| SOx | 0.03 | 0.03 | 0.00 | 0.03 | 0.01 | 0.02 | 0.03 | 0.00 | **0.14** |
| PM10 | 1.04 | 1.06 | 0.09 | 1.18 | 0.35 | 0.59 | 0.97 | 0.10 | **5.37** |
| PM2.5 | 0.31 | 0.32 | 0.03 | 0.35 | 0.11 | 0.18 | 0.29 | 0.03 | **1.62** |
| **SCAQMD (South Coast)** | | | | | | | | | |
| CO | 7.31 | 0.00 | 0.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **7.96** |
| NOx | 6.39 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **6.96** |
| ROG | 0.54 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.59** |
| SOx | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.05** |
| PM10 | 1.76 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **1.91** |
| PM2.5 | 0.53 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.58** |

## Summary of Worker Commute Vehicle Emissions - HECA

4/18/2012

**Calculations for Worker Commute Vehicle Operation Modeling**

| OFFSITE - 50 MPH | | | | | | | | EF (g/mile) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onroad Vehicle | Fuel Type | Vehicle Type | Total Number of Workers per day | Daily Vehicle Count | Round Trip Distance (miles/vehicle/day) | Trips per day | VMT (Annual) | CO | NOx | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ | TOC |
| Personal Commuting Vehicles | G/D | LDA/ LDT | 200 | 154 | 40.0 | 1 | 2,246,154 | 1.6825 | 0.1930 | 0.4234 | 0.1134 | 3.50E-03 | 0.0540 |

**Assumptions:**

Assumed average distance traveled off site for all employees commuting will be 20 miles

times 2 for return trip = 40 miles

365 days per year

Number of workers per commuter vehicle = 1.3

EMFAC2007 emissions are for fleet mix years 1971-2015 travelling at 50 mph.

| Area | Description | Annual Emission Rates (tons/year) all worker commute vehicles | | | | | |
|---|---|---|---|---|---|---|---|
| | | CO | NOx | PM10 | PM2.5 | SO2 | VOC |
| SJVAPCD (San Joaquin Valley), CA | Personal Commuting Vehicles | 4.17 | 0.48 | 1.05 | 0.28 | 0.01 | 0.13 |

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,

E = [ k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

| | k |
|---|---|
| | **g/VMT** |
| **PM2.5** | 0.25 |
| **PM10** | 1.00 |

**Fleet mix on highway**

| | | | |
|---|---|---|---|
| W= | 9.1 | tons, average | |
| sL= | 0.031 | g/m2 | Default value from URBEMIS 9.2 for Kern County |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | |

E=

0.09836 g/VMT PM2.5
0.39344 g/VMT PM10

| Vehicle weight (tons) | | fraction of each vehicle type |
|---|---|---|
| 1.6 | passenger vehicles | 0.75 |
| 40 | large trucks | 0.18 |
| 9 | 2-4 axle trucks | 0.07 |

9.1 weighted average for all vehicles (ton)

On I-5 near the Project, 75% of all vehicles are passenger vehicles,
of the remaining vehicle, 73% are 5-axle trucks and the remainder are 2-4 axle trucks.
From information provided by California Department of Transportation for the traffic analysis.

| Commodity Handled | Petcoke | Coal | Liquid Sulfur | Gasification | Ammonia | Urea | UAN | Equipment | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|
| **Expected plant operation** | | | | | | | | | |
| Expected plant operation is 8000 hours / year | | | | | | | | | |
| The plant will operate 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day | 24 hours / day |
| The plant will operate 333 days / year | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr | 333 days / yr |
| Shipment by trucks | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % | 100 % |
| Shipment by train | 0 % | 100 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % | 0 % |
| **Production rate** | | | | | | | | | |
| Required Normal Flow / day | 1,140 tons / day | 4,580 tons / day | 100 tons / day | 839 tons / day | 500 tons / day | 833 tons / day | 1,392 tons / day | | |
| Required Normal Flow / year | 380,000 tons / yr | 1,525,000 tons / yr | 33,000 tons / yr | 280,000 tons / yr | 167,000 tons / yr | 280,000 tons / yr | 464,000 tons / yr | | |
| Required Maximum Flow day | 1,368 tons / day (3) | 6,107 tons / day (4) | 200 tons / day (5) | 1,678 tons / day (6) | 1,000 tons / day (6) | 1,666 tons / day (6) | 2,784 tons / day (6) | | |
| **Truck Shipments** | | | | | | | | | |
| Truck Capacity | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck | 25 tons / truck |
| Required trucks loads for normal operation / day | 46 trucks / day | 183 trucks / day | 4 trucks / day | 34 trucks / day | 20 trucks / day | 33 trucks / day | 56 trucks / day | 2 trucks / day | 3 trucks / day |
| Required trucks loads for normal operation / yr | 15,200 truck / yr | 61,000 truck / yr | 1,320 truck / yr | 11,200 truck / yr | 6,680 truck / yr | 11,200 truck / yr | 18,560 truck / yr | | |
| Required trucks loads for maximum operation /day | 55 trucks / day | 244 trucks / day | 8 trucks / day | 67 trucks / day | 40 trucks / day | 67 trucks / day | 111 trucks / day | | |
| **Train Shipments** | | | | | | | | | |
| Railcar Capacity | | 117 tons / car | 100 tons / car | 100 tons / car | 117 tons / car | 117 tons / car | 117 tons / car | | |
| Assume a train has 13,000 ton capacity | | | | | | | | | |
| Required railcars for normal operation / day | | 39 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | | |
| Required railcar loads for normal operation / yr | | 13,034 cars / yr | 0 cars / yr | 0 cars / yr | 0 cars / yr | 0 cars / yr | 0 cars / yr | | |
| Required railcars for maximum operation / day | | 200 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | 0 cars / day | | |
| **Basis** | - 91% availability<br>- 25% petcoke (heat input)<br>- 25 ton/truck<br>- 7 days/week receiving<br>- 25% excess truck | - 91% availability<br>- 75% coal (heat input) per year<br>- 117 tons/car<br>- 100% coal for maximum<br>- Rack sized to handle two trains/day | - 91% availability<br>- High sulfur case - 100<br>- 25 ton/truck<br>- Weekdays only | - 91% availability<br>- 75% coal max annual<br>- Maximum is double the daily average rate | - 91% availability<br>- 500 t/d NH3 sales<br>- Ability to ship 7500 tons over 10 days (75% of tank plus some production) | - 91% availability<br>-empty 45 day storage in 10 days | - 91% availability<br>-empty 45 day storage in 10 days | ' | |
| **Traffic route** | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route | Truck Route |
| Destination/Origin<br>Address<br>Distance<br>Route | Carson Refinery<br>1801 E Sepulveda, Carson<br>140 miles<br>Alameda<br>405 Fwy<br>5 Fwy<br>Stockdale hwy<br>Morris Road<br>Station Road | Wasco rail terminal to site<br>26.5 miles | California Sulfur<br>2509 E Grant Street, Wilmington<br>142 miles<br>Grant<br>Henry Ford<br>Alameda<br>405 Fwy<br>5 Fwy<br>Stockdale hwy<br>Morris Road<br>Station Road | Various<br>80 mile radius<br>40 mile radius<br>Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Various<br>40 mile radius<br>Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Various<br>40 mile radius<br>Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Various<br>40 mile radius<br>Station Road<br>Morris Road<br>Stockdale Hywy<br>5 Fwy | Various<br>40 mile ratius<br>5 fwy<br>Stockdale Hwy<br>Dairy Road | Various<br>40 mile ratius<br>5 fwy<br>Stockdale Hwy<br>Dairy Road |
| | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route | Rail Route |
| Destination/Origin<br>Address<br>Distance<br>Route | None | Elk Ranch New Mexico<br>801 miles<br>Kern County: 139.2 miles (County Line near Boron, CA to north property line of plant)<br>Mine to Boron, CA: 662 miles<br>Total Distance: 801.2 miles | None | None | None | None | None | None | None |

**Notes**
1) Equipment Maintenance Trucks are considered to be 2% of the total trucks per day for the feed and product operation.
2) Miscellaneous trucks are considered to be 3% of the total trucks per day for the feed and product operation.
3) The maximum flow rate of coke is ratioed up from the normal flow rate at 25% to 30% of feed
4) The maximum flow rate of coal is ratioed up from the normal flow rate at 75% to 100% of feed
5) The maximum flow rate of sulfur is 2 times the normal production
6) The maximum flow rate of these commodities is 2 times the normal production
7) The sources of flow data used in the Production Rate calculation were based on the flow rates provided in "Conference Note: Rail and Truck Traffic - Planning Session" and the "FertilizerProductMovement Update", 01-25-12.

4/18/2012

**Calculations for Trucks Operation Modeling**

| Data Supplied By Client | | | | | |
|---|---|---|---|---|---|
| Parameter | Petcoke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
| | Running Emissions | Idling Emissions | Running Emissions | Idling Emissions | Running Emissions |
| Distance Traveled (mi)* | 0.96 | | 2.49 | | 2.20 |
| Per Truck Idle Time (hr) | | 0.083 | | 0.083 | |
| Maximum number of trucks or loads: | | | | | |
| 1-hr | 30 | 30 | 30 | 30 | 5 |
| 3-hr | 90 | 90 | 89 | 89 | 5 |
| 8-hr | 239 | 239 | 237 | 237 | 5 |
| 24-hr | 299 | 299 | 296 | 296 | 5 |
| Annual average trucks or loads | 76,200 | 76,200 | 48,960 | 48,960 | 1,818 |

**EMFAC2007 Emission Factors + Fugitive Dust (g/mi or g/idle-hour) For Truck Model year 2010**

| | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions (g/mile/trk) | Idling Emissions (g/idle-hour/trk) | Running Emissions (g/mile/trk) | Idling Emissions (g/idle-hour/trk) | Running Emissions (g/mile/trk) |
| CO | 3.03 | 43.69 | 3.03 | 43.69 | 3.03 |
| NOx | 5.43 | 122.65 | 5.43 | 122.65 | 5.43 |
| ROG | 1.39 | 7.74 | 1.39 | 7.74 | 1.39 |
| SOx | 0.03 | 0.06 | 0.03 | 0.06 | 0.03 |
| PM10 * | 0.92 | 0.11 | 0.92 | 0.11 | 0.92 |
| PM2.5 * | 0.29 | 0.10 | 0.29 | 0.10 | 0.29 |

EMFAC2007 is the approved federal model for vehicle combustion emissions

* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007

PM factors from EMFAC = combustion exhaust + tire wear + break wear

EMFAC emissions are for fleet year 2010 travelling at 10 mph.

**1-hr Emission Rates for AERMOD (g/s) all trucks**

| | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 2.407E-02 | 3.027E-02 | 6.196E-02 | 2.997E-02 | 1.010E-02 |
| NOx | 4.314E-02 | 8.496E-02 | 1.111E-01 | 8.415E-02 | 1.810E-02 |
| ROG | 1.103E-02 | 5.365E-03 | 2.840E-02 | 5.313E-03 | 4.629E-03 |
| SOx | 2.385E-04 | 4.295E-05 | 6.139E-04 | 4.254E-05 | 1.000E-04 |
| PM10 | 7.289E-03 | 7.897E-05 | 1.876E-02 | 7.822E-05 | 3.058E-03 |
| PM2.5 | 2.325E-03 | 7.205E-05 | 5.985E-03 | 7.135E-05 | 9.754E-04 |

**3-hr Emission Rates for AERMOD (g/s) all trucks**

| | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 2.407E-02 | 3.027E-02 | 6.196E-02 | 2.997E-02 | 1.010E-02 |
| NOx | 4.314E-02 | 8.496E-02 | 1.111E-01 | 8.415E-02 | 1.810E-02 |
| ROG | 1.103E-02 | 5.365E-03 | 2.840E-02 | 5.313E-03 | 4.629E-03 |
| SOx | 2.385E-04 | 4.295E-05 | 6.139E-04 | 4.254E-05 | 1.000E-04 |
| PM10 | 7.289E-03 | 7.897E-05 | 1.876E-02 | 7.822E-05 | 3.058E-03 |
| PM2.5 | 2.325E-03 | 7.205E-05 | 5.985E-03 | 7.135E-05 | 9.754E-04 |

**8-hour Emission Rates for AERMOD (g/s) all trucks**

| | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| Pollutant | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 2.407E-02 | 3.027E-02 | 6.196E-02 | 2.997E-02 | 1.010E-02 |
| NOx | 4.314E-02 | 8.496E-02 | 1.111E-01 | 8.415E-02 | 1.810E-02 |
| ROG | 1.103E-02 | 5.365E-03 | 2.840E-02 | 5.313E-03 | 4.629E-03 |
| SOx | 2.385E-04 | 4.295E-05 | 6.139E-04 | 4.254E-05 | 1.000E-04 |
| PM10 | 7.289E-03 | 7.897E-05 | 1.876E-02 | 7.822E-05 | 3.058E-03 |
| PM2.5 | 2.325E-03 | 7.205E-05 | 5.985E-03 | 7.135E-05 | 9.754E-04 |

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**24-hour Emission Rates for AERMOD (g/s) all trucks**

| Pollutant | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks |
|---|---|---|---|---|---|
| | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions |
| CO | 1.003E-02 | 1.261E-02 | 2.582E-02 | 1.249E-02 | 1.010E-02 |
| NOx | 1.798E-02 | 3.540E-02 | 4.627E-02 | 3.506E-02 | 1.810E-02 |
| ROG | 4.598E-03 | 2.235E-03 | 1.183E-02 | 0.000E+00 | 4.629E-03 |
| SOx | 9.937E-05 | 1.790E-05 | 2.558E-04 | 1.772E-05 | 1.000E-04 |
| PM10 | 3.037E-03 | 3.291E-05 | 7.818E-03 | 3.259E-05 | 3.058E-03 |
| PM2.5 | 9.688E-04 | 3.002E-05 | 2.494E-03 | 2.973E-05 | 9.754E-04 |

**Annual Emission Rates for AERMOD (g/s) all trucks**

| Pollutant | Coke and Coal Trucks | | Product Trucks | | Miscellaneous Trucks | | |
|---|---|---|---|---|---|---|---|
| | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | Idling Emissions (at each Idle Point) | Running Emissions | TOTAL (g/s) | TOTAL (tpy) |
| CO | 6.997E-03 | 8.797E-03 | 1.168E-02 | 5.652E-03 | 3.839E-04 | 3.35E-02 | 1.17E+00 |
| NOx | 1.254E-02 | 2.470E-02 | 2.094E-02 | 1.587E-02 | 6.880E-04 | 7.47E-02 | 2.60E+00 |
| ROG | 3.207E-03 | 1.559E-03 | 5.356E-03 | 1.002E-03 | 1.760E-04 | 1.13E-02 | 3.93E-01 |
| SOx | 6.932E-05 | 1.248E-05 | 1.158E-04 | 8.021E-06 | 3.803E-06 | 2.09E-04 | 7.28E-03 |
| PM10 | 2.119E-03 | 2.295E-05 | 3.538E-03 | 1.475E-05 | 1.162E-04 | 5.81E-03 | 2.02E-01 |
| PM2.5 | 6.758E-04 | 2.094E-05 | 1.129E-03 | 1.346E-05 | 3.708E-05 | 1.88E-03 | 6.52E-02 |

Volume, Line Sources

| | | | |
|---|---|---|---|
| Guidance for Air Dispersion Modeling, SJVAPCD, 2007 and Section 1.2.2 of Volume II of ISC User's Guide | | | |
| 2.3.2 Oyo=12W/2.15 | | | |
| Truck Traveling vol src | | Truck Idling pt src | |
| 6 | ft Release height | 12.6 | ft Release height |
| 12 | ft Width | 0.1 | m diam |
| 66.98 | ft init horz dim Syo | 51.71 | m/s vel |
| 5.58 | ft init vert dim Szo | 366 | K Temp |
| | | 199.134 | F Temp |

Volume, Stand Alone

| | |
|---|---|
| Guidance for Air Dispersion Modeling, SJVAPCD, 2007 | |
| 2.3.2 + modelers judgement + ISC guidance | |
| Truck Traveling vol src | |
| 6 | ft Release height |
| 12 | ft Width |
| 2.79 | ft init horz dim Syo |
| 5.58 | ft init vert dim Szo |
| | |

## Summary of On-Site Operations Truck Emissions — Emissions Summary

4/18/2012

| Transportation Information | | Notes |
|---|---|---|
| - Onsite Vehicle = | 20 trucks | - Information Provided By Applicant |
| - Vehicle year= | 2010 | - Information Provided By Applicant |
| - Maximum annual mileage = | 10,000 miles/truck-year | - All routine vehicular traffic is anticipated to travel exclusively on paved roads |
| | | - Assumed 15 mph average speed within HECA facility |

**Calculations for Trucks Operation Modeling per Truck**

| | Onsite O&M Trucks |
|---|---|
| **Mileage** | |
| 1-hr | 1 |
| 3-hr | 3 |
| 8-hr | 9 |
| 24-hr | 27 |
| Annual average trucks or loads | 10000 |

**EMFAC2007 Emission Factors (g/mi) For Truck Model year 2010**

| | AERMOD | |
|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 |
| CO | 0.229 | 0.920 |
| NOx | 0.064 | 0.672 |
| ROG | 0.014 | 0.085 |
| SOx | 0.011 | 0.005 |
| PM10 * | 0.167 | 0.176 |
| PM2.5 * | 0.054 | 0.062 |

EMFAC2007 is the approved federal model for vehicle combustion emissions
* PM10 and PM2.5 includes fugitive dust factor for paved roads obtained from AP-42 Ch. 13 plus PM factors from EMFAC 2007
PM factors from EMFAC = combustion exhaust + tire wear + break wear
EMFAC emissions are for fleet year 2010 travelling at 15 mph.

**1-hr Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**3-hr Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**8-hour Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**24-hour Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | |
|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 |
| CO | 1.45E-03 | 5.83E-03 |
| NOx | 4.06E-04 | 4.26E-03 |
| ROG | 8.88E-05 | 5.39E-04 |
| SOx | 6.98E-05 | 3.17E-05 |
| PM10 | 1.06E-03 | 1.11E-03 |
| PM2.5 | 3.40E-04 | 3.91E-04 |

**Annual Emission Rates for AERMOD (g/s) all trucks**

| | AERMOD | | | |
|---|---|---|---|---|
| Pollutant | Gas LHDT1 | Diesel LHDT2 | TOTAL (g/s) | TOTAL (tpy) |
| CO | 1.45E-03 | 5.83E-03 | 7.29E-03 | 0.253 |
| NOx | 4.06E-04 | 4.26E-03 | 4.67E-03 | 0.162 |
| ROG | 8.88E-05 | 5.39E-04 | 6.28E-04 | 0.022 |
| SOx | 6.98E-05 | 3.17E-05 | 1.01E-04 | 0.004 |
| PM10 | 1.06E-03 | 1.11E-03 | 2.17E-03 | 0.076 |
| PM2.5 | 3.40E-04 | 3.91E-04 | 7.32E-04 | 0.025 |

## Fugitive Dust on Paved Road

4/18/2012

AP 42 13.2.1 Paved Roads, updated January 2011

For a daily basis,
E = [ k (sL)^0.91 x (W)^1.02](1-P/4N) (2)

P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period
W = average weight (tons) of vehicles traveling the road
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (g/m^2)

| | k |
|---|---|
| | **g/VMT** |
| **PM2.5** | 0.25 |
| **PM10** | 1.00 |

Table 13.2.1-1
PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

**Large Trucks**

| | | | Empty truck | full truck | Load Capacity |
|---|---|---|---|---|---|
| W= | 17.5 | tons, average | 5 | 30 | 25 tons |
| sL= | 0.031 | g/m2 Default value from URBEMIS 9.2 for Kern County | | | |
| P= | 36 | days/year Buttonwillow Station 1940-2011, WRCC | | | |

E=
0.19149 g/VMT PM2.5 large delivery trucks
0.76594 g/VMT PM10 large delivery trucks

**Operation and Maintenance Vehicles**

W= 3 tons
sL= 0.031 g/m2 Default value from URBEMIS 9.2 for Kern County
P= 36 days/year Buttonwillow Station 1940-2011, WRCC

E=
0.03169 g/VMT PM2.5 large delivery trucks
0.12675 g/VMT PM10 large delivery trucks
#vol sources= 10

**Fertilizer Product + Sulfur Product trucks + Gas Solids trucks + Misc trucks**

218 max trucks/day for Ammonia + Urea + UAN 24 hrs/day
8 max trucks/day for Sulfur
67 max trucks/day gas solids
3 miscellaneous truck along this path
**296** Total product trucks max/day

4000 meters, approximate length of road for product trucks: eastern fenceline to southern fenceline to middle loop and back out the opposite way
2.49 miles

| | | |
|---|---|---|
| 0.47593 grams PM2.5/truck/day | 141.064 g PM2.5/day for all product trucks | 5.8777 g PM2.5/hr |
| 1.90373 grams PM10/truck/day | 564.257 g PM10/day for all product trucks | 23.5107 g PM10/hr |

# volume source in model
73 8.0516E-02 g PM2.5/hr/volume source
3.2206E-01 g PM10/hr/volume source

**Coke + coal feedstock trucks**

**299** max feedstock trucks/day

1539 meters, approximate length of road loop to truck feedstock unloading facility on east side
0.96 miles

| | | |
|---|---|---|
| 0.18312 grams PM2.5/truck/day | 54.800 g PM2.5/day for all product trucks | 2.2833 g PM2.5/hr |
| 0.73246 grams PM10/truck/day | 219.201 g PM10/day for all product trucks | 9.1334 g PM10/hr |

# volume source in model
34 6.7157E-02 g PM2.5/hr/volume source
2.6863E-01 g PM10/hr/volume source

## Fugitive Dust on Paved Road

4/18/2012

**Miscellaneous Delivery Trucks**

**5** max trucks/day

3540 meters, approximate length of road from end of product truck south road, along southern fenceline, north toward main site, to parking lot and back
2.20 miles

| | | |
|---|---|---|
| 0.421 grams PM2.5/truck/day | 2.299 g PM2.5/day for all product trucks | 0.0958 g PM2.5/hr |
| 1.685 grams PM10/truck/day | 9.196 g PM10/day for all product trucks | 0.3832 g PM10/hr |

# volume source in model

| | |
|---|---|
| 5 | 1.9158E-02 g PM2.5/hr/volume source |
| | 7.6631E-02 g PM10/hr/volume source |

*Hydrogen Energy California LLC* *4/18/2012*
*HECA Project*

GHG emissions are numerically depicted as metric tons (tonne) of carbon dioxide equivalents ($CO_2e$). $CO_2e$ represents $CO_2$ plus the additional warming potential from $CH_4$ and $N_2O$. $CH_4$ and $N_2O$ have 21 and 310 times the warming potential of $CO_2$, respectively.

**Onsite LHD Gasoline Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Onsite Trucks | | 10 | trucks | | EF $CO_2$ = | 1,175 | g/mi |
| Total Annual VMT | | 10,000 | miles/ truck | | EF $CH_4$ = | 0.0157 | g/mi |
| | | | | | EF $N_2O$ = | 0.0101 | g/mi |
| $CO_2$ = | 118 | tonne/yr | | | | | |
| $CH_4$ = | 1.57E-03 | tonne/yr = | 3.E-02 | tonne $CO_2e$/yr | | | |
| $N_2O$ = | 1.01E-03 | tonne/yr = | 3.E-01 | tonne $CO_2e$/yr | | Total tonne $CO_2e$/yr = | 118 |

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty gasoline trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light gasoline trucks.

**Onsite LHD Diesel Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Onsite Trucks | | 10 | trucks | | EF $CO_2$ = | 519 | g/mi |
| Total Annual VMT | | 10,000 | miles/ truck | | EF $CH_4$ = | 0.001 | g/mi |
| | | | | | EF $N_2O$ = | 0.0015 | g/mi |
| $CO_2$ = | 52 | tonne/yr | | | | | |
| $CH_4$ = | 1.00E-04 | tonne/yr = | 2.E-03 | tonne $CO_2e$/yr | | | |
| $N_2O$ = | 1.50E-04 | tonne/yr = | 5.E-02 | tonne $CO_2e$/yr | | Total tonne $CO_2e$/yr = | 52 |

CO2 emissions from EMFAC2007 for fleet year 2010 for light heavy-duty diesel trucks travelling at 15 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for light diesel trucks.

**Onsite Petcoke & Coal Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 76,200 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 1.0 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| Truck Idle Time | | 0.08 | hr/load | | EF $N_2O$ = | 0.0048 | g/mi |
| | | | | | EF $CO_2$ = | 6,542 | g/ idle hr |
| | | | | | EF $CH_4$ = | 0.011 | g/ idle hr |
| | | | | | EF $N_2O$ = | 0.010 | g/ idle hr |
| $CO_2$ = | 272 | tonne/yr | | | | | |
| $CH_4$ = | 4.39E-04 | tonne/yr = | 9.E-03 | tonne $CO_2e$/yr | | | |
| $N_2O$ = | 4.13E-04 | tonne/yr = | 1.E-01 | tonne $CO_2e$/yr | | Total tonne $CO_2e$/yr = | 272 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Onsite Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 48,960 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 2.49 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| Truck Idle Time | | 0.08 | hr/load | | EF $N_2O$ = | 0.0048 | g/mi |
| | | | | | EF $CO_2$ = | 6,542 | g/ idle hr |
| | | | | | EF $CH_4$ = | 0.011 | g/ idle hr |
| | | | | | EF $N_2O$ = | 0.010 | g/ idle hr |
| $CO_2$ = | 412 | tonne/yr | | | | | |
| $CH_4$ = | 6.64E-04 | tonne/yr = | 1.E-02 | tonne $CO_2e$/yr | | | |
| $N_2O$ = | 6.25E-04 | tonne/yr = | 2.E-01 | tonne $CO_2e$/yr | | Total tonne $CO_2e$/yr = | 412 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Onsite Miscellaneous Diesel Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Truck loads | | 1,818 | truck loads | | EF $CO_2$ = | 3,165 | g/mi |
| Distrance Travelled Onsite | | 2.2 | mi/ load | | EF $CH_4$ = | 0.0051 | g/mi |
| | | | | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 13 | tonne/yr | | | | | |
| $CH_4$ = | 2.04E-05 | tonne/yr = | 4.E-04 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.92E-05 | tonne/yr = | 6.E-03 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 13 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 10 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles.

**Offsite Coal Trains**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Train cars per year | | 13,034 | per year | | EF $CO_2$ = | 10,217 | g/gal |
| Miles Traveled Per Train | | 801 | Miles one way | | EF $CH_4$ = | 0.8 | g/gal |
| Rail Freight Fuel Consumption | | 480 | ton-mile/gallon | | EF $N_2O$ = | 0.26 | g/gal |
| Loaded train car weight | | 142 | ton | | | | |
| Unloaded train car weight | | 25 | ton | | | | |
| All Trains - Round Trip | | 1.74E+09 | ton-miles/year | | | | |
| Fuel Use for all Trains - Round Trip | | 3,632,203 | gal/year | | | | |
| $CO_2$ = | 37,110 | tonne/yr | | | | | |
| $CH_4$ = | 2.91 | tonne/yr = | 61.02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 0.94 | tonne/yr = | 292.76 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 37,464 |

New engines will meet Tier 3 emissions (40 CFR Part 1033, EPA Switch and Line-haul Locomotive Emission Standards). CH4 and N2O factors are from California Climate Action Registry General Reporting Protocol Version 3.1 (January 2009), Table C.6 (Methane and Nitrous Oxide Emission Factors for Non-Highway Vehicles) for locomotives.

**Offsite Coal Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 61,000 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 26.5 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 1,616,500 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 2,701 | tonne/yr | | | | | |
| $CH_4$ = | 8.24E-03 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 7.76E-03 | tonne/yr = | 2.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 2,703 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Petcoke Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 15,200 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 280 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 4,256,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 7,110 | tonne/yr | | | | | |
| $CH_4$ = | 2.17E-02 | tonne/yr = | 5.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.04E-02 | tonne/yr = | 6.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 7,117 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Liquid Sulfur Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 1,320 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 284 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 374,880 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 626 | tonne/yr | | | | | |
| $CH_4$ = | 1.91E-03 | tonne/yr = | 4.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 1.80E-03 | tonne/yr = | 6.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 627 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Gasification Solids Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 11,200 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 160 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 1,792,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 2,994 | tonne/yr | | | | | |
| $CH_4$ = | 9.14E-03 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 8.60E-03 | tonne/yr = | 3.E+00 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 2,997 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Ammonia Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 6,680 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 534,400 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 893 | tonne/yr | | | | | |
| $CH_4$ = | 2.73E-03 | tonne/yr = | 6.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.57E-03 | tonne/yr = | 8.E-01 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 894 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Urea Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 11,200 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 896,000 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 1,497 | tonne/yr | | | | | |
| $CH_4$ = | 4.57E-03 | tonne/yr = | 1.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 4.30E-03 | tonne/yr = | 1.E+00 | tonne $CO_2$e/yr | Total tonne $CO_2$e/yr = | | 1,498 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

*Hydrogen Energy California LLC* *4/18/2012*
*HECA Project*

**Offsite UAN Product Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 18,560 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 1,484,800 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 2,481 | tonne/yr | | | | | |
| $CH_4$ = | 7.57E-03 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 7.13E-03 | tonne/yr = | 2.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 2,483 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Equipment and Miscellaneous Trucks**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Number of Trucks | | 1,818 | truck per year | | EF $CO_2$ = | 1,671 | g/mi |
| Distance traveled per Truck (Round Trip) | | 80 | miles/ truck | | EF $CH_4$ = | 0.0051 | g/mi |
| Total Annual VMT | | 145,440 | miles/ year | | EF $N_2O$ = | 0.0048 | g/mi |
| $CO_2$ = | 243 | tonne/yr | | | | | |
| $CH_4$ = | 7.42E-04 | tonne/yr = | 2.E-02 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 6.98E-04 | tonne/yr = | 2.E-01 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 243 |

CO2 emissions from EMFAC2007 for fleet year 2010 heavy-heavy duty diesel trucks travelling at 50 mph. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for diesel heavy duty vehicles. Idling emission Factor for N2O and CH4 were extrapolated based on the ratio of CO2 emission factor for running vs idling.

**Offsite Employee Commute Vehicles**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Total Number of Employee | | 200 | employees/day | | EF $CO_2$ = | 364 | g/mi |
| Number of Worker per Commuter Vehicle | | 1.3 | | | EF $CH_4$ = | 0.0159 | g/mi |
| Daily Vehicle Count | | 154 | vehicles/day | | EF $N_2O$ = | 0.0093 | g/mi |
| Distance traveled per vehicle (Round Trip) | | 40 | miles/ vehicle/ day | | | | |
| Day of Commute per Month | | 365 | days/yr | | | | |
| Total Annual VMT | | 2,246,154 | miles/year | | | | |
| $CO_2$ = | 817 | tonne/yr | | | | | |
| $CH_4$ = | 3.57E-02 | tonne/yr = | 7.E-01 | tonne $CO_2$e/yr | | | |
| $N_2O$ = | 2.09E-02 | tonne/yr = | 6.E+00 | tonne $CO_2$e/yr | | Total tonne $CO_2$e/yr = | 824 |

CO2 emission factor for CO2 is from EMFAC 2007 (average of light duty automobile and light duty truck) for the vehicle model year fro m1971 to 2015. Running emission Factor for N2O and CH4 is based on Table C.4, California Climate Action Registry General Reporting Protocol Version 3.1, Jan 2009 for average of gasoline passenger cars, gasoline light trucks, diesel passenger cars, and diesel light truck.

| | |
|---|---|
| **Total tonne $CO_2$e/yr for Mobile Sources=** | **57,717** |

# GHG Emissions Summary for Mobile Sources

*Hydrogen Energy California LLC* *4/18/2012*
*HECA Project*

**Greenhouse Gas Emissions Associated with the Mobile Sources During Project Operations**

| Source | Annual CO2e Emissions (tonne/year) |
|---|---|
| Onsite Trucks | 867 |
| Offsite Workers Commuting | 824 |
| Offsite Trucks | 18,562 |
| Offsite Trains | 37,464 |
| **Total CO2e Annual Emissions** | **57,717** |

Notes:

Onsite worker travel and associated emissions are negligible

# Appendix E-13

# $CO_2$ Vent Study

# $CO_2$ VENT STUDY

The PHAST (Process Hazard Analysis Software Tool; by DNV) dispersion model was used to evaluate the potential for $CO_2$ venting to affect workers in the plant. This $CO_2$ venting occurs only during the Rectisol Unit startup or abnormal operating conditions when the off-taker, pipeline, or $CO_2$ compressor can not take the $CO_2$ product gas. The vent gas is released through the Scrubber outlet which is located on the Methanol Wash Column at 260 feet above grade. Work platforms are located on the Gasifier structure about 330 feet south-west from the $CO_2$ vent and 260 feet above grade. This location is the closest in proximity to the release location and the results of the modeling were evaluated at that location.

The Immediately Dangerous to Life and Health (IDLH) value is used as a threshold of unacceptable exposure to plant personnel. It is based on a healthy individual's ability to tolerate exposure to the specified limit for 30 minutes without irreversible health effects. The IDLH for $CO_2$ is 40,000 ppm.

The Clean Air Act states that the final offsite consequence analysis endpoints for an accidental release should be based on an Emergency Response Planning Guide (ERPG) value of 2 (ERPG-2). Currently an ERPG-2 value has not been established for $CO_2$. Therefore, the OSHA 8-hour TWA value for $CO_2$ (5000 ppm) is used as a substitute and conservative limit.

The tables below summarize the stability class, wind speeds, and vent gas rates used in the analysis.

**Weather Stability Classes**

| Stability Class | Condition | Wind Speed |
|---|---|---|
| A | Extremely Unstable | 3 m/s |
| B | Moderately Unstable | 5 m/s |
| D | Stable | 5 m/s |
| F | Calm | 1.0 m/s |

**$CO_2$ Vent Gas Properties**

| % of Full Flow Rate | 100% | 50% | 25% | 10% |
|---|---|---|---|---|
| Flow lb/hr | 761,400 | 380,700 | 190350 | 76140 |
| Volumetric flow, acf/s | 1831 | 916 | 458 | 183 |
| Stack Velocity, ft/sec | 190 | 95 | 48 | 19 |
| Vent $CO_2$ Temp, Deg F | 65 | 65 | 65 | 65 |

None of the dispersion plumes reach ground level within or outside the plant. Only the Class F stability full flow vent release plume has the potential to be near the gasification platform; however, it remains elevated above 300 feet. Due to the predicted proximity of the $CO_2$ plume, administrative controls are recommended during startup and abnormal operations to limit access to the gasifier platform. Also, it is recommended that $CO_2$ detectors (with alarms) be installed at the gasifier platform along with air packs for emergency use. An alarm that activates when $CO_2$ is venting would alert operators of a potential toxic threat. The healthy onsite worker who is trained to respond to a siren or horn upon the detection of a high $CO_2$ level can escape or seek shelter within the 30 minute period associated with the IDLH 40,000 ppm toxicity level. Only the Class F full vent release plume extends beyond the plant boundary; however, it remains elevated. The offsite public is not affected by the $CO_2$ vent release. The results of the PHAST model dispersion study are graphically shown on the attached elevation views of vent plume concentration contours for the various combinations of meteorology and venting rates.

# Attachment A
# Dispersion Plumes

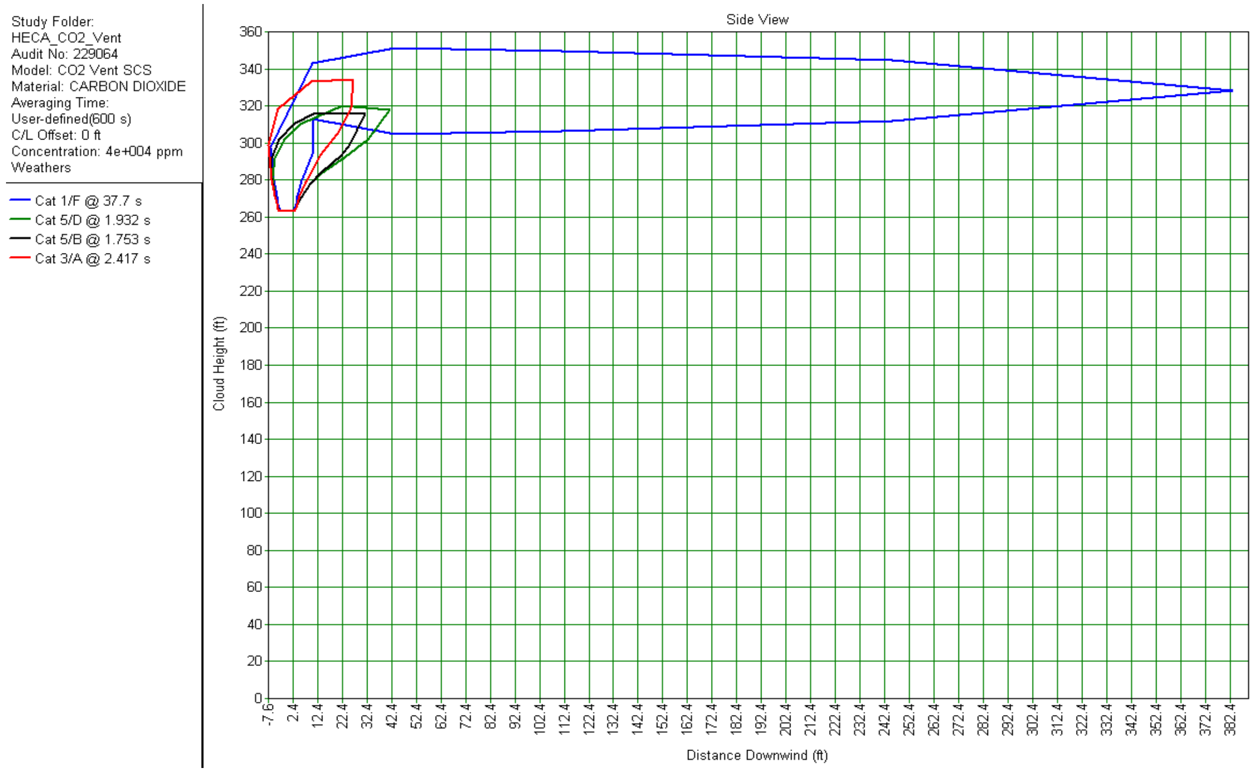



Figure 1a: Dispersion of a $CO_2$ release from the Vent; 100% Flow (40,000 ppm contour)

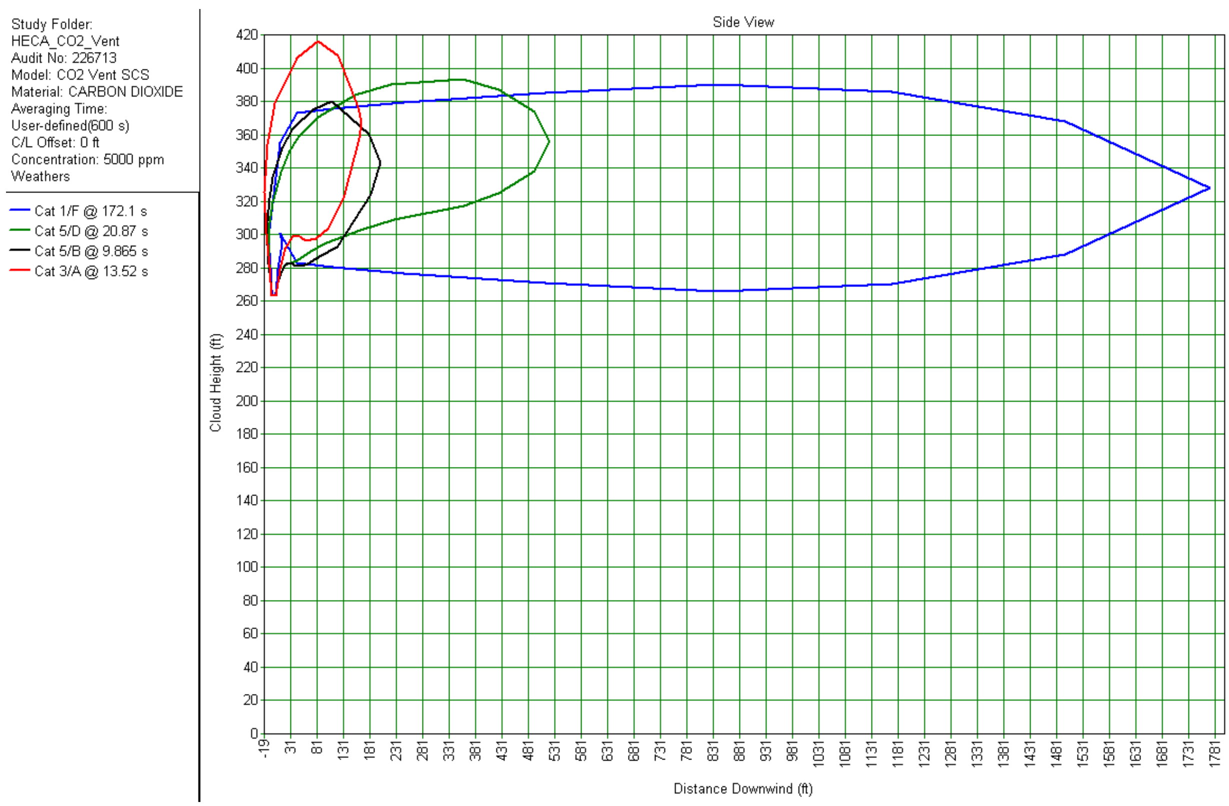



Figure 1b: Dispersion of a $CO_2$ release from the Vent; 100% Flow (5,000 ppm contour)

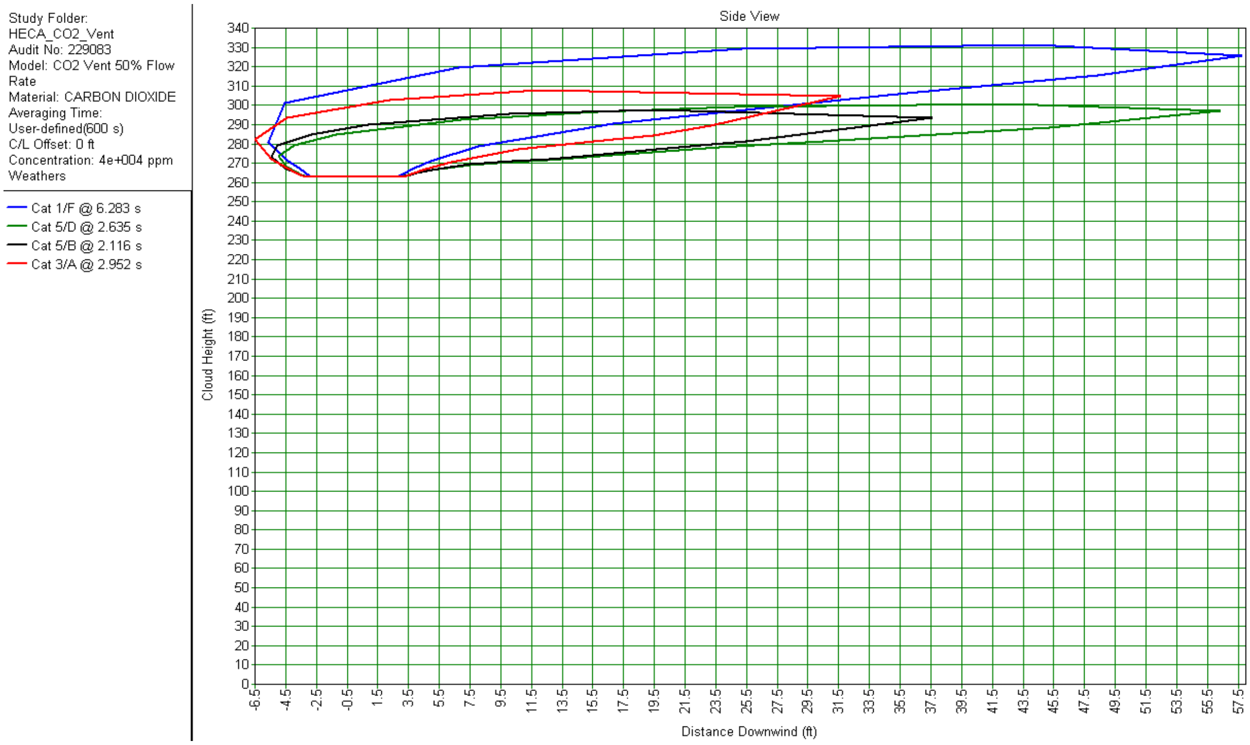



Figure 2a: Dispersion of a $CO_2$ release from the Vent; 50% Flow (40,000 ppm contour)

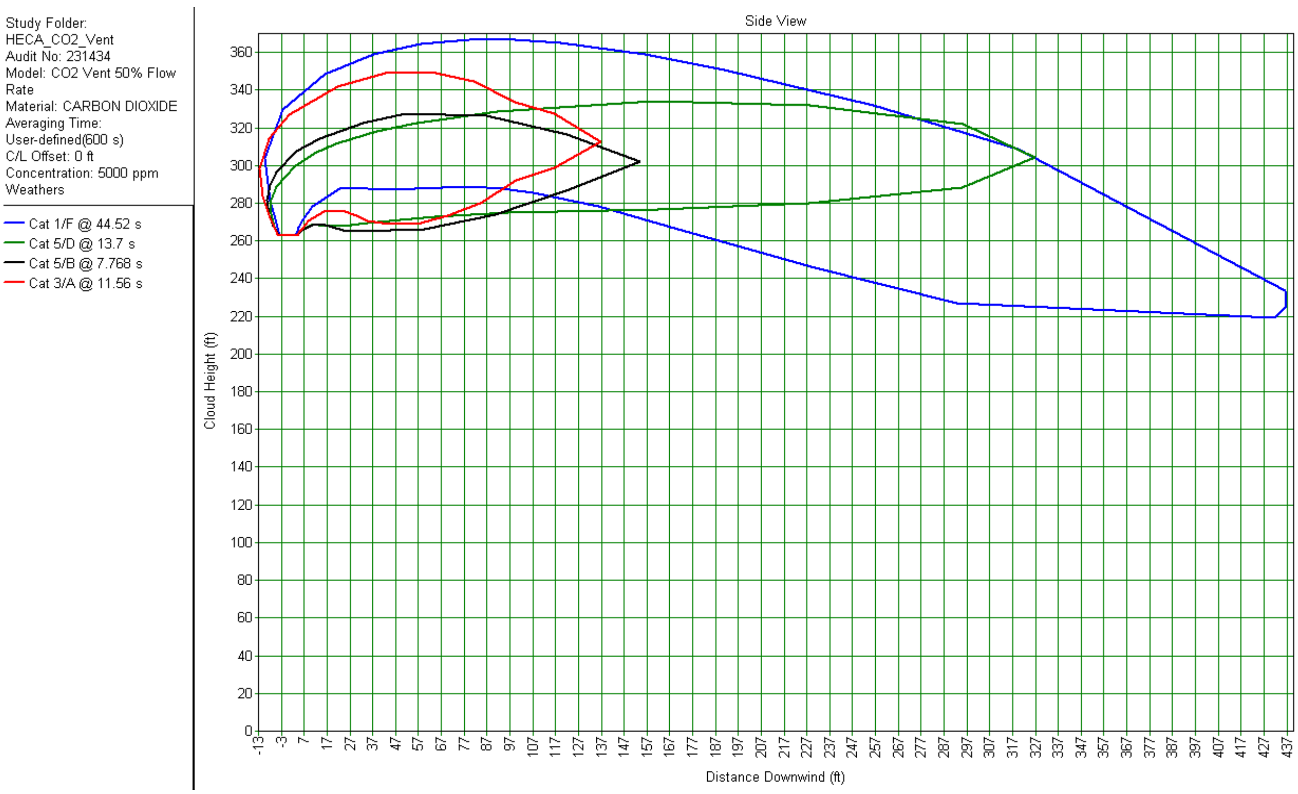



Figure 2b: Dispersion of a $CO_2$ release from the Vent; 50% Flow (5,000 ppm contour)

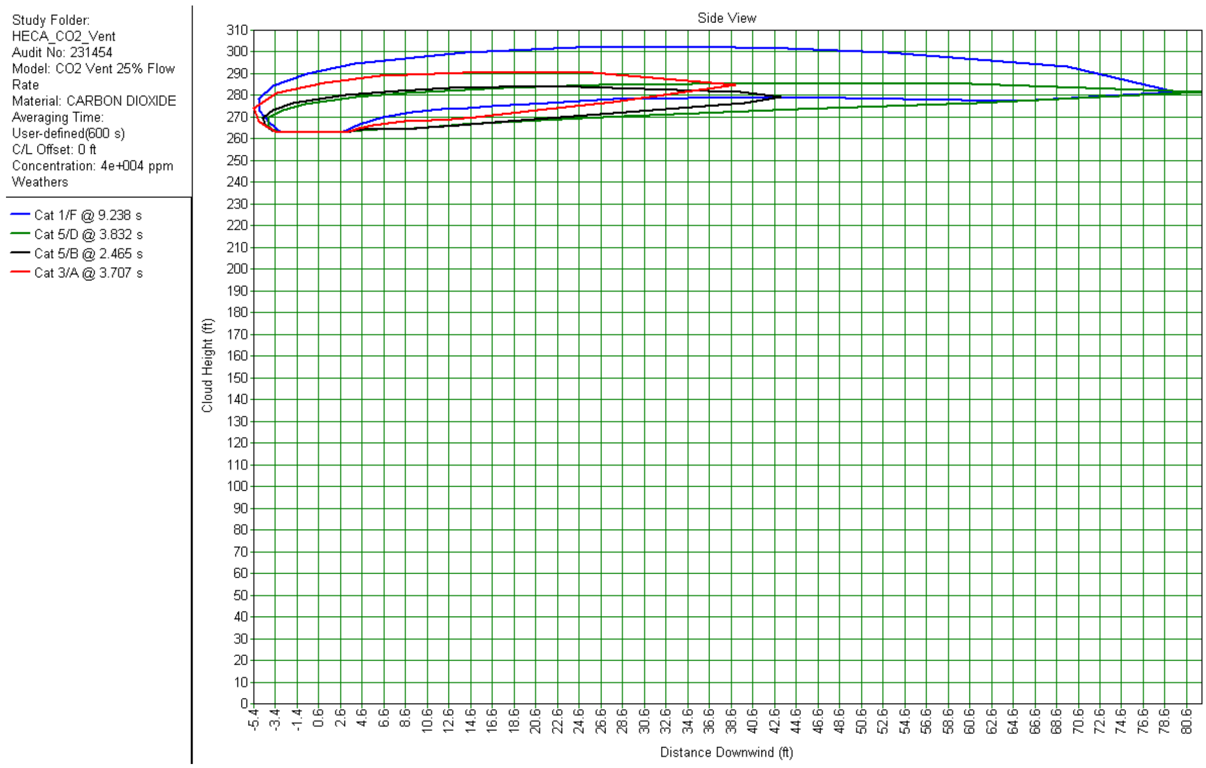



Figure 3a: Dispersion of a $CO_2$ release from the Vent; 25% Flow (40,000 ppm contour)

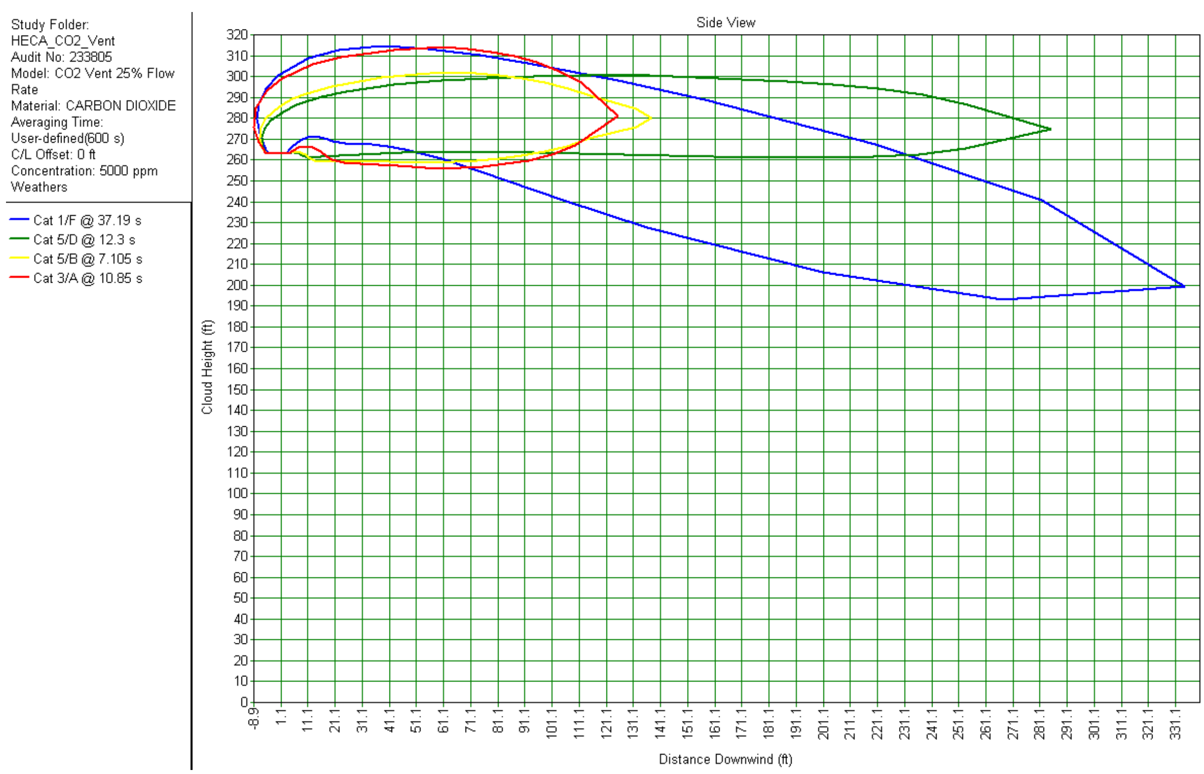



Figure 3b: Dispersion of a $CO_2$ release from the Vent; 25% Flow (5,000 ppm contour)

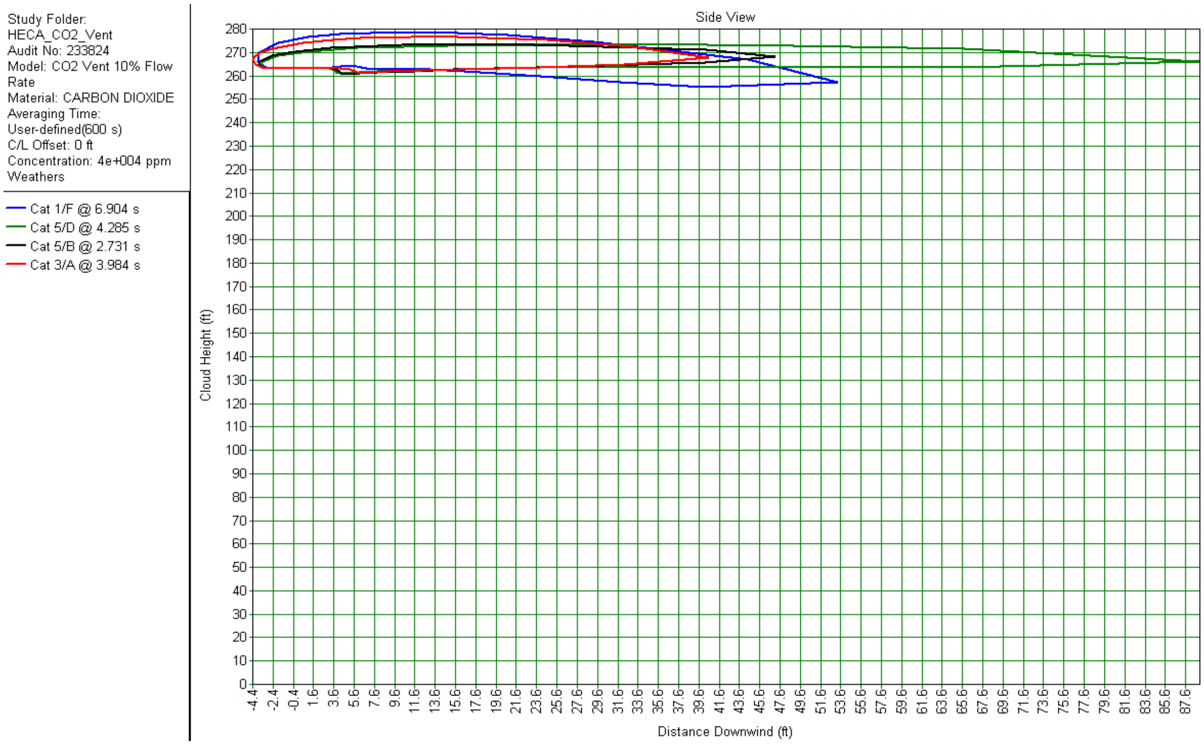



Figure 4a: Dispersion of a $CO_2$ release from the Vent; 10% Flow (40,000 ppm contour)

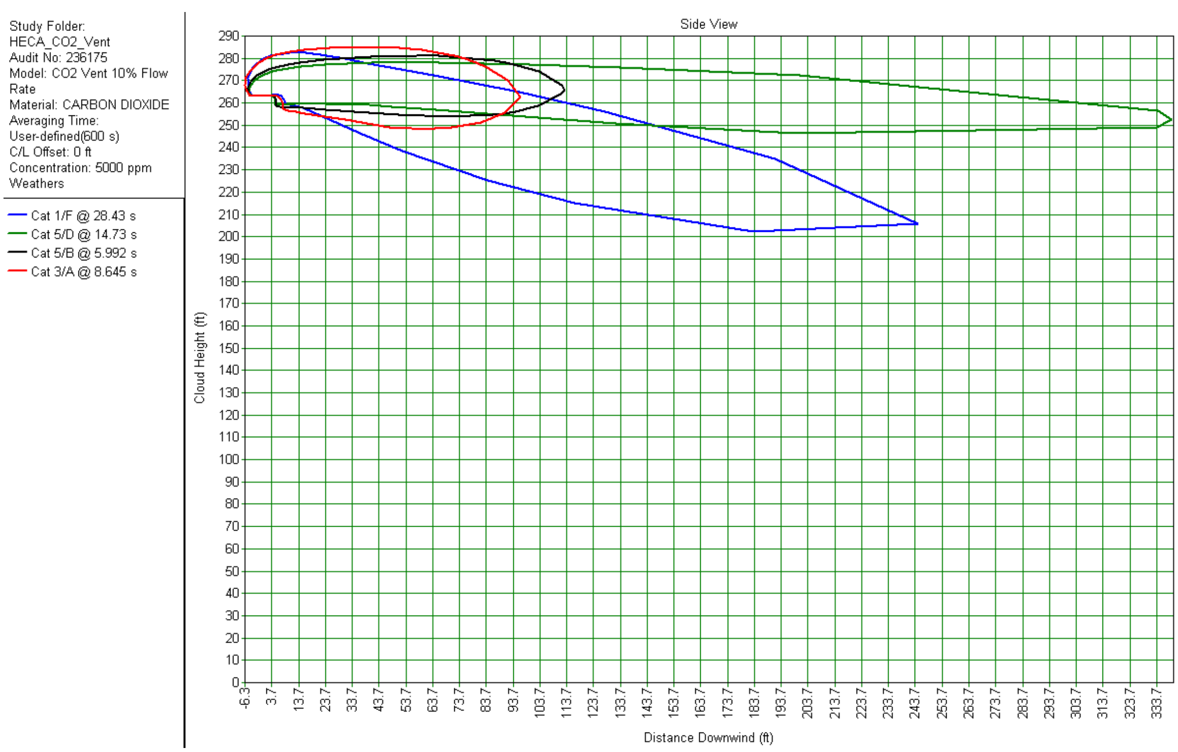



Figure 4b: Dispersion of a $CO_2$ release from the Vent; 10% Flow (5,000 ppm contour)

# Appendix E-14

# List of Projects from Response to DR 32

## BACKGROUND

The AFC, page 5.1-70, indicates that the results of a cumulative impacts analysis will be provided under separate cover and that Appendix J provides a list of projects located within 6 miles of the site from the SJVAPCD. However, staff's review indicates that Appendix J contains a list of projects from Kern County and not stationary source projects from the SJVAPCD. Staff needs the applicant to obtain the project list from the SJVAPCD and complete the cumulative impacts analysis.

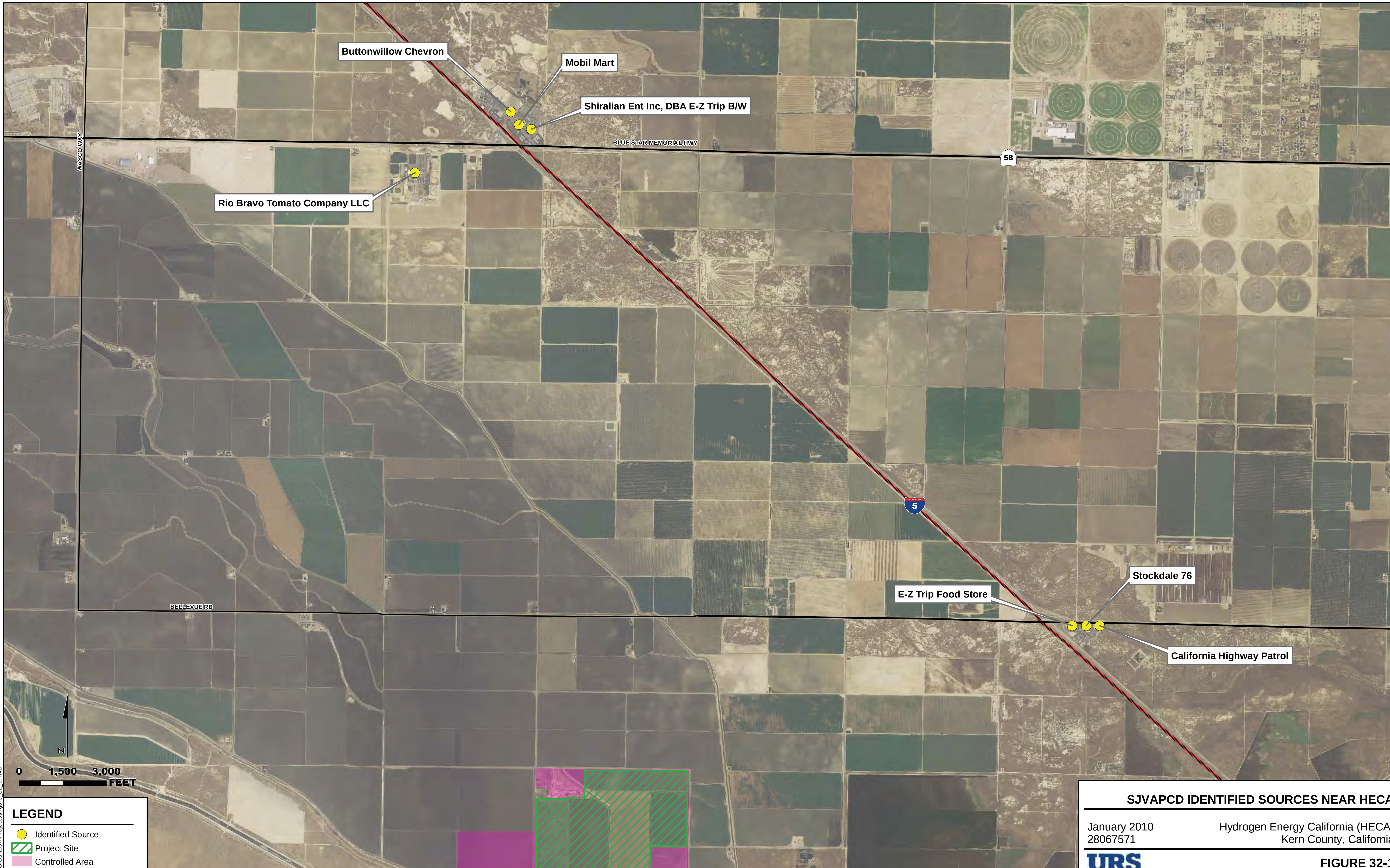
## DATA REQUEST

***32. Please provide a list from the SJVAPCD of large stationary source projects with permitted emissions, for projects with greater than 5 tons of permitted emissions of any single criteria pollutant, located within six miles of the project site that have been recently permitted, but did not start operation prior to 2009, or are in the process of being permitted.***

## RESPONSE

A public records request was submitted to the SJVAPCD requesting the list of sources meeting the criteria specified in this data request; a copy of that request is included as Attachment 32-1. SJVAPCD responded with a list of sources, a copy of which is included as Attachment 32-2. There are no sources on the list that meet all of the criteria for inclusion specified in this data request. Specifically, all sources on the list emit less than 5 tons per year of any single criteria pollutant. Therefore, there are no sources to be included in the cumulative impacts modeling requested in Data Request 33. For information purposes only, all the sources from the SJVAPCD list are located and identified on Figure 32-1.

**FIGURE 32-1**




U:\GIS\HECA\Projects\Figure_32_1.mxd

**SJVAPCD IDENTIFIED SOURCES NEAR HECA**

January 2010
28067571

Hydrogen Energy California (HECA)
Kern County, California

URS

**FIGURE 32-1**

**ATTACHMENT 32-1**
**PUBLIC RECORDS REQUEST SUBMITTED TO**
**THE SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT**

San Joaquin Valley
Air Pollution Control District
1990 E. Gettysburg Avenue, Fresno, CA 93726-0244
(559) 230-6000 www.Valleyair.org

**Public Records Requests**
Phone (559) 230-6000
Fax (559) 230-6061

*Office Use Only*
**CONTROL NUMBER**

# PUBLIC RECORDS REQUEST FORM

**ATTENTION REQUESTOR**: To expedite your request for District records, please fill out this form completely. Identify specifically the type of records you are requesting. Please limit your request to one facility or one site address for each request form filed, and three requests items per form. Additional forms or pages can be used if requesting information for more than one facility or for records not identified on this form. Requests should reasonably describe identifiable records prepared, owned, used, or retained by the District. Staff is available to assist you in identifying those records in the District's possession. The District is not required by law to create a new record or list from an existing record. By submission of this form I hereby agree to reimburse the SJVUAPCD for the direct cost of duplicating the requested records in accordance with Gov. Code Sec. 6253(b).

## REQUESTOR INFORMATION

NAME: Mark Strehlow DATE: Oct 26, 2009

COMPANY: URS Corporation, on behalf of Hydrogen Energy International LLC

MAILING ADDRESS: 1333 Broadway Suite 800

CITY: Oakland STATE: CA ZIP CODE: 94612

PHONE # 510 874 3055 FAX # E-MAIL: Mark_Strehlow@URSCorp.com

## DOCUMENTS REQUESTED *(3 Items per form)*

- ☐ Permit Application(s)
- ☐ Permit(s) to Operate (PTO)
- ☐ Authorities to Construct (ATC)
- ☐ Engineering Evaluation(s)
- ☐ Emissions Inventory Statement(s)
- ☐ Health Risk Assessment(s)
- ☐ Site Inspection Report(s)
- ☐ Source Test Report(s)
- ☐ Air Monitoring Data
- ☐ Complaints
- ☐ Notice(s) of Violation (NOV)
- ☐ Notice(s) to Comply (NTC)
- ☐ All Records/General File Review
- ☐ Toxic Sources within 1/4 mi School Review
- ☐ Asbestos Notification(s)/Record(s)
- ☐ AB2588 “Hot Spots” Information
- ☑ Other (*Describe below or on additional pages*):

Please provide a list of large stationary source projects with permitted emissions, for projects with greater than 5 tons of permitted emissions of any single criteria pollutant, located within 6 miles of HECA project site that have been recently permitted, but did not start operation prior to 2009, or are in the process of being permitted. In addition, please provide any emissions inventory applicable to the former Port Organics operation on the proposed HECA property regardless of any minimum criteria pollutant emission rate.

DATE OF DOCUMENTS REQUESTED: From: To:

## REQUESTED FACILITY INFORMATION *(If Applicable)*

FACILITY NAME: Hydrogen Energy California (HECA) FACILITY I.D. NO. *(if known)*

FACILITY ADDRESS: Section 10 of Township 30 South, Range 24 East in Kern County

CITY: STATE: CA ZIP CODE:

## METHOD OF DELIVERY (Check all that apply)

- ☐ Pick Up
- ☐ U.S. Mail
- ☐ FAX (Maximum 30 Pages)
- ☐ CD/DVD
- ☑ Email (Maximum 5 MB)
- ☑ Other
- ☐ Inspection of records only, no copies required (District will contact you to setup an appointment for inspection)

☐ I request that the SJVUAPCD contact me prior to completing the requested records if the cost exceeds $

# ATTACHMENT 32-2
# LIST OF EMISSIONS SOURCES PROVIDED BY
# THE SAN JOAQUIN VALLEY AIR POLLUTION CONTROL DISTRICT

# ATC Within 6 Miles

APPs Received Between 1/1/2009 and 12/31/2009

All Sources less than 5 Tons

**Region** S

*Facility ID* 1456

*Facility Name* E-Z TRIP FOOD STORE
*Facility Type* GASOLINE DISPENSING

*Distance To Location* 5641.616
*Degrees* 26.37063

| | Received | Type | Status | Description |
|---|---|---|---|---|
| VOC | 1/14/2009 | ATC | FINAL | installation of Healy EVR Phase II |

*Facility ID* 2002

*Facility Name* STOCKDALE 76
*Facility Type* GASOLINE DISPENSING

*Distance To Location* 5527.26
*Degrees* 26.96527

| | Received | Type | Status | Description |
|---|---|---|---|---|
| VOC | 10/5/2009 | ATC | PR-INCO | installation of Phase II EVR and new dispensers |

*Facility ID* 2187

*Facility Name* SHIRALIAN ENT INC, DBA E-Z TRIP-B/W
*Facility Type* GASOLINE DISPENSING

*Distance To Location* 7835.253
*Degrees* 353.6736

| | Received | Type | Status | Description |
|---|---|---|---|---|
| VOC | 1/14/2009 | ATC | FINAL | installation of Healy EVR Phase II |

**Facility ID** 2346

**Facility Name** CALIFORNIA HIGHWAY PATROL
**Facility Type** POLICE PROTECTION

**Distance To Location** 5773.069
**Degrees** 25.67612

| | Received | Type | Status | Description |
|---|---|---|---|---|
| VOC | 3/16/2009 | ATC | FINAL | modify GDF/remove Phase II, per Rule 4622 ORVR exemption |

**Facility ID** 2797

**Facility Name** BUTTONWILLOW CHEVRON
**Facility Type** GASOLINE DISPENSING

**Distance To Location** 7835.387
**Degrees** 353.6724

| | Received | Type | Status | Description |
|---|---|---|---|---|
| | 8/5/2009 | ATC | FINAL | Veeder Root Phase II Upgrade with ISD |
| VOC | 3/17/2009 | ATC | FINAL | installation of six new dispensers |
| | 1/20/2009 | ATC | FINAL | VST Phase II upgrade with Veeder Root vapor filter and without ISD |

**Facility ID** 3043

**Facility Name** MOBIL MART
**Facility Type** GASOLINE DISPENSING

**Distance To Location** 7818.377
**Degrees** 353.4922

| | Received | Type | Status | Description |
|---|---|---|---|---|
| VOC | 3/30/2009 | ATC | FINAL | Vapor polisher upgrade |

*Facility ID* 3550

*Facility Name* RIO BRAVO TOMATO COMPANY LLC

*Facility Type* TOMATO PROCESSING

*Distance To Location* 7865.64

*Degrees* 344.3918

NOx
3.5 Tons/year

| Received | Type | Status | Description |
|---|---|---|---|
| 3/30/2009 | PEER | FINAL | PEER: ONE (1) BOILER |

# Appendix F

# Biological Resources

# Appendix F-1

# CNDDB Database

**State of California**
**Department of Fish and Game**
**California Natural Diversity Database**
**January 2012 Version**

| Scientific Name | Common Name | Element Code | Federal Status | State Status | G Rank | S Rank | CNPS |
|---|---|---|---|---|---|---|---|
| **Birds** | | | | | | | |
| *Plegadis chihi* | white-faced ibis | ABNGE02020 | None | None | G5 | S1 | |
| *Dendrocygna bicolor* | fulvous whistling-duck | ABNJB01010 | None | None | G5 | S1 | |
| *Elanus leucurus* | white-tailed kite | ABNKC06010 | None | None | G5 | S3 | |
| *Buteo swainsoni* | Swainson's hawk | ABNKC19070 | None | Threatened | G5 | S2 | |
| *Falco mexicanus* | prairie falcon | ABNKD06090 | None | None | G5 | S3 | |
| *Charadrius alexandrinus nivosus* | western snowy plover | ABNNB03031 | Threatened | None | G4T3 | S2 | |
| *Charadrius montanus* | mountain plover | ABNNB03100 | Proposed Threatened | None | G2 | S2? | |
| *Coccyzus americanus occidentalis* | western yellow-billed cuckoo | ABNRB02022 | Candidate | Endangered | G5T3Q | S1 | |
| *Athene cunicularia* | burrowing owl | ABNSB10010 | None | None | G4 | S2 | |
| *Eremophila alpestris actia* | California horned lark | ABPAT02011 | None | None | G5T3Q | S3 | |
| *Toxostoma lecontei* | Le Conte's thrasher | ABPBK06100 | None | None | G3 | S3 | |
| *Lanius ludovicianus* | loggerhead shrike | ABPBR01030 | None | None | G4 | S4 | |
| *Agelaius tricolor* | tricolored blackbird | ABPBXB0020 | None | None | G2G3 | S2 | |
| *Agelaius tricolor* | tricolored blackbird | ABPBXB0020 | None | None | G2G3 | S2 | |
| *Xanthocephalus xanthocephalus* | yellow-headed blackbird | ABPBXB3010 | None | None | G5 | S3S4 | |
| **Mammals** | | | | | | | |
| *Sorex ornatus relictus* | Buena Vista Lake shrew | AMABA01102 | Endangered | None | G5T1 | S1 | |
| *Eumops perotis californicus* | western mastiff bat | AMACD02011 | None | None | G5T4 | S3? | |
| *Ammospermophilus nelsoni* | Nelson's antelope squirrel | AMAFB04040 | None | Threatened | G2 | S2 | |
| *Perognathus inornatus inornatus* | San Joaquin pocket mouse | AMAFD01061 | None | None | G4T2T3 | S2S3 | |
| *Dipodomys ingens* | giant kangaroo rat | AMAFD03080 | Endangered | Endangered | G2 | S2 | |
| *Dipodomys nitratoides nitratoides* | Tipton kangaroo rat | AMAFD03152 | Endangered | Endangered | G3T1 | S1 | |
| *Dipodomys nitratoides brevinasus* | short-nosed kangaroo rat | AMAFD03153 | None | None | G3T1T2 | S1S2 | |
| *Onychomys torridus tularensis* | Tulare grasshopper mouse | AMAFF06021 | None | None | G5T1T2 | S1S2 | |
| *Vulpes macrotis mutica* | San Joaquin kit fox | AMAJA03041 | Endangered | Threatened | G4T2T3 | S2S3 | |
| *Taxidea taxus* | American badger | AMAJF04010 | None | None | G5 | S4 | |

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**State of California**
**Department of Fish and Game**
**California Natural Diversity Database**
**January 2012 Version**

| Scientific Name | Common Name | Element Code | Federal Status | State Status | G Rank | S Rank | CNPS |
|---|---|---|---|---|---|---|---|
| **Reptiles** | | | | | | | |
| *Emys marmorata* | western pond turtle | ARAAD02030 | None | None | G3G4 | S3 | |
| *Gambelia sila* | blunt-nosed leopard lizard | ARACF07010 | Endangered | Endangered | G1 | S1 | |
| *Phrynosoma blainvillii* | coast horned lizard | ARACF12100 | None | None | G4G5 | S3S4 | |
| *Masticophis flagellum ruddocki* | San Joaquin whipsnake | ARADB21021 | None | None | G5T2T3 | S2? | |
| *Thamnophis gigas* | giant garter snake | ARADB36150 | Threatened | Threatened | G2G3 | S2S3 | |
| **Habitats** | | | | | | | |
| *Valley Saltbush Scrub* | Valley Saltbush Scrub | CTT36220CA | None | None | G2 | S2.1 | |
| *Valley Sacaton Grassland* | Valley Sacaton Grassland | CTT42120CA | None | None | G1 | S1.1 | |
| *Alkali Seep* | Alkali Seep | CTT45320CA | None | None | G3 | S2.1 | |
| *Great Valley Cottonwood Riparian Forest* | Great Valley Cottonwood Riparian Forest | CTT61410CA | None | None | G2 | S2.1 | |
| *Great Valley Mesquite Scrub* | Great Valley Mesquite Scrub | CTT63420CA | None | None | G1 | S1.1 | |
| **Singular Insect** | | | | | | | |
| *Protodufourea zavortinki* | Zavortink's protodufourea bee | IIHYM77020 | None | None | G1 | S1 | |
| **Plants** | | | | | | | |
| *Cirsium crassicaule* | slough thistle | PDAST2E0U0 | None | None | G2 | S2.2 | 1B.1 |
| *Madia radiata* | showy golden madia | PDAST650E0 | None | None | G2 | S2.1 | 1B.1 |
| *Stylocline citroleum* | oil neststraw | PDAST8Y070 | None | None | G2 | S2 | 1B.1 |
| *Stylocline masonii* | Mason's neststraw | PDAST8Y080 | None | None | G1 | S1.1 | 1B.1 |
| *Monolopia congdonii* | San Joaquin woollythreads | PDASTA8010 | Endangered | None | G3 | S3 | 1B.2 |
| *Caulanthus californicus* | California jewel-flower | PDBRA31010 | Endangered | Endangered | G1 | S1 | 1B.1 |
| *Atriplex cordulata* | heartscale | PDCHE040B0 | None | None | G2? | S2.2? | 1B.2 |
| *Atriplex coronata var. vallicola* | Lost Hills crownscale | PDCHE04250 | None | None | G4T2 | S2 | 1B.2 |
| *Atriplex minuscula* | lesser saltscale | PDCHE042M0 | None | None | G1 | S1.1 | 1B.1 |
| *Atriplex subtilis* | subtle orache | PDCHE042T0 | None | None | G2 | S2.2 | 1B.2 |
| *Astragalus hornii var. hornii* | Horn's milk-vetch | PDFAB0F421 | None | None | G4G5T2T3 | S1 | 1B.1 |
| *Eremalche kernensis* | Kern mallow | PDMAL0C031 | Endangered | None | G3?T1Q | S1 | 1B.1 |
| *Eschscholzia lemmonii ssp. kernensis* | Tejon poppy | PDPAP0A071 | None | None | G5T1 | S1.1 | 1B.1 |
| *Eriastrum hooveri* | Hoover's eriastrum | PDPLM03070 | Delisted | None | G3 | S3.2 | 4.2 |
| *Delphinium recurvatum* | recurved larkspur | PDRAN0B1J0 | None | None | G3 | S3 | 1B.2 |
| *Calochortus striatus* | alkali mariposa-lily | PMLIL0D190 | None | None | G2 | S2 | 1B.2 |

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**State of California**
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**January 2012 Version**

| Scientific Name | Common Name | Element Code | Federal Status | State Status | G Rank | S Rank | CNPS |
|---|---|---|---|---|---|---|---|

1: Global Ranking

G1= Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factor:

G2= Imperiled—At high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors

G3= Vulnerable—At moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factor:

G4= Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors

G5= Secure—Common; widespread and abundant.

T#= Infraspecific Taxon (trinomial)—The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T subrank cannot imply the subspecies or variety is more abundant than the species . For example, a G1T2 subrank should not occur. A vertebrate anima population, (e.g., listed under the U.S. Endangered Species Act or assigned candidate status) may be tracked as an infraspecific taxon and given a T-rank; in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status.

2: Subnational Ranking

S1= Critically Imperiled— Critically imperiled in the jurisdiction because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the jurisdiction.

S2= Imperiled— Imperiled in the jurisdiction because of rarity due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation from jurisdiction.

S3= Vulnerable— Vulnerable in the jurisdiction due to a restricted range, relatively few populations, recent and widespread declines, or other factors making it vulnerable to extirpation.

S4= Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors

S5= Secure— Common, widespread, and abundant in the jurisdiction.

CNPS
- 1 Seriously endangered in California
- 1B Plants that are rare or endangered in California and elsewhere
- 2 Fairly endangered in California
- 3 Not very endangered in California
- 4 Plants that have limited distribution in California

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# Appendix F-2

# Waters of the U.S.

# (Submitted Separately Under the Rules of Confidentiality)

# Appendix F-3

# Resumes

| Name | Education | Experience | Expertise |
|---|---|---|---|
| Alyssa Berry | B.A. Earth and Environmental Studies, Wesleyan University | 3 years | Plant and wildlife surveys |
| Andy Evans | B.S. Geological Sciences, UCSB | 2 years | Blunt-nosed leopard-lizard surveys |
| Chris Julian | B.S. Biology, UCSB | 10 years | Wetland regulatory sciences, clean water act regulation |
| Cletis England | B.S. Ecology and Systematic Biology, California Polytechnic, San Luis Obispo | 11 years | Ecologist |
| David Compton | M.A. U.S. History, Marquette University | 11 years | General biology, BNLL |
| David Kisner | M.S., Ecology, San Diego State University | 19 years | Plant and wildlife surveys |
| Gilda Barboza | B.A. Geography and Environmental Studies/International Development Studies, UCLA | 6 years | Section 7consultation, rare plant and wildlife surveys |
| Jamie Deutsch | B.S. Forestry, California Polytechnic, San Luis Obispo | 4 years | Plant and wildlife surveys |
| Jan Novak | B.S. Soils Science, California Polytechnic, San Luis Obispo | 11 years | Clean Water Act regulations, wetland delineations |
| Jane Donaldson | B.S. Biological Sciences, California Polytechnic, San Luis Obispo | 15 years | Sensitive species monitoring; botany |
| Jessica Birnbaum | M.S. Natural resources; Planning and Interpretation, Humboldt State University | 7 years | Botany, BNLL surveys, habitat assessment. |
| Johanna Kisner | M.S. Environmental Science and Management, UCSB | 11 years | Botany, wetland delineation. |
| Jolie Henricks | B.S. Wildlife and Fisheries, UC Davis | 8 years | Wildlife biology, GIS analysis |
| Kate Eldredge | B.S. Biology, California State University, Bakersfield | 21 years | Plant and wildlife surveys, BNLL |
| Kelly Kephart | B.S. Forestry, California Polytechnic, San Luis Obispo | 6 years | Botany, wetland delineation, rare plant surveys |
| Mark Wilson | B.A., Environmental Studies, Saint Mary’s College of | 3 years | Biology/Conservation Biology, Biological |

| Name | Education | Experience | Expertise |
|---|---|---|---|
| | California | | Monitoring, Habitat Assessments |
| Melissa Newman | M.S. Biology, UC San Diego | 6 years | Wildlife biology surveys, habitat assessment, environmental impact analysis, ESA |
| Robin Murray | B.S. Botany, Humboldt State University | 3 years | Botany, BNLL |
| Ronald Cummings | B.S. General Biology, Oregon State University | 22 years | General biology, BNLL |
| Steve Zembsch | B.S., Soil Resource Management, UC Berkeley | 31 years | Stream Restoration, Wetland Mitigtion/Creation, Revegetation/Pest Species Eradication |
| Wayne Vogler | B.S., Biological Sciences, UC Irvine | 12 years | Biological surveys, BNLL |

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# Alyssa J. Berry

*Staff Biologist*

## Overview

Mrs. Berry is a field biologist with over three years of experience monitoring California Threatened and Endangered species and restoring native habitat. Alyssa's survey work has covered areas of the central coast, the high desert region of Northern California, and Mojave desert, focusing on California red-legged frogs and arroyo toads in the Los Padres National Forest, the Northern spotted owl in the Klamath National Forest and desert tortoise in Johnson Valley. Her conservation efforts have included ecological restoration, concentrating on the re-vegetation of disturbed habitat with genetically local, native plant species. Alyssa has propagated site-specific grassland, chaparral, riparian and coastal dune species for ecological restoration. She has aided in the design and installation of several restoration sites. More recently Alyssa has expanded her herpetological survey experience to include blunt-nosed leopard lizard and California tiger salamander.

## Areas of Expertise

Monitoring Threatened and Endangered Amphibians of California
Wildlife Surveys
Habitat Restoration

## Years of Experience

With URS: >1 Year
With Other Firms: 2 Years

## Education

BA/Earth and Environmental Science/ 2004/Wesleyan University, CT
Course Work in Animal Diversity, Ornithology at Santa Barbara City College/2006

## Project Specific Experience

<u>**Wildlife Experience**</u>

**California Tiger Salamander (*Ambystoma californiense*)**
Santa Maria, CA – Under the supervision of Tom Olson and authorization of his recovery permit, visually evaluated burrows with a scope to determine presence of California tiger salamanders and hand excavated vacant burrows to prevent future use. Perform daily early morning clearance surveys to detect California tiger salamanders prior to construction activities, from March 2008 to present.

**Blunt-Nosed Leopard Lizard (*Gambelia sila*)**
Four positive identifications under supervision of a Level II surveyor

- California Valley, CA – Surveyed for blunt-nosed leopard lizards using the CA Department of Fish and Game Protocol.
- Belridge, CA – Surveyed for blunt-nosed leopard lizards using the CA Department of Fish and Game Protocol. Identified blunt-nosed leopard lizards at a reference site.
- Coalinga, CA – Surveyed for blunt-nosed leopard lizards using the CA Department of Fish and Game Protocol.

**Desert Tortoise (*Gopherus agassizii*)**
Over 16 hours of positive contact

- Attended the Desert Tortoise Council's Introduction to surveying, monitoring and handling techniques workshop.
- Conducted USFWS Protocol surveys for DT in Johnson Valley, CA.

**California Red-legged Frog (*Rana aurora draytonii*)**
Over 50 hours of positive contact

- Construction monitoring and relocation of California red-legged frogs for the Winchester Canyon Road Culvert Repair Project, Santa Barbara County, CA. Relocation authorization given by USFWS biologist, Chris Dellith.
- Biology and Management of California red-legged frog Workshop, Elkhorn Slough National Estuarine Research Reserve, Instructors, Galen Rathbun and Norman Scott.
- Santa Maria, CA – Morning eye-shine surveys to clear soil remediation site. Qualifications approved by USFWS biologist, Chris Dellith.
- Guadalupe, CA – Evening eye-shine surveys to monitor presence/absence of CRLF in newly created wetlands within the Guadalupe Soil Remediation site.
- Los Padres National Forest, Santa Barbara, CA – Surveyed for California red-legged frog egg masses, tadpoles, sub-adults and adults. Captured all life stages to measure morphological characteristics. Used Garmin GPS waypoints to map locations of individuals and areas of critical, potential and unsuitable habitat. Performed night surveys to monitor for breeding individuals, using eye-shine techniques.

**Arroyo Toad (*Bufo californicus*)**
Over 30 hours of positive contact

- Los Padres National Forest, Santa Barbara, CA – Surveyed for Arroyo toad egg strings, tadpoles, sub-adults and adults. Captured all life stages to measure morphological characteristics. Used Garmin GPS waypoints to map locations of individuals and areas of critical, potential and unsuitable habitat. Performed night surveys to monitor for breeding individuals, using eye-shine techniques.

**Small Mammal Trapping**

- California Valley, CA – Processed small mammal traps, capturing San Joaquin pocket mice (*Perognathus inornatus*), under the permit and training of Curtis Uptain.
- California Valley, CA – Under the permit and training of Paul Collins, curator of Santa Barbara Natural History Museum, baited Sherman's traps and processed small mammals, including San Joaquin pocket mouse, California pocket mouse (*Chaetodipus californicus*) and Heermann's kangaroo rat (*Dipodomys heermanni*).
- Guadalupe Dunes, CA – Processed small mammals under the supervision of Jane Donaldson, including California pocket mouse and Heermann's kangaroo rat.

**Northern Goshawk (*Accipiter gentilis*)**
5 hours of positive contact

- Klamath National Forest – Performed transect surveys while playing recorded vocalizations to solicit a response from Northern goshawks. Performed nest searches.

**Swainson's Hawk (*Buteo swainsonii*)**
20 hours of positive contact

- Macdoel, CA – Performed nest searches to locate Swainson's hawk fledglings and pairs. Banded individuals and recorded band numbers of previously banded individuals.

## Habitat Restoration Experience

- Developed a restoration plan for six wetland pools designed for California red-legged frogs, California tiger salamanders and Western spadefoot toads, including specification for plant species to be planted, monitoring and maintenance procedures and irrigation at the Casmalia Landfill, CA.
- Conducted annual vegetation transect monitoring to measure plant cover and diversity of restoration sites.
- Composed annual restoration monitoring reports for the Santa Barbara Airport wetland restoration. Analysis included percent native and non-native cover, percent survival and percent cover by species.
- Assisted in the restoration of tidal wetlands at the Santa Barbara Airport by collecting local, California native plant seed and propagating native plants for re-vegetation.
- Assisted in restoration of disturbed coastal dunes by collecting genetically local, native plant seed.
- Assisted in the bluff's restoration at Nicholas Canyon State Park, Malibu by in-planting 2,000 native plants.
- Assisted in restoration of the Santa Barbara County landfill by installing irrigation systems, planning and planting 1,000 California native plants.
- Removed invasive weeds, including tamarisk, yellow/purple star-thistle and pampas grass from the Los Padres National Forest.

## Vegetation Survey Experience

- Orcutt, CA – Created vegetation community maps using the Sawyer and Keeler-Wolfe, Rapid Assessment method for over 1400 acres of oil field property.
- Bakersfield, CA – Conducted a rare plant survey along a pipeline linear to document sensitive plant species prior to pipeline removal.
- Orcutt, CA – Conducted rare plant surveys throughout the Careaga oil field lease to document sensitive plant species within the property. Generated a report including maps of the observed species and recommendations for avoidance and conservation of identified species.

- San Bernardino NF, CA – Conducted vegetation surveys to map the presence/absence of the invasive weed, *Arrundo donax* along river channels.
- Los Padres NF, Santa Barbara District, CA – Conducted vegetation surveys to map the presence/absence of yellow star thistle.
- Los Padres NF, Santa Barbara District, CA – Conducted rare plant presence/absence surveys for the Santa Ynez false-lupine (*Thermopsis macrophylla* var. *angina*), Late-flowered mariposa lily (*Calochortus weedii var. vestus*) and the Refugio Manzanita (*Arctostaphylos refugioensis)*.

## Specialized Training

HAZWOPER Annual Refresher
June 2008

Loss Prevention System
August 2007

Smith Systems Driver Training
June 2007

First Aid/CPR/AED
December 2007

## Contact Information

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Alyssa_Berry@URSCorp.com

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# Andrew Evans

*Staff Scientist*

## Areas of Expertise

Structural Geology
Geomorphology
Petroleum Geology
Geologic Mapping & Field Methods
Geophysics
Sedimentary & Igneous Petrology

## Years of Experience

With URS: 2 Years

## Education

BS/Geological Sciences/2007/University of California, Santa Barbara

## Registration/Certification

2008/California Geologist in Training (GIT)

## Overview

Mr. Andrew Evans is a staff geologist with experience in various aspects environmental consulting and remediation projects. His field experience includes soil classification, boring and trench logging, environmental sampling, and biological surveying. He has operational experience with basic air monitoring devices (PID, 5 gas monitors) and Tremble hand held GPS devices. He has assisted with the preparation of field assessment work plans and assessment reports related to a variety of oil field remediation projects. He has also assisted with various project management and project preparation activities such as historical research, permitting, Health and Safety plans, and project planning.

## Awards

Edwin V. Van Amringe Scholarship (PCC), Miller Scholarship (PCC), Robert M. Norris Award in Field Geology (UCSB), Outstanding Graduating Senior Award (UCSB), Outstanding Academic Achievement Award (UCSB), Webb Award (UCSB)

## Experience

**Environmental Assessment**

- Performed site assessment activities at a former oil-facility in East Cat Canyon, Santa Barbara County, California. Portions of the site were within a California Tiger Salamander Habitat. Directed excavation activities, site controls and collected soil samples. The assessment work was performed under permit with the County of Santa Barbara.
- Participated in environmental sampling for an ecological risk assessment at a former hazardous waste disposal facility.
- Assisted with the installation of wells and set up of soil vapor extraction system at a former oil-facility.

**Blunt-nosed Leopard Lizard surveys**

- California Valley Reference Site: Under the direction of a Level II surveyor, observed juvenile blunt-nosed leopard lizard in the wild.
- Elk Hills Project Site: Assisted with four surveys in 2009 – no blunt-nosed leopard lizards were detected.
- California Valley Project Site: Assisted with 28 surveys in 2009 – no blunt nosed leopard lizards were detected.

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# Christopher Julian

*Project Biologist, Regulatory Specialist*

## Areas of Expertise

Multidisciplinary Project Management
CEQA/NEPA Environmental Analysis
Caltrans Natural Environment Studies
Section 404/1600 Permitting
Delineation of Streams and Wetlands
Wetlands Functional Assessment
404(b)(1) Alternatives Analysis
Section 7 Consultation
CESA Incidental Take Permitting
Stream Ecology and Bioassessment
Environmental Compliance Monitoring
Protocol Surveys for Plant and Wildlife Species

## Years of Experience

With URS: 8 Years
With Other Firms: 2 Years

## Education

BS/Biology/2001/University of California, Santa Barbara

## Overview

Mr. Julian manages the Biological Services group at URS Santa Barbara, and has over ten years of postgraduate work experience as an environmental consultant, including six years as an interdisciplinary project manager. His technical emphases include environmental analyses under NEPA and CEQA, all aspects of state (California) and federal stream and wetlands permitting (including agency coordination and negotiations, jurisdictional determination, wetlands functional assessment, and 404(b)(1) analysis), and endangered species permitting. He has effectively assisted clients with designing projects to ensure compliance with agency regulations, and has managed and prepared highly complex CEQA, NEPA, and ESA documents. Mr. Julian also has an extensive stream ecology background, encompassing lake and stream bioassessments, surveys for common and special-status aquatic wildlife species, and mapping of aquatic habitats.

## Project Specific Experience

### Jurisdictional Delineation / Permitting Experience

**Newhall Ranch Resource Management and Development Plan, Santa Clarita Valley, Ca:** Managed delineation of all Corps-jurisdictional waters of the U.S., including wetlands, and CDFG-jurisdictional streambeds within the 12,000 acre Newhall Ranch site in the Santa Clarita Valley, California. All jurisdictional features were delineated in the field using a GPS unit capable of sub-meter accuracy, and nearly 100 wetland delineation data forms were completed. The results of the delineation were provided to the Corps and CDFG, and both agencies concurred with the delineated boundaries, which were utilized as the environmental baseline during environmental analysis of comprehensive permitting proposals on the site. Mr. Julian also prepared a Section 404(b)(1) alternatives analysis for this complex project.

**California High Speed Train, Fresno-Bakersfield and Bakersfield-Palmdale Segments:** Worked with and oversaw a crew of URS wetland scientists delineating all waters of the U.S., including wetlands, and CDFG-jurisdictional streambeds located along several alternative proposed high-speed rail alignments between Fresno and Bakersfield in California's Central Valley and between Bakersfield and Palmdale in the Tehachapi Mountains and Mojave Desert. All jurisdictional features were delineated in the field using a GPS unit capable of sub-meter accuracy, and the study conformed to the latest regulatory guidance, including the Arid West Regional Supplement to the Wetland Delineation Manual, and the Corps/USEPA's joint Rapanos Guidance Memorandum.

**West Goleta Slough Enhancement and Restoration Project:** Prepared permit application and supporting materials for the U.S. Army Corps of Engineers, the Central Coast Regional Water Quality Control Board, the California Department of Fish and Game, and the California Coastal Commission in support of a wetland restoration project in Santa Barbara County, California. The project aimed to restore tidal circulation to two vacant parcels within the Goleta Slough ecosystem that had been hydrologically isolated by construction of manmade berms. Key issues of concern included presence of listed species and adverse temporary impacts that would occur during project implementation.

**Los Angeles Mission College Athletic Fields Project:** Prepared and submitted permit application materials to the U.S. Army Corps of Engineers, the Los Angeles Regional Water Quality Control Board, and the California Department of Fish and Game in support of bank stabilization and storm drain outlets associated with expanding a collegiate athletics complex. Key issues on the project included presence of least Bell's vireo and in-stream sediment management, as well as the nature and extent of mitigation.

**Marine Corps Base Camp Pendleton Infrastructure Improvement Projects:** Was responsible for senior technical review of permit applications and supporting materials submitted to the U.S. Army Corps of Engineers and San Diego Regional Water Quality Control Board for two projects (P-1093 and P-1094) seeking to improve aging electrical, telecommunications, water, wastewater, and natural gas distribution infrastructure within Marine Corps Base Camp Pendleton in San Diego County, California. Key issues on the project included presence of listed species, including spreading navarretia, San Diego button celery, least Bell's vireo, southwestern willow flycatcher, tidewater goby, arroyo toad, California gnatcatcher, yellow-billed cuckoo, and two fairy shrimp taxa.

**Ellwood Pump Station Removal Project:** Prepared and submitted permit applications to the California Department of Fish and Game seeking authorization to remove an abandoned pump station structure from the bank of the Kern River in Kern County, California. Key issues on the project included avoidance of sensitive resources, including riparian vegetation, as well as safety concerns due to the site's location in an active oil field. Because the project was designed to avoid the need for grading and placement of fill material, a letter to the U.S. Army Corps of Engineers was composed, informing the Corps of the project and seeking concurrence with the opinion that Section 404 Permit was not required.

**Other Representative Jurisdictional Delineations**

- Johnson Valley Solar Project: Corps waters and CDFG Streambeds

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- California Valley Solar Ranch Project: Corps waters, Corps wetlands, and CDFG streambeds
- Edwards Air Force Base solar project: CDFG Streambeds
- Gaviota Creek Culvert Replacement: Corps wetlands, coastal wetlands
- Piru Creek Bank Protection: Corps waters, CDFG streambeds
- Castaic Creek in Valencia Commerce Center: CDFG streambeds

### Wetlands Functional Assessment Experience

**Newhall Ranch Resource Management and Development Plan, Santa Clarita Valley, Ca:** Worked with URS staff and representatives from the U.S. Army Corps of Engineers to develop and implement a hybrid functional assessment method suitable for assessing impacts of a comprehensive permitting endeavor along the Santa Clara River, California. The end result was a method based on a combination of three established methods (CRAM, HGM, and SAMP LLFA), which was robust and rigorous enough to meet the Corps' assessment needs yet flexible and qualitative enough to meet the cost and schedule limitations of the proposed project. The hybrid method was utilized to measure existing functional capacity within the project site, and a set of predictive assumptions was established to allow comparison of various post-project scenarios with the existing condition. The method developed by URS was one of the most valuable impact assessment tools used in assessing impacts of the proposed permitting project. To validate the method, Mr. Julian used the method to assess a set of reference-quality sites in the Santa Clara River watershed outside the project area, as well as a number of existing compensatory mitigation sites.

**California High Speed Train, Fresno-Bakersfield Segment:** Assessed the condition of jurisdictional waters, including wetlands, along several alternative high-speed rail alignments between Fresno and Bakersfield in California's Central Valley using the California Rapid Assessment Method (CRAM). The aquatic features assessed included individual vernal pools, vernal pool complexes, and depressional wetlands located on the floor of the Central Valley, as well as riverine wetlands along the Kings River and Poso Creek. A certified CRAM instructor participated in the assessment.

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# Cletis England

*Biologist/Ecologist*

## Overview

Mr. England is an ecologist with experience working with a variety of native habitats along the Central California coast. Cletis' experience ranges from site assessments of industrial and commercial sites to restoring and enhancing native habitats and erosion control projects. He has over ten years of professional experience including botanical surveys and mapping, habitat assessment, habitat restoration design, implementation, and monitoring, wetland determinations, wildlife surveys, construction compliance and monitoring, and GIS mapping. Cletis' project experience has included working with federal, state, and local agencies to find solutions to project constraints that meet the goals of several parties with conflicting interests to facilitate the successful completion of projects. Cletis has developed and instituted monitoring protocols, developed restoration plans, and has monitored multiple development projects.

## Areas of Expertise

- Birds of the Western United States
- Site Assessment and Monitoring of Endangered Birds of California
- Habitat Assessment
- Wildlife Survey
- Botanical Assessment
- Permit Compliance
- Construction Monitoring

## Years of Experience

With URS: 0.75 Years
With Other Firms: 10 Years

## Education

B.S./Ecology and Systematic Ecology/2000/Cal Poly, San Luis Obispo
A.S./Biology/1994/Cuesta Community College

## Registration/Certification

2002/Adult CPR and First Aid/CA
2002/Wilderness First Aid/CA
2002/National Safety Council Defensive Driver Training/CA

## Project-Specific Experience

**Land Rehabilitation Coordinator, Fort Hunter Liggett, CA July 2006 – March 2008**
**Colorado State University, Fort Collins, Colorado**

- Identified, evaluated and coordinated rehabilitation sites and erosion control projects
- Coordinated and oversaw implementation of long term revegetation plans and seasonal crews
- Researched methods to improve efficacy of various restoration projects and resources
- Coordinated with Environmental Division and Range Control Trainers
- Coordinated purchases and outsourcing for materials and subcontractors
- Identified and monitored invasive species treatment areas and appropriate control methods
- Collected and utilized native materials to augment rehabilitation efforts

**Field Biologist/Project Manager Nov. 2004 – June 2006**
**Sierra Delta Corporation**

- Prepared Biological Assessments
- Prepared and coordinated environmental regulatory permits and consultations for projects
- Designed and prepared Habitat Mitigation / Restoration Plans
- Coordinated, managed, and monitored restoration projects
- Coordinated purchases and outsourcing for materials and sub-contractors
- Conducted target surveys for rare and sensitive plants and animals

**Field Biologist March 2003 – Nov. 2004**
**Althouse and Meade, Inc.**

- Prepared Biological Assessments
- Served as environmental monitor for residential and commercial developments
- Conducted State and Federal protocol surveys / Special Status Species habitat assessments
- Developed G.I.S. habitat maps and site plans for environmental planning
- Conducted salmonid habitat assessment and coordinated restoration projects
- Generated preliminary wetland descriptions
- Prepared and tracked CDFG, USACE and RWQCB permits and agency consultations
- Implemented erosion control plans and operated a hydro-seeder

**Fish Habitat Biologist August 2002 – Nov. 2002**
**Hoopa Valley Tribal Fisheries Department**

- Evaluated and monitored Coho salmon and anadromous fish habitat
- Supervised, trained, and evaluated technicians for multiple projects
- Analyzed and interpreted field data and prepared final reports
- Handled and assessed wild and hatchery fish at traps and weirs
- Prepared proposals and grant applications for project funding
- Conducted site reviews and biological monitoring of timber harvest plan areas
- Monitored sediment load and channel morphology to assess habitat changes
- Provided technical support, G.I.S. map generation, and document layout
- Investigated and prioritized stream reaches and uplands for enhancement projects
- Participated in Interdisciplinary Team for E.I.A. of timber management areas

**Fish and Wildlife Scientific Aid May 2000 – July 2002**
**California Department of Fish and Game**

- Trained and supervised aids in project survey protocols for the High Mountain Lakes Project
- Trained seasonal aids in wilderness orienteering and plotting with GPS.
- Coordinated excursions into wilderness areas including equip. and supplies
- Researched and assisted in preparing land management plans for ecological reserves
- Assisted in budgeting expenses and equipment purchases
- Documented aquatic/terrestrial habitat and morphology of lakes and streams
- Tagged and herded fish, planted eggs and hatchery fish, and assisted in electrofishing streams

- Conducted land and vegetation surveys and created G.I.S. layers for habitat management
- Assisted in timberlands resource assessment
- Coordinated and implemented endangered species identification and monitoring
- Procured bids and contracts with private firms for state projects

**Fish and Wildlife Technician April 1998 – Dec. 1999**
**Camp Roberts Hunting and Fishing Program**

- Collected, analyzed, and documented data on wildlife species
- Summarized data and wrote annual reports
- Operated pest removal project and water quality monitoring project
- Surveyed and monitored endangered species by radio telemetry, trapping, spotlighting, and mist netting
- Coordinated with military police and Fish and Game wardens to enforce military regulations and applicable laws, and issued hunting permits

## Other Technical Experience

**California Red-legged Frog**

- Attended N.R.C.S. red-legged frog workshop at Pierdras Blancas Lighthouse, San Simeon, CA instructed by Norman Scott (2003)
- Conducted protocol surveys for red-legged frogs at over 20 sites from Monterey, San Luis Obispo, and Santa Barbara Counties
- Positively identified and observed over 30 adult, over 50 sub-adult red-legged frogs, and over 20 larvae
- Conducted pre-activity surveys and pre-construction training sessions for projects in red-legged frog habitat

**Other Rare and Sensitive Amphibians and Reptiles**

- Supervised and trained 6 Scientific Aides in protocol surveys for Mountian yellow-legged frog and Yosemite toad while working on the High Mountain Lakes Project for the California Department of Fish and Game
- Conducted protocol surveys, identified and observed 9 adult and multiple sub-adult mountain yellow-legged frogs and larvae in the Emigrant Wilderness while working for the California Department of Fish and Game
- Conducted protocol surveys, identified, and observed 3 adult and multiple Yosemite toad larvae
- Identified and observed over 300 foothill yellow-legged frog adults, sub-adults, and larvae while working on the North Coast Watershed Assessment Program for the California Department of Fish and Game
- Identified and observed two adult arboreal salamanders during a Biological Assessment of Santa Margarita Ranch, San Luis Obispo County, California
- Identified and observed over 100 California newts on various Biological Assesments conducted in San Luis Obispo County

- Identified and observed over 100 larvae and 3 adult spadefoot toads by visual observation, and hundreds of adults by acoustic observation during field work and Biological Assessments in San Luis Obispo County
- Identified and observed 3 two-striped racers during field work in Monterey and San Luis Obispo Counties.

**San Joaquin Kit Fox**
- Identified and observed one-collared fox at Camp Roberts National Guard Facility and two foxes encountered during various field surveys and Biological Assessments Experience includes spotlight surveys, burrow evaluations, and radio telemetry (Camp Roberts National Guard Facility, 1997-1999)

**Burrowing Owl**
- Identified and observed over 25 adult owls during baseline surveys for the proposed Palo Prieto Conservation Bank and other field work in San Luis Obispo County

**Other Ornithological and Acoustics**
- Instructed in the identification of birds by acoustics by Dr. Eric Johnson, California Polytechnic Institute, San Luis Obispo, California (1998)
- Conducted over 50 acoustic and visual surveys for migratory nesting birds
- Volunteered for mist-netting and banding for MAPS stations at Chorro Creek, San Luis Obispo County and Oso Flaco Lake, Guadelupe Dunes, Santa Barbara County

**Rare Plants**
**Pismo Clarkia**
- Identified, delineated, and assisted in the planning and protection of one distinct population during the planning phase of a residential development in Arroyo Grande, San Luis Obispo County, California
- Well's Manzanita
- Chorizanthe rectispina
- Brewer's spine flower
- Monardella frutescens

**Coho Salmon and Steelhead**
- Identified, handled, and assessed hundreds of adult, smolt, and fry on the Trinity River Humboldt County while working as a Fisheries Biologist for the Hoopa Valley Indian Tribe
- Identified and observed over 300 juvenile steelhead in San Luis Creek, San Luis Obispo County, California
- Identified and observed 5 adult steelhead in Chorro Creek, San Luis Obispo County while working in coordination with Dave Highland, Native Fish Habitat Biologist with the California Department of Fish and Game

**Other Fisheries**

- Habitat Restoration Projects
- Steelhead
- Coho and Steelhead
- Riparian
- Wetland
- Central Coast Riparian Scrub

## Specialized Training

- OSHA 40-Hour HAZWOPER
  September, 2008
- Smith Systems Driver Training
  August, 2008
- N.R.C.S. Red-legged frog workshop with Norm Scott
  2003
- Loss Prevention System
  August, 2008

## Chronology

04/98-12/99: Camp Roberts Hunting and Fishing Program/Camp Roberts National Guard Facility, CA
05/00-07/02: California Department of Fish and Game/Fresno, CA
08/02-11/02: Hoopa Valley Tribal Fisheries Department/Hoopa, CA
03/03-11/04: Althouse and Meade, Inc./Paso Robles, CA
11/04-06/06: Sierra Delta Corporation/Paso Robles, CA
07/06-03/08: Colorado State University/Fort Collins, Colorado

## Contact Information

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# David A. Kisner

*Project Biologist, Santa Maria Biology Group Leader*

## Overview

Mr. Kisner is a wildlife biologist with extensive experience working with threatened and endangered birds within southern California coastal and riparian areas. David completed his Master's in Ecology through San Diego State University looking at the impact of the non-native Giant Reed (*Arundo donax*) on the riparian bird community. While in San Diego, David worked with the U.S. Geologic Survey for four years conducting presence/absence and nest monitoring surveys for Least Bell's Vireos and Southwestern Willow Flycatchers. David has a broad background in biology and has also worked for Santa Barbara County Planning and Development as a Biologist and Planner. David is currently managing the biology portion of environmental documents associated with power development projects in Southern California and is involved with a large-scale soil remediation and restoration projects.

## Areas of Expertise

- Birds of the Western United States
- Site Assessment and Monitoring of Endangered Birds of California
- Habitat Assessment
- Wildlife Survey
- Botanical Assessment
- Permit Compliance
- Construction Monitoring

## Years of Experience

With URS: 4 Years
With Other Firms: 12 Years

## Education

MS/Ecology/2004/San Diego State University

BA/Biology, Evolution, & Ecology/1994/University of California, Santa Barbara

## Specialized Training

- OSHA 40-Hour HAZWOPER
- OSHA 8-Hour Supervisor HAZWOPER
- Loss Prevention System
- Smith System Driver

## Project Specific Experience

**Project Management**

- Biology Task Lead for Hydrogen Energy California, Kern County – Managed and authored section for environmental document assessing biological impacts associated with 315-acre power plant and associated linears. March 2008 to present.

- Biology Task Lead for General Energy Solar Project, Kern County – Managed and authored section for environmental document assessing biological impacts associated with 280-acre solar power project and associated linears. March 2009 to present.

- Biology Task Lead for Sentinel Energy Project, Riverside County – Managed and co-authored section for environmental document assessing biological impacts associated with 37-acre power plant and associated linears. January 2007 to present.

- Biology Task Lead for San Gabriel Generating Station, San Bernardino County – Managed and co-authored section for environmental document assessing biological impacts associated with 17-acre power plant and associated linears. February 2005 to present.

- Wildlife Task Manager for the Guadalupe Dunes Restoration Project – Organized, coordinated, and oversaw wildlife monitoring and permit compliance of 2,700-acre soil remediation site. Communicated with On-site Environmental Coordinator regarding restoration, monitoring, coordinate operations with wildlife monitors, and reporting of sensitive species found on site. Oversaw monitoring efforts for Western Snowy Plovers, California Red-legged Frogs, small mammal trapping and numerous sensitive species. February 2006 to December 2008.

- Delhi Sands Restoration for SCE – Organized and oversaw restoration of a half-acre site for the endangered Delhi Sands Flower-loving Fly. April 2006 to present.

- Designated Biologist for SCE Mountainview Power Project – Organized and oversaw biological monitoring of 18 mile gas line and power plant construction site. Ensured construction was conducted according to permit conditions and worked with client and regulatory agencies to address biological concerns. April 2004 to April 2006.

- West Figueroa Bird Usage Study for the City of Santa Barbara – Conduct winter, spring, and breeding bird surveys to determine species usage and habitat values prior to proposed creek enhancement and native plant restoration efforts. January 2006 to July 2006.

- Project Manager and Lead Biologist for CalTrans SR 118/23 Widening Project – surveyed 5 miles of riparian habitat for Least Bell's Vireo and Willow Flycatchers. Managed project, contract biologist, and report production. 2004.

**Sensitive Species Survey Experience**

**Least Bell's Vireo (*Vireo bellii pusillus*)**
Over 350 positive contact hours

- Santa Clara and Ventura Rivers, Ventura County - Conducted presence/absence surveys for vireos and mapped territories. 2004 and 2005.
- San Timeteo River, Riverside County – Conducted presence/absence surveys for vireos and mapped territories. 2005.
- San Luis Rey River, San Diego County – Conducted area searches for Least Bell's Vireos. Monitored nest for fledging success, predation, and parasitism by Brown-headed Cowbirds. Banded nestlings with color bands. 2000 to 2003.
- Santa Barbara, Ventura, and Los Angels Counties - Conducted focused surveys for Least Bell's Vireos. 1998 and 1999.

**Southwestern Willow Flycatcher (*Empidonax traillii extimus*)**
Over 175 positive contact hours

- San Timeteo River – Riverside County - Conducted presence/absence surveys for vireos and mapped territories. 2005.
- Camp Pendleton, San Diego County – conducted area censuses for Willow Flycatchers and followed individuals and pairs through the breeding season. 2000 and 2001.
- Santa Barbara, Ventura, and Los Angeles Counties - conducted focused surveys for Willow Flycatchers. 1999.
- Vandenberg Air Force Base, Santa Barbara County – conducted surveys for Willow Flycatchers and monitored nest for success, predation, and parasitism by Brown-headed Cowbirds. 1998.

**Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)**
Over 50 positive contact hours

- Tijuana River Estuary, San Diego – conducted passive surveys in the Tijuana River Valley in conjunction with sound study. 2002.
- Goleta Slough, Santa Barbara – conducted passive surveys in and around Goleta Slough to determine habitat usage. 1998 and 1999.
- Goleta Slough, Santa Barbara – assessed population dynamics and habitat selection of the Belding's Savannah Sparrows. 1993 and 1994.

**Western Snowy Plover (*Charadrius alexandrinus nivosus*)**
Over 130 positive contact hours

- Guadalupe Dunes, San Luis Obispo County – assisted with nest searching and monitoring. July 2006.
- Coal Oil Point, Santa Barbara County –monitored Snowy Plovers, educated the public, and enforced beach use regulations. Recorded human, dogs, and other wildlife's affects on the plovers. November 2005 to February 2006.
- Guadalupe UNOCAL Oil Field Response Monitoring, Santa Barbara and San Luis Obispo Counties – searched for and monitored Snowy Plover nests. 1994 and 1995.
- McGrath Beach Natural Resource Damage Assessment, Ventura County – searched for and monitored Snowy Plover nests. Recorded the number, behavior, and localities of wintering Snowy Plovers. 1994.

**California Least Tern (*Sterna antillarum browni*)**
Over 30 positive contact hours

- Mission Bay Bird Usage Study, San Diego County – passive observation of Least Terns foraging and breeding within the study area. 2000 to 2002.
- McGrath Beach Natural Resource Damage Assessment, Ventura County – searched for and monitored Least Tern nests. Surveyed the beach, river mouth, and coastal dune pond for birds and signs of habitat damage. 1994.

**California Red-Legged Frog (*Rana aurora draytonii*)**
Over 20 positive contact hours

- Guadalupe Restoration Project, San Luis Obispo County – assisted with quarterly eye-shine surveys, egg mass surveys, tadpole sampling, and day-time work zone clearances; adults, yearlings, tadpoles, and egg masses seen. March 2006 to present.
- *Rana* Capture and PIT Tag Training from Dr. Galen Rathbun - training involved approximately 30 minutes of lecture followed by over 3 hours of field work, where participants practiced finding and capturing bullfrogs by hand, taking basic metrics (sex, age-class, total length, weight), toe-clipping, and PIT tagging. October 2006.

**David A. Kisner**

- Ventura River, Ventura County – assisted with USFWS protocol CRLF Surveys along the Ventura River. Captured numerous Bullfrogs located with the main Ventura River channel. 2004.
- Gaviota State Beach, Santa Barbara County – day time habitat assessment; adults and egg mass seen. 2004.

**Desert Tortoise (*Gopherus agassizii*)**
2 positive contact hours

- Johnson Valley Energy Project – Conducted protocol surveys on portions of 8,000-acre project site looking for desert tortoise, sign, tracks, scat, and burrows. Collectively, crew found five individuals; each was passively measured and burrows were assessed.

**General Bird Surveys, Wildlife Surveys, and Habitat Assessment**

- Santa Barbara Airport Bird Usage Studies – Conducted regimented observations of bird usage of control and experimental tidal basins to determine potential strike hazards, assessed breeding bird habitat and directed vegetation removal to minimize nesting within certain areas, located and monitored nests within study areas in order to ensure there were no "take" under the Migratory Bird Treaty Act, and conducted Belding's Savannah Sparrow and general bird observations in and around construction to ensure there were no impacts. 2004 to present.

- Lake Casitas Waterfowl and Bird Usage Study – conducted year round surveys of Lake Casitas for ducks, grebes, and other "aquatic" bird species. Surveys required determining the number, species, and location of all individuals. Fall 2004 to Winter 2005.

- Oxnard Plain Groundwater Recharge Project EIS/EIR – conducted surveys for Least Bell's Vireo and general wildlife within the project site. Compiled historic data, recent survey results, and third party observations and assessed potential impacts to the biologic resources by proposed project activities. Made suggestions for avoidance and mitigation measure to negate and/or minimize impacts. 2005.

- National Forest Avian Point Count Assessment, Santa Barbara, Ventura, Los Angeles, and San Diego Counties – conducted point counts within four Southern California National Forests; coordinated field crew and access logistics. 2003.

- Camp Pendleton MAPS sites, San Diego County – captured, measured, and banded riparian birds to determine productivity and survivorship. Supervised field crew in 2003. 2000 to 2003.

- Point Loma Breeding Bird Assessment, San Diego County – conducted point counts to determine habitat usage and breeding bird composition. 2000 to 2003.

## David A. Kisner

- Upper Tijuana Estuary Bird Usage Study, San Diego County – conducted seasonal surveys of U.S. Navy lands within the Tijuana River Valley to determine species composition and abundance. 2002.

- Mission Bay Bird Usage Study, San Diego County – conducted monthly surveys of the basins and wetlands to determine bird species composition and abundance. 2000 to 2002.

- Santa Barbara Municipal Airport Wetland Mitigation Feasibility Study, Santa Barbara – conducted surveys of bird usage of wetland basins within Goleta Slough to predict possible outcome of restoration efforts on bird-plane interactions. 1998 to 1999.

- Summerland Greenwell Park, Santa Barbara County – developed restoration plan using native plants to restore and enhance riparian and coastal scrub communities for new wildlife preserve. 1998.

- Golden Gate National Recreation Area Brown-headed Cowbird Census, Marin County –censused 5 locations using point count survey method for birds and searched riparian areas for nests. Monitored nests for parasitism (by Brown-head Cowbirds), predation, and fledging success. Trained volunteers in nest search methodology and directed their search efforts, and resolved logistical problems. 1996.

- San Miguel Island Small Mammal Trapping – used Sherman traps to capture deer mice. Mice were tagged, blood was drawn for Haunta virus testing, and morphometric data was collected before releasing the mice were released.

**<u>Botanical Experience</u>**
**Field Experience:**

- Johnson Valley Energy Project – conducted botanical surveys on portions of 8,000-acre project site looking for rare and sensitive plant species.

- Guadalupe Restoration Project – conduct active and passive restoration assessments and assist with population censuses for State Threatened surf thistle and beach spectaclepod, and Federally Endangered and State Threatened La Graciosa thistle. Oversee construction activity to ensure minimization of impact and avoidance of sensitive species. February 2006 to present.

- Santa Clara River Habitat Mapping - conducted several rapid assessments and mapped vegetation according to the Sawyer and Keeler-Wolf classification method along the Santa Clara River from the esturary to Newhall Ranch, including the Piru Creek tributary in Fall 2005.

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David A. Kisner

- Mountainview Power Project – Conducted regular surveys within and near work zones to ensure no sensitive plants were present. Restored project area after disturbance; collected quantitative data on restoration success. April 2004 to April 2006.

- Santa Barbara Airport / Goleta Slough quantitative restoration monitoring –Assisted with quantitative data collection on restoration transects through out the salt marsh and transition habitats. Spring 2004 and 2005.

- L.A. Metropolitan Water District HCP site assessment. March 2004 and 2005. Surveyed large parcels within the northern Mojave Desert for rare and sensitive plant species.

- USGS – 2000 to 2004 – conducted habitat/vegetation assessments of sensitive species breeding areas/territory. Conducted "stacked cube" qualitative vegetation assessment of restoration site.

- Santa Barbara County Planning and Development – Conducted baseline surveys of proposed project sites to determine habitat function and value. November 1996 to August 1999.

- Northeastern Washington Timber Management Project – Conducted line transects through pine woodlands and mountain riparian zones in conjunction to avian survey routes. 1995.

**Course Work:**

- CNPS Vegetation Mapping and Classification Workshop, August 2005. Participated in the rapid habitat assessments and mapped vegetation according to the Sawyer and Keeler-Wolf classification method.

- Flora of California - UC Santa Barbara, 1993 Quarter long course with laboratory and field trips covering the plant families of California taught by Dr. Bob Haller. Focus of course involved keying plants to species using A Flora of California by Philip Munz (1974).

- Flora of California - Santa Barbara City College, 1998. Quarter long course with laboratory covering the plant families of California taught by Mr. Al Flinck. Focus of course was to key plants to species using The Jepson Manual, Higher Plants of California (1993).

**Environmental Permitting and Regulations**

- Contract Biologist/Planner, Santa Barbara County Planning and Development – processed development projects in Santa Barbara County under applicable local, state, and federal environmental and planning regulations and laws. Assessed impacts to Biologic Resources and reviewed environmental documents. March 1998 to August 1999.

**David A. Kisner**

- Permit Compliance, Santa Barbara County Planning and Development – ensured compliance with Conditions of Approval connected to discretionary projects. Assessed success of mitigation measures, environmental protection plans, and restoration efforts. Responded to public inquiries, complaints, and concerns. August 1997 to January 1998.

- Biologist/Planner, Santa Barbara County Planning and Development – processed development projects in Santa Barbara County under applicable local, state, and federal environmental and planning regulations and laws. Assessed impacts to Biologic Resources and reviewed environmental documents. November 1996 to August 1997.

## Specialized Training

- OSHA 40-Hour HAZWOPER
  December 2004
  HAZWOPER annual refresher
  February 2008
- OSHA 8-Hour Supervisor HAZWOPER Training
  April 2005
- Shell "Yellowbook" Safety Training
  August 2008
- Smith Systems Driver Training
  September, 2006
- *Rana* Capture and PIT Tag Training with Dr. Rathbun
  October 2006
- Loss Prevention System
  March 2006
- Red Cross First Aide, CPR, & AED
  July 2006
- CNPS Vegetation Mapping and Classification Workshop
  August 2005

## Contact Information

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# A. Gilda Barboza

*Biologist*

## Overview

Ms. Barboza has over six years of experience working in the environmental field on restoration, construction, and transportation projects. She has experience conducting Section 7 Consultation under the Federal Endangered Species Act (ESA), conducting biological studies and surveys for wildlife and plant species in California, preparing CEQA/NEPA compliance documents (BA, NLAA, ITP, EIR/EIS, agency permit applications, etc.), and attaining regulatory agency permits. Responsibilities include field surveys, data entry and statistical analysis, report and document preparation, agency permit applications, scientific writing, biological monitoring for construction projects, identification and quantification of vegetation communities, and extensive field surveys including rare and endangered plant and wildlife species (oak woodland, chaparral, desert scrub, salt marsh, seasonal wetlands, vernal pools, annual grasslands and alkali flats).

## Areas of Expertise

ESA Section 7 Consultation
Environmental Regulations
Regulatory Permitting
Plant, Wildlife, and Habitat Assessment
Wetland Delineations and Restoration
Biological Monitoring
Special Status Species Surveys

## Years of Experience

With URS: 4 Years
With Other Firms: 3 Years

## Education

BA/Geography and Environmental Studies/2004/University of California, Los Angeles
BA/International Development Studies/2004/University of California, Los Angeles
Minor/Latin American Studies/2004/University of California, Los Angeles

## Permits/Training

Scientific Collecting Permit/# SC-10480/CDFG
Plant Voucher Collecting Permit/#2081 (a)-08-06-V/CDFC
Port of Oakland All Areas and Escort Access Badge
HAZWOPER/40 Hour + Refreshers/Cal OSHA
CPR/First Aid
Wilderness First Aid

## Project Specific Experience

**Biologist, Oakland Airport Runway Safety Area Improvements, Oakland, CA, Port of Oakland, 2010 – Present:** Conducted habitat assessment surveys and vegetation mapping. Searched for mitigation options for wetlands and species habitat. Prepared Biological Assessmet (BA) and biological sections of the Environmental Assessment (EA).

**Biologist, Town of Hillsborough Fire Hazard Mitigation and Fuel Reduction Program, Hillsborough, CA, FEMA- PDMC, 2009 – Present:** Conducted rare plant surveys and habitat assessment in the open spaces of the Town of Hillsborough, in San Mateo County, CA. Served as primary author of the biological assessment for formal consultation with the USFWS. Consultation was completed for the following species: California red-legged frog (*Rana draytonii*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), bay checkerspot butterfly (*Euphydryas editha bayensis*), Mission blue butterfly (*Icaricia icarioides missionensis*), and five federally listed and serpentine endemic plants.

**Biologist, West Fork Embankment Repairs, Calpella, CA, Calpella County Water District and FEMA, 2009:** Conducted habitat assessments and prepared the biological assessment for formal consultation with the NMFS on a project located on the west fork of the Russian River, in Calpella, Mendocino County, CA. Consultation was completed for the following anadromous fish species: Central California Coast coho salmon (*Oncorhynchus kisutch*), Central California Coast steelhead (*Oncorhynchus mykiss*), and California Coastal Chinook salmon (*Oncorhynchus tshawytscha*).

**Biologist, Section 7 ESA Consultations on Multiple Projects, Multiple Counties, CA, Federal Emergency Management Agency (FEMA), 2002 – Present, $15M:** Prepared Biological Assessments (BA) on endangered species for projects funded by various FEMA programs, including the Public Assistance (PA) Program, Pre-disaster Mitigation (PDM), and Hazard Mitigation Grant Program (HMGP) during presidentially declared disasters in California. The disasters include DR-1628, 1646, and 1585. She has consulted formally and informally with the USFWS and NMFS under Section 7 of the Federal ESA. Projects vary from flood control, vegetation management, fire prevention, highway improvement, and repairs to pre-disaster conditions. Responsible for conducting environmental site assessments, including characterization of habitat at project sites to determine suitability for federally listed species and preparing impact analysis and conducting biological assessments and surveys.

**Biologist, Power Project, Hydrogen Energy California (HECA), Buttonwillow, CA, 2010:** Field biologist conducting protocol level surveys for blunt-nosed leopard lizard (*Gambelia sila*) along sections of a proposed pipeline and hydrogen-powered electricity generating facility for the Kern County area, CA. It plans to use petroleum coke that is a by-product of oil refining, (or blends of petroleum coke with coal, as needed) as feedstock to create hydrogen that will be used for power generation.

**Biologist, Burrowing Owl Surveys at the Oakland International Airport, Oakland, CA, Port of Oakland, 2010 – 2011, $75K:** Conducted routine burrowing owl surveys in the North Field during the breeding and non-breeding season. Addressed client environmental questions, as needed. Had authorization and clearance for full access badge to conduct field surveys at the airport's North Field.

**Biologist, Uvas Creek Bridge Replacement Project, Gilroy, CA, Caltrans, 2008 – 2009:** Conducted San Francisco Dusky-footed woodrat *(Neotoma fuscipes annectens)* field surveys and trapping and relocation efforts. Surveys included mapping of active nests, dismantling nests, and trapping woodrats at the site over a two week period.

**Biologist, Alamo Creek Detention Basin Project/FEMA Federal Disaster Assistance for the Northern California 2005/2006 Winter Floods, Vacaville, Solano County, CA, Federal Emergency Management Agency (FEMA), 2008, $700K:** Biological field studies were needed for a 77-acre detention basin project proposed to be built north of Alamo Creek near Vacaville, CA, to reduce the potential for flooding in Vacaville during severe storm events. The project required protocol-level surveys for the California red-legged frog (R*ana draytonii*), the valley elderberry longhorn beetle, and rare-plant surveys. Participated in biological assessment for the city of Vacaville. Conducted both day and night amphibian surveys with specific emphasis on California red-legged frog (R*ana draytonii*). Surveyed streams for amphibian presence indicated by egg masses, tadpoles, and adult specimens.

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# Jamie Deutsch

*Biologist*

## Overview

Mr. Deutsch has been involved with habitat restoration and construction projects in an array of environments all over the southern California. He is experienced in the identification of native and non-native plant species as well as local wildlife. This includes locally sensitive or listed species such as the Western Snowy Plover and the Nipomo Dune Lupine. Mr. Deutsch also has an extensive background in GPS navigation and GIS mapping.

## Areas of Expertise

-Natural Resource Management
-Ecosystem Management
-Habitat Restoration
-Permitting and Environmental Analysis
-Permit Compliance
-Sustainable Forest Management
-Environmental Impact Analysis & Management
-Watershed Management and Restoration
-Forest Health
-Measurements/Sampling: Forest/Environments
-GPS & GIS Mapping
-Dendrology
-Forest Surveying
-Fire Ecology

## Years of Experience

With URS: >1 Year
With Other Firms: 3 Years

## Education

BS/Forestry and Natural Resources Management (Ecosystem Management), California Polytechnic State University, San Luis Obispo

## Registration/Certification

OSHA 40-Hour Hazwoper Trained
CPR/First Aid Certified, 2010
NSC Defensive Driving Course
PADI Rescue Diver
Smith Driver Training

## Project Specific Experience

### Project Management

Lompoc, CA-

- **Assistant Project Manager**-Served as assistant project manager for Allan Hancock College Public Safety Training Facility and associated permit compliance. Conducted surveys for rare plants and general wildlife. Served as onsite lead biologist and corresponded with sub-contractors, AHC personnel, and construction manager on construction based CEQA compliance.

### Construction Monitoring

Salton Sea, CA-

- Conducted sensitive species surveying and monitoring during the installation of a drill and excavation of gold and rock at a quarry east of the Salton Sea. Sensitive species located included nesting loggerhead shrikes which needed to be flagged off and restricted.

Desert Hot Springs, CA-

- Conducted pre-construction plant and wildlife surveys, wildlife monitoring during construction, and the relocation of several species of small mammals and reptiles prior to and during construction. Performed 15 nights of small mammal trapping to remove mammals from laydown area before clearing began. Each species was identified and logged prior to relocation.

Lancaster, CA-

- Conducted pre-construction wildlife surveys and wildlife monitoring and relocation during construction activities.

Lompoc, CA-

- Conducted pre-construction plant and wildlife surveys, wildlife monitoring during construction, relocated several species of small mammals and reptiles prior to and during construction

### Vegetative Survey Experience

Desert Hot Springs, CA

- Conducted floristic surveys of the CPV Sentinel project site, laydown area, and associated linears for rare plants including the listed Coachella Valley and triple-ribbed milk-vetch. Surveys were conducted to comply with CDFG and USFWS protocols.

Bakersfield, CA

- Conducted floristic surveys of the HECA project area and associated linears for rare plants and wetland indicator species. Surveys were conducted to comply with CDFG and USFWS protocols.

Nipomo/Guadalupe Dunes, CA

- Conducted vegetation sampling in dune scrub habitats. Rare plant surveys were performed throughout dune environment for endangered Nipomo Dune Lupine. Once located, the site was marked, flagged, and GPS'd for population monitoring and mapping purposes.

URS

# Jan Novak, P.W.S.

*Senior Wetland Scientist*

## Areas of Expertise

Jurisdictional Delineations
Environmental Impact Assessment
Permitting and Regulatory Compliance
Species and Plant Surveys
Soil Analysis

## Years of Experience

With URS: 5 Years
With Other Firms: 5 Years

## Education

BS/Soil Science/2000/California Polytechnic State University, San Luis Obispo, CA

## Registration/Certification

Professional Wetland Scientist/ 2010/#2022/Society of Wetland Scientists Certification Program, Inc.

CDFG Scientific Collecting Permit/Animals SC-0010473

CDFG Scientific Collecting Permit/ State-Listed Plants # 2081(a)-08-08-V

URS Project Management Certification, 2009

2006/OSHA 40-Hour HAZWOPER

## Overview

Mr. Novak is a Professional Wetland Scientist (PWS) with ten years of experience in performing wetland delineations that have been approved by the U.S. Army Corps of Engineers and the California Coastal Commission. He has also contributed to or prepared environmental documents under CEQA, NEPA, regulatory permitting applications (U.S. Army Corps of Engineers, multiple Regional Water Quality Control Boards, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service), and peer review. Additional skills include mitigation and monitoring plans, special status species surveys, rare plant surveys, and construction monitoring.

## Project Specific Experience

### Wetland Scientist

**Soil Scientist, Adak Former Naval Complex Biological and Cultural Resource Surveys, Adak, AK, U.S. Navy, 2011, $743K DO**: Soil scientist for 600-acre wetland delineation. The project involves the ongoing removal of munitions and explosives of concern at Operable Unit (OU) B 2 at the former Adak Naval Complex. These studies were conducted to meet the substantial permit requirements under CERCLA (Comprehensive Environmental Response, Compensation and Liability Act of 1980). Field work focused on wetland delineations of areas with organic and volcanic soil. Pre-survey information included researching volcanic soils, contacting USACE and NRCS Alaska staff.

**Wetland Task Order Manager/Technical Assistant, Bakersfield to Palmdale High-Speed Train Project, California High-Speed Rail Authority and Federal Railroad Administration, 2010 – Present, $7M:** Coordinated with USACE on delineation methodologies for difficult areas. Oversaw the first half of a delineation with a twelve-person team for the Bakersfield to Palmdale section of the High Speed Train Project. Nearly 100 miles of land was observed, recorded, and mapped using a variety of delineation techniques. Assisting with post-field data preparation and offering technical guidance.

**Wetland Task Order Manager, Golden Gate National Recreation Area (GGNRA), San Francisco Presidio, CA, Golden Gate National Parks Conservancy (GGNPC), 2011, $5K:** Performed delineation of potential wetland area and assisted on completion of technical document. Delivered technical wetland memo to client, meeting their strict deadline and budget requirements.

**Wetland Delineation Manager, High Speed Train Environmental Services, Fresno to Bakersfield, CA, California High Speed Train Authority, 2009 – Present, $7M:** Oversaw sixteen-person team for delineation of Fresno to Bakersfield section. Over 100 miles of land was observed, recorded, and mapped in accordance with the 2008 Ordinary High Water Mark Delineation and the 2008 Arid West Delineation manuals. Managed and submitted preliminary jurisdictional determination report to USACE, as well as wetland components to another technical document and the EIR/EIS.

**Internal Technical Review – Wetland Delineation, GE Tehachapi Photovoltaic Solar Project Conditional Use Permit Application, Tehachapi, CA, GE Energy, 2010, $395K:** Performed the Internal Technical Review for a jurisdictional determination of federal or state wetlands and/or waters. The determination was prepared to satisfy conditions/mitigation measures of a Conditional Use Permit and CEQA Mitigated Negative Declaration for construction and operation of a 330-acre, 30 to 40 megawatt solar energy project located in Kern County, California.

**Senior Wetland Scientist/Task Order Manager, Olancha/Cartago 4-Lane Project, Wetland Delineation, Inyo County, CA, Caltrans, 2009, $80K:** Oversaw the jurisdictional delineation for wetlands and waters of the United States at the 994-acre Olancha/Cartago 4-Lane Project. Work included site research and preparation, two weeks of staffing and leading the field delineation (utilizing the 2008 Ordinary High Water Mark Delineation and the 2008 Arid West Delineation Manuals), conducting health and safety meetings, coordinating with and ensuring delivery of the delineation report to the U.S. Army Corps of Engineers. A total of 30.22 acres of Waters of the U.S (WUS) were delineated during the survey.

**Senior Soil Scientist, SunGen Solar Project, McKittrick, CA, Complete Energy Holding, LLC's (CEH), 2009, $25K:** Oversaw and led delineation for waters of the U.S. and Waters of the State (WS) in the project area. Responsible for the submittal of a preliminary Jurisdictional Determination to client for submittal to USACE, CDFG and Central Valley RWQCB.

**Senior Wetland Scientist/Task Order Manager, Los Vaqueros Ranch Mitigation Property, Monterey County, CA, Chevron Pipe Line Company, 2007 – 2008, $350K:** Oversaw the jurisdictional delineation for waters of the United States, and Waters of the State, at the 2,167-acre Los Vaqueros Ranch mitigation property. Work included a site reconnaissance, site research and preparation, three weeks of staffing and leading the field delineation, conducting health and safety meetings, coordinating with and ensuring delivery of the delineation report to the U.S. Army Corps of Engineers.

**Senior Soil Scientist, Chart House Mitigation Area Wetland Analysis, Half Moon Bay, CA, Caltrans, 2008 – Present, $600K (Overall Project), $20K (Delineation):** Delineated mitigation areas to verify if they meet the criteria for U.S. Army Corps of Engineers (USACE) and the California Coastal Commission (CCC) wetlands in 2008, 2010, and 2011. . Emphasis was placed on soils analysis as a key issue in explaining the poor response of mitigation plantings. Delivered status memos to client in 2008 and 2010, and currently preparing the 2011 final memo for delivery to the agencies.

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## Jan Novak, P.W.S.

**Soil Scientist, Crescent City Airport Terminal Replacement Project, Crescent City, CA, Del Norte County, 2007, $500K:** Reviewed previous delineation of the 25 acre site, including herbaceous and forested environments. Delineation included analysis of forested soils to categorize them as histic/organic or mineral. Prepared both delineations for submittal to the USACE and CCC. Delineation verified by the USACE and CCC.

**Senior Soil Scientist, Crescent City Runway Safety Analysis, Crescent City, CA, Del Norte County, 2007, $350K:** Reviewed previous delineation of 111 acre site. Delineated the study area, consisting of herbaceous and lacustrine environments. Reviewed both delineations for submittal to the U.S. Army Corps of Engineers and the California Coastal Commission.

**Soil Scientist, Merced Dominion Annexation, Merced, CA, County of Merced/Robert Rucker, 2006, $76K:** Delineated wetlands and waters of the United States on 280 acres of complex habitat. Used multiple GPS devices for precise measurements. Wrote jurisdictional delineation report. Client coordination.

**Soil Scientist, Balloon Property, Eureka, Humboldt County, CA, U.S. Army Corps of Engineers and the California Coastal Commission, 2005 – 2006, $200K:** Participated in a group delineation of a 50-acre property. Prepared separate jurisdictional delineation reports for the U.S. Army Corps of Engineers and the California Coastal Commission.

**Soil Scientist, Sonoma 3, Sonoma County, CA, Federated Indians of Graton Rancheria, 2004 – 2005, $400K:** Individually delineated the initial 2,000 acre site in Sonoma County, followed by the 400 acre site in Rohnert Park. Wrote the jurisdictional delineation, which was verified by the U.S. Army Corps of Engineers.

**Soil Scientist, Bethel Island, Contra Costa County, CA, Claremont Homes, Inc., 2004 – 2006, $200K:** Individually delineated 400 acres of complex delta histic (muck) soils. Soils analysis of histic soils. Performed two seasons of extensive hydrology testing to determine wet season water table. Wrote jurisdictional delineation.

**Wetland Task Manager, SunGen Solar Project, McKittrick, CA, Complete Energy Holding, LLC's (CEH), 2011, $25K:** Managing delineation for waters of the U.S. (WUS) and Waters of the State (WS) in the project area for a proposed 120 MW solar PV farm. The presence/absence survey will be submitted to USACE, CDFG and the Central Valley RWQCB. Tasks include project management and correction of the document.

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# Jane Donaldson

*Staff Biologist*

## Overview

Mrs. Donaldson is a field biologist with over 15 years of professional experience working within a variety of native habitats within California. Her field work has included conducting wildlife surveys, overseeing construction compliance, and compliance monitoring for a large remediation project. She has conducted surveys for California red-legged frogs, California tiger salamander, San Joaquin kit fox, western snowy plover, burrowing owl, coast horned lizards, silvery legless lizards, two-striped garter snakes, and point-count bird surveys. Her habitat restoration and sensitive plant conservation efforts include general habitat surveys and coastal dune wetlands restoration using genetically local native plant species.

### Areas of Expertise

Monitoring Threatened and Endangered Birds, Mammals and Amphibians of California
Wildlife Surveys
Vegetation Surveys
Habitat Restoration

### Years of Experience

With URS: 4 Years
With Other Firms: 11 Years

### Education

BS/ Biological Sciences/1993/ California Polytechnic State University, San Luis Obispo

### Registration/Certification

OSHA 40-Hour HAZWOPER Trained, OSHA Refresher July 2009
CPR/First Aid Certified, 2009
Smith Systems Driver Training, June 2009
Loss Prevention System, March 2006, refresher July 2010
Behavior Based Safety, 2006, with annual refreshers

### Scientific Collection Permit

Scientific Collecting Permit #SC2981

## Wildlife Surveys and Monitoring

**California Red-Legged Frog (*Rana aurora draytonii*)**

Over nine years experience of surveying and handling California red-legged frogs (CRLF) in diverse habitats. Have observed and participated in surveys for CRLF presence during all life stages, i.e. eyeshine surveys, dip netting and minnow trapping. Survey work includes the following:

**Guadalupe Restoration Project, Guadalupe, CA (June 2000 – April 2010):** Authorized by USFWS, under project specific Biological Opinion, to survey for, handle, capture, and relocate CRLF. Conducted quarterly census counts, pre-construction surveys, minnow trap and dip net surveys for tadpoles, observation of all life phases of species, and relocation from work areas. Assisted in the development of monitoring measures for large scale excavation activities in proximity to known CRLF habitat.

**San Joaquin Kit Fox (*Vulpes macrotis mutica*)**

**San Ardo Oil Field, San Ardo, CA:** Conducted pre-disturbance surveys for presence of kit fox. Utilized motion cameras and track stations to determine presence/absence of kit fox under buildings slated for demolition.

**Camp Roberts Army National Guard, Paso Robles, CA**: Surveyed for San Joaquin kit fox using USFWS protocol for spotlighting under the supervision of Dr. Michael Hanson, Director of Cal Poly Endangered Species Program. Located and monitored kit fox dens. Set up track stations, and assisted in live-trapping and radio-collaring activities.

**Desert Tortoise (*Gopherus agassizii*)**

**Calico Solar Project, Barstow, CA:** Conducted desert tortoise surveys for Calico Solar Project at a proposed relocation site near Newberry Springs, CA.

**Silvery-legless lizard (*Anniella pulchra pulchra*)**

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**Guadalupe Restoration Project, Guadalupe, CA:** Construction monitoring and relocation of individuals. Over 75 hours of positive contact.

**Spade-foot toad (*Spea hammondii*)**
**Guadalupe Restoration Project, Guadalupe, CA:** Construction monitoring, eyehsine surveys and relocation efforts at Guadalupe Restoration Site, Guadalupe, CA. 10 hours of positive contact.

**Blunt-nosed leopard lizard (*Gamelia sila*)**
**California Valley (Carrizo Plains), CA:** Surveyed for blunt-nosed leopard lizards using the CA Department of Fish and Game Protocol. Identified blunt-nosed leopard lizards at a reference site. Two hours of positive contact.

**Flat-tailed horned lizard (*Phrynosoma mcallii*)**
**El Centro, CA:** Performed flat-tailed horned lizard surveys using tracking techniques in conjunction with California Dept. of Fish and Game and Bureau of Land Management. Three hours of positive contact.

**California Tiger Salamander (*Ambystoma californiense*)**
Conducted larval dip-net surveys with Tom Olson 27 May 2010 at Escolle Lease.

**Coast horned lizard (*Phrynosoma coronatum*)**
**Guadalupe Restoration Project, Guadalupe, CA:** Construction monitoring, general wildlife surveys and relocation efforts. Over 60 hours of positive contact.

**Bird Surveys**
**Camp Roberts and Camp San Luis Obispo, CA:** Conducted comprehensive bird surveys each spring from 1995 - 2000 on established plots using line transect method for the U.S. Army's Land Condition Trend Analysis program.

## Botanical Experience

**Guadalupe Restoration Project, Guadalupe, CA (June 2000 – April 2010):** Was cross-trained and approved to monitor sensitive and endangered plant species including La Graciosa thistle, surf thistle, and beach spectacle pod during remediation and construction activities. Assisted in the vegetation restoration and monitoring of wetland habitats. Assisted with annual sensitive plant species census.

**Camp Roberts Army National Guard, Paso Robles, CA (Mar 1995 – June 2000)**: Conducted chaparral/coastal scrub, grassland, oak woodland and riparian vegetation surveys using point transects and belts.

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# Johanna Kisner

*Senior Biologist*

## Areas of Expertise

- Habitat Restoration Project Management-Planning, Implementation, and Monitoring (creeks, wetlands, bioswales, vernal pools, grasslands, riparian, coastal sage scrub, coastal dune scrub, chaparral, and oak woodland)
- Vegetation/Rare Plant surveys
- USFWS 10(a)(1)(A) recovery permit #TE-204436-0 for tidewater goby and California red-legged frog
- Survey Experience for Special-Status Species Including: steelhead trout, California tiger salamander, Coast horned lizard, desert tortoise, least Bell's vireo, white-tailed kite, Western snowy plover, burrowing owl, golden eagle, blunt-nosed leopard lizard and Stephen's kangaroo rat
- Small mammal trapping
- Bird and General Wildlife Surveys
- CEQA/NEPA Biological Assessments
- Stream monitoring
- Wetland Delineation
- Construction Compliance and Monitoring
- GPS and GIS mapping

## Years of Experience

With URS: 6 Years
With Other Firms: 5 Years

## Education

MS/Environmental Science and Management/2001/University of California, Santa Barbara

BS/Environmental Studies/1999/ University of California, Santa Barbara

## Overview

Ms. Kisner's combined education and professional background provide a wide range of experience in ecology, biological resource assessment, and habitat restoration. She has eleven years of professional experience including botanical surveys and mapping, habitat assessment, habitat restoration design, implementation, and monitoring, wetland delineation, wildlife surveys (particularly birds, and holds a U.S. Fish and Wildlife Service (USFWS) recovery permit (TE204436-0) for tidewater gobies and California red-legged frogs), construction compliance and monitoring, and GIS mapping. Ms. Kisner has been the project manager for several multi-million dollar habitat restoration projects in Santa Barbara and Ventura Counties. She has managed and coordinated complex biological resource sections for several CEQA/NEPA documents in southern and central California. She has assisted clients with obtaining and complying with regulatory permits for agencies such as USFWS, California Department of Fish and Game, California Coastal Commission, Army Corp of Engineers, and Regional Water Quality Control Board.

## Project Specific Experience

**Project Management Experience**

Project manager for several habitat restoration projects including Arroyo Burro Estuary Restoration, Santa Barbara Airport (SBA) Safety Grading Mitigation Restoration Monitoring, SBA Airfield Safety Projects Creek Relocation, SBA Tidal Basin Experiment, SBA Area I Restoration, SBA Wetland Restoration Monitoring, Calleguas Creek Restoration, Bohnett Park Creek Restoration Monitoring, Lake Casitas Wetland and Grassland Restoration, and Ellwood Mesa Native Grassland Restoration. She also manages several biology related projects such as SB Flood Control District and Public Works Department Tidewater Goby Surveys, SBA Airfield Safety Projects Pre-Construction Environmental Compliance and SBA wetland delineation projects.

**CEQA/NEPA Biological Assessments/Reports**

- Application for Certification (AFC) Projects: Biology Task Leader for Bullard Energy Center, Panoche Energy Center, and Anaheim Municipal Power Station
- Natural Environmental Study- Biology Task Leader for Laetitia Winery and City of Goleta Ekwill-Fowler
- 

**Habitat Restoration Experience**

- In addition to managing several restoration projects, Ms. Kisner has been involved in the design and implementation of the Casmalia B Drainage Wetlands Project (mitigation for CRLF and CTS), design for Cabrillo Bridge Restoration Project and Western Goleta Slough

Wetland Enhancement Project, and monitoring and implementation of several restoration projects in Santa Barbara and Ventura counties, such as Guadalupe Restoration Project (coastal dunes), several Santa Barbara Airport projects including Firestone Drainage, Las Vegas Creek, Tecolotito Creek Relocation and Berm Restoration, Area I wetland mitigation, Tidal Restoration Experiment, Verhelle Bridge (riparian), Airfield Storm Drains (slough), Turnpike Bioswale, Rhoads Bioswale, Lake Casitas (oak, wetland, grassland, and sage scrub), and Foster Park (riparian).

- Restoration Coordinator, University of California. Responsible for creating native grassland, vernal marsh, and vernal pool habitat related to environmental mitigation. Supervised the initial grading of the landscape for proper topography. Duties included collecting native seed, planting native species, and removing exotic species. Conducting various flora, fauna, and environmental monitoring for performance criteria. Developing research projects related to vernal pool habitat restoration.

**Botanical Experience**

Botanical experience includes work in Santa Barbara, Ventura, and San Luis Obispo Counties, Berkeley, Mojave Desert, and Southern California.

- Prepared several vegetation maps for projects such as Santa Clara River Vegetation Mapping, Lake Casitas Recreation Area RMP, Lake Cachuma RMP, Santa Barbara Fire Management EIR, Meiners Oaks Trunk Sewer Relocation, Goleta Slough Fish and Game Properties, Mountain View Power Project, Gaviota Creek, Foster Park (Ventura River), Piru Creek, and Lauro Reservoir.

- Conducted point-intercept and quadrat vegetation transect monitoring for several projects such as Lake Perris Recreation Area Grassland Experiment, UCSB Restoration Projects, Santa Barbara Airport Safety Area Grading Project and Wetland Restoration Monitoring Projects, Ellwood Grassland Restoration, and Guadalupe Restoration Project.

- Performed rare plant surveys for projects in Santa Barbara County including Santa Maria Pacific's Careaga oilfield, Lauro Reservoir EA, Lake Cachuma RMP, Lake Casitas RMP, and Guadalupe Restoration Project, San Bernardino County including a Solar Energy Project in Johnson Valley, MWD Colorado Aqueduct HCP (Mojave Desert), and Mountain View Power Project, Monterey County for the Los Vaqueros Ranch Mitigation Site, and Kern County McKittrick Oilfields.

**Wetland Delineations and Functional Assessments**

- Performed wetland delineations for Newhall Ranch, Santa Barbara Airport, Santa Barbara Ranch Project, Gaviota Bridge Project and Goleta Old Town Improvement Project.

# Jolie Henricks

*Wildlife Biologist and Assistant GIS Specialist*

## Areas of Expertise

Wildlife Biology – Amphibians, Birds (Songbirds and Raptors), Mammals (including bats), Reptiles
Biological Monitoring
GIS Analysis
Cartography

## Years of Experience

With URS: 6 Years
With Other Firms: 2 Years

## Education

BS/Wildlife & Fisheries Biology/1995/University of California, Davis

## Overview

Ms. Henricks has extensive field experience in numerous areas such as construction monitoring in sensitive landscapes, biological monitoring for birds, amphibians and mammals, and general wildlife identification as well as vegetation mapping,, tidal and storm water sampling, bird and bat banding, and fire fuels monitoring. She also has experience handling such wildlife as birds, including raptors, bats, reptiles and mammals, in both captive and wild environments. An avid birder who has also taught birding classes, her wildlife experience also includes field surveys for nesting birds, including both migratory songbirds and raptors. She also has diverse professional experience with a variety of environmental and geotechnical mapping programs such as ArcGIS and ArcView as well as cartographic design and production.

## Project Specific Experience

**Biologist, Devil's Slide Tunnel Project, Half Moon Bay, CA, Caltrans, 2011, $600K:** Conducted site-assessment for installation of water pipeline in conjunction with initial project that was currently under construction. Area surveyed was known habitat as well as critical habitat of California red-legged frog. Walked project area and documented conditions of sites surveyed. Created report on site status as well as conducted GIS analysis for impacts. Prepared report for CDFG.

**Biologist, Tesla Portal, San Joaquin County, CA, San Francisco Public Utilities Commission (SFPUC), 2009, $50K:** Conducted protocol-level surveys for burrowing owl and nesting birds at planned development site. Prepared reports for client regarding sightings and nesting locations. Produced maps for all survey completed on the project site.

**Biologist, Isabel Ave-580 Interchange, Alameda County, CA, California Department of Transportation (Caltrans), 2009, $50K:** Conducted pre-construction surveys for highway project for California red-legged frog and California tiger salamander. Prepared and conducted environmental awareness training program for all workers on site. Developed safety plan for those monitoring site. Acted as construction monitor for site, reported non-compliance issues and reacted to changing situations on site by providing guidance for crew.

**Biologist, San Antonio Reservoir Pipeline Abandonment, Alameda County, CA, Chevron Pipe Line Company, 2009, $200K:** Monitored removal of abandoned pipeline at drainage crossing on private land. Site is known habitat of California tiger salamander and California red-legged frog. Performed daily pre and post-work site assessments for wildlife safety and other compliance measures including stream avoidance and dust abatement. Conducted on-site environmental compliance training for all personnel.

## Jolie Henricks

**Biologist, Urban Levee Geotechnical Investigations, Sacramento, CA, California Department of Water Resources (DWR), 2008, $35M:** Conducted biological monitoring services for geotechnical investigations on urban levees in the Stockton/Lathrop area of the Central Valley. Ensured project compliance with environmental regulations, including state and federal Endangered Species Acts and wetlands regulations. USFWS-approved monitor for the federally endangered riparian brush rabbit and giant garter snake.

**Biologist/Construction Monitor, San Antonio Reservoir Pipeline Relocation, Livermore, CA, Chevron Pipe Line, 2007, $2M:** Participated as one of the lead monitors in a five month project conducting wildlife surveys including nesting raptor monitoring and as environmental monitor for pipeline relocation project that involved both drilling and trenching activities. Responded to inquiries and situations on site to manage and maintain environmental compliance. Received snake handling training and subsequent experience to deal with snake encounters on project site. Also reported raptor and wildlife observations and assisted with mapping new wildlife observations. Site was possible range for San Joaquin Kit Fox and repeated observations took place to monitor possible den sites becoming active by inspecting the dens for physical evidence of use.

**GIS Specialist, High Speed Train Environmental Analysis, Bakersfield to Palmdale, CA, California High-Speed Rail Authority, 2010, $62M:** Conducted digitization of existing cultural resource data for analysis of impacts and planning of field efforts by cultural team.

**GIS Specialist, Gulf of Mexico Oil Spill Response GIS Mapping, Mobile, AL and Venice, LA, BP, 2010:** Stationed at the Incident Command Center in AL and outlying field station in LA as GIS support personnel for the Deepwater Horizon oil spill response effort in the Gulf of Mexico. Participated in numerous ongoing data and mapping products as well as production for a variety of one-time maps. Worked with a wide variety of internal clients to produce maps for general information and data analysis. Major projects included working with Civil Air Patrol uploading and processing aerial imagery to generate access shapefiles with photo linkages. Updated a variety of maps for scheduled daily updates for mass distribution within the facility. Coordinated with fellow GIS team members to streamline production and ensure quality products. Assisted with technical troubleshooting for site personnel as necessary.

**GIS Specialist, High Speed Train Environmental Analysis, Fresno to Bakersfield, CA, California High-Speed Rail Authority, 2010, $62M:** Assisted with GIS analysis and cartographic production of report maps for submission with EIR. Analyzed and edited field-collected data, attributed data and presented in final mapped form. Assisted with reviews and edits of various maps. Analyzed data for presentation with written text of the report. Georeferenced historic aerial imagery of the project footprint for cultural analysis. Assisted with planning and digitization of field collected data mapping land use between Fresno and Bakersfield. Also digitized cultural resources for impact analysis.

URS

# Katheryn Eldredge

***Biological Resources***

## Areas of Expertise

- Wildlife Biology
- Botany

## Years of Experience

With URS: 1 Year
With Other Firms: 20 Years

## Education

BS/Biology/1993/California State University, Bakersfield

BA/Anthropology/1978/ California State University, Bakersfield

## Overview

Ms. Eldredge has over 31 years of experience, with more than 21 as a biologist. She has experience coordinating and conducting all on- and off-site biological related facets of projects, including pre- and post-plant and animal surveys, monitoring of site activities, providing project specific endangered species training, permit writing, pre-and post-activity project reporting, preparing trapping and monitoring plans for listed species, and biological input into multifaceted reports, such as EIRs and HCPs.
Ms. Eldredge has conducted listed species surveys to agency protocol levels, including the blunt-nosed leopard lizard (BNLL), provided consulting to clients (including oil & gas and other energy) and regulatory agencies, developed and implemented revegetation requirements, and managed cultural resources for a major oil and gas operator.

## Project Specific Experience

**Biologist, Trapping and Handling, Elk Hills, CA:** Ms. Eldredge performed live trapping for several endangered and listed animal species, including the San Joaquin kit fox, San Joaquin antelope squirrel, giant kangaroo rat, San Joaquin pocket mouse and short-nosed kangaroo rat.

**Biologist, Population Monitoring (BNLL), Various Locations, CA:** Ms. Eldredge performed driving and walking transects during the summer and fall months to monitor the blunt-nosed leopard lizard population. At least 100 positive identifications were made for this species. The surveys were performed at California Department of Fish & Game (CDFG) protocol level. Specific areas surveyed include Kern County, California Valley, Cuyama Valley and Coalinga area.

**Biologist, Species Specific Surveys, Various Locations, CA:** Ms. Eldredge conducted species specific surveys for small mammals, botanicals, desert tortoise, and San Joaquin kit fox were performed at CDFG protocol levels. Kit fox monitoring experience includes monitoring dens, dusting dens and reading tracks, assessment of usage (active and natal) and spotlighting. She has also participated in botanical and desert tortoise surveys in the eastern Kern County area.

**Biologist, Baseline Studies, Cuyama Valley, CA:** Ms. Eldredge performed line intersect and density plant studies for acquisition of initial baseline habitat information. She summarized results in report format for submittal to appropriate agencies.

**Biologist, Permit and Document Writing, Various Locations, CA:** Ms Eldredge wrote biological input for EIRs and HCPs. She completed state and federal Incidental Take Permits and Lake and Streambed Alteration Permits for CDFG. She wrote documentation needed to support CEQA regulations.

**Biologist, Revegetation and Restoration, Various Locations, CA:** Ms Eldredge prepared and implemented revegetation and restoration plans. She also performed tasks such as monitoring, reporting, supervising initial restoration/planting activities and making field corrections to sites.

**Biologist, Conservation Planning, Various Locations, CA:** Ms Eldredge located and acquired suitable mitigation lands that met local state and federal requirements. She assisted in land acquisition in cooperation with mitigation land banks.

**Biologist, Seismic Studies, Various Locations, CA:** Ms. Eldredge monitored seismic crews, surveyors, and shot-hole crews. She wrote the initial report and work plan prior to initiation of project. She acquired permits as needed for listed species, conducted pre-activity surveys, and wrote daily reports.

**Anthropologist, Cultural Resources Management, Elk Hills, CA:** Ms Eldredge managed all aspects of cultural resources at the former Naval Petroleum No. 1 facility, including contribution to the Cultural Resources Management Plan, maintenance of known sites, and management of the local prehistoric and historic artifact collection.

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# Kelly J. Kephart

*Biologist*

## Overview

Ms. Kephart is a biologist with more than six years experience with habitat restoration and California native and non-native species. She has participated in the restoration of hundreds of acres of habitat on the Central Coast, and southern California. Ms. Kephart is experienced at special status plant surveys, the identification of sensitive and Federally and State listed plant species, salvage of listed and sensitive plant species, vegetation sampling, pre-disturbance surveys, data analysis and reporting. Ms. Kephart is also experienced with many sensitive and listed wildlife species including: California red-legged frog, silvery-legless lizard, two-striped garter snake, coast-horned lizard, tidewater goby, and desert tortoise. Ms. Kephart is also experienced with sensitive shorebird species including western snowy plover and California least tern. Ms. Kephart has extensive technical experience that includes work with multiple GPS systems and ArcGIS map projects.

## Areas of Expertise

Natural Resource Management
Habitat Restoration:
Riparian, chaparral, coastal sage scrub, coastal dune scrub, desert scrub, and native grassland
Vegetation surveys
Invasive/Non-native species
Construction Monitoring
Wildlife Monitoring
Monitoring of Threatened and Endangered Shorebirds of California
GPS and GIS mapping

## Years of Experience

With URS: 5 Years
With Other Firms: 1 Year

## Education

BS/Forestry and Natural Resources Management, Land Rehabilitation Minor/2006/California Polytechnic State University

## Registration/Certification

OSHA 40-Hour Hazwoper Trained, OSHA Refresher February 2012
CPR/First Aid Certified, 2009
Smith Systems Driver Training, June 2009
Loss Prevention System, March 2006
LPS refresher, July 2010
Behavior Based Safety, 2006, with annual refresher

## Project Specific Experience

### Vegetation Survey Experience

- **Sonoran West, Blythe, CA-** Conducted rare plant surveys, and mapped populations.
- **Allen Hancock, Lompoc, CA**-Conducted rare plant surveys for listed Seaside Bird's Beak (*Cordylanthus rigidus ssp. Littoralis*), mapped populations and conducted pre-disturbance surveys for additional sensitive plants.
- **Casmalia B Drainage Wetlands, Casmalia, CA**-Performed qualitative and quantitative monitoring of restoration wetland habitat.
- **Escolle Lease Remediation Assessment, Santa Maria, CA**-Conducted rare plant surveys prior to remediation activities, conducted habitat mapping, wetland delineation and conducted quantitative monitoring of native grassland habitat.
- **Caltrans, Towne Pass, Death Valley NP, CA**- Conducted pre-disturbance surveys for rare plant and sensitive plant species.
- **GE Energy Tehachapi Photovoltaic Solar Project, Tehachapi, CA**- Performed wetland delineations and botanical surveys.
- **Hydrogen Energy California, Bakersfield, CA**- Conducted rare plant surveys to document sensitive plant species, and conducted wetland delineations.
- **Guadalupe Restoration Project, Guadalupe, CA**- Conducted vegetation sampling in dune scrub, strand, and wetland habitats. Sampled and assessed the level of restoration for active restoration and passive restoration sites. Assessed erosion at restoration sites. Conducted pre-disturbance and post-disturbance

surveys for construction activities. Conducted site-wide weed mapping and weed transects. Conducted the yearly census of Beach Spectacle Pod (*Dithyrea maritime,* State Threatened), La Graciosa Thistle and Surf Thistle (*Cirsium rhothophilum*, State Threatened).

- **Solar One, Barstow, CA**- Conducted visual sampling of desert wash plant communities. Mapped boundaries between desert plant communities and conducted surveys for rare desert plants.
- **Oceano Dunes State Vehicular Recreation Area, Oceano, CA**- Conducted vegetation transects through dune scrub habitat.
- **Palos Verdes Land Conservancy, Palos Verdes, CA**- Conducted vegetation transects through coastal sage scrub, grassland, chaparral and riparian habitats.

## Habitat Restoration Experience

- **Guadalupe Restoration Project, Guadalupe, Guadalupe, CA**-
  - Assisted in the restoration of over 30 acres of habitat in the Guadalupe Dunes. Duties included installation of straw plugs, sand fence, scheduling and management of seed collection, out-planting of over 60,000 4 inch and gallon plants, seeding and management of CCC crews.
  - Conducted maintenance at restoration sites by conducting erosion control and maintenance, conducting quarterly and yearly restoration monitoring, installing photopoints and taking yearly monitoring photos, managing weed control crews, identifying and removing non-native species.
  - Assisted in the salvage and relocation of multiple Beach Spectacle Pod (*Dithyrea maritime,* State Threatened), and thousands of La Graciosa Thistle (*Cirsium loncholepis,* Federal Endangered, State Threatened)
  - Assisted in the growing facility by conducting maintenance, collecting seed, and propagating plants.
  - Composed multiple reports including: the quarterly ecological monitoring report, which included the results of monitoring of restoration sites, analysis of percent cover of restoration sites, weed control statistics and detailed any ground disturbance that occurred each quarter. The yearly Biological Opinion Report, which detailed the results of total take of listed species for the year for agencies. The yearly and five year Weed Control Report, which detailed the results of weed control, and composed site specific restoration plans for disturbance areas.

# Mark Wilson

*Biologist*

## Areas of Expertise

Biology/Conservation Biology
Biological Monitoring
Habitat Assessments

## Years of Experience

With URS: 2 Years
With Other Firms: < 1 Year

## Education

BA/Environmental Studies/2008/
Saint Mary's College of California

## Overview

Mr. Wilson is a staff biologist with academic training in geology, hydrology, biology, conservation biology, ecology, GIS mapping, environmental chemistry, and environmental geology. While in school, he conducted fieldwork in the Cascade Mountains where he tracked mountain goats by GPS collar and sampled natural salt licks used by the goats. He also participated in field studies in Alaska, which included a focus on glaciology, hydrology, disturbance ecology, and geomorphology. At URS he has assisted with a number of projects for federal, state, and private entities including field work and written reports.

## Project Specific Experience

**Biologist, Calaveras Dam Replacement Project, Sunol, CA, San Francisco Public Utilities Commission (SFPUC), 2008 – Ongoing, $12M:** Conducting construction monitoring for California red-legged frog, California tiger salamander, and San Joaquin kit fox and other species.

**Biologist, Fish Surveys, Pit River, Shasta County, CA, Pacific Gas & Electric Company (PG&E), 2008, $120K:** Conducted fish monitoring surveys using techniques carried out from a boat, barge, and on foot using electrofishing backpacks.

**Biologist, ESA Consultations on FEMA Disaster 1628 Projects, Marin, Mendocino, Del Norte, and Contra Costa Counties, CA, Federal Emergency Management Agency (FEMA), 2008 – Present, $3.4M:** Conducting site visits to examine projects and compliance with ESA for projects funded by the Federal Emergency Management Agency (FEMA). Consulting formally and informally with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Characterizing habitat at project sites to determine suitability for endangered species; preparing biological assessments for endangered species in California.

**Biologist, Biological Monitoring, Livermore, Alameda County, CA, Chevron Pipeline Company, 2009, $500K:** Conducted construction monitoring for California red-legged frog, California tiger salamander, San Joaquin kit fox, and other species.

**Biologist, Interstate-580 Truck Climbing Lane, Alameda County, CA, California Department of Transportation (Caltrans), 2009, $130K:** Wrote several documents after conducting field work and habitat assessments. Classified habitat types and identified potential breeding sites for listed amphibians and invertebrates. Prepared documents for Caltrans including a Natural Environment Study, Biological Assessment, Request for amendment to Biological Opinion, and assisted with a Jurisdictional Wetland Delineation study. Also conducted environmental permitting efforts for this project. These documents represented a summary of the project area, biological resources, and impacts to listed species, water resources, and vegetation types.

**Biologist, Wetland and Riparian Mitigation Monitoring, San Jose, CA, California Department of Transportation (Caltrans), 2008 $45K:** Conducted annual monitoring for Wetland and Riparian Mitigation site adjacent to Route 87 and Guadalupe River. Reviewed data and rewrote mitigation and monitoring report with new data, conclusions and suggestions. Coordinated maintenance efforts and acted as temporary lead task manager in 2010 monitoring effort.

**Biological Monitor, Bodfish Creek, Gilroy, CA, California Department of Transportation (Caltrans), 2009, $200K:** Served as biological monitor for a linear transportation project adjacent to Bodfish Creek. Duties included: monitoring ESA fencing installation and excavation work according to the construction plans. Monitoring was completed for the following federally listed species: California tiger salamander (*Ambystoma californiense*) and California red-legged frog (*Rana draytonii*). Additional monitoring included avoiding removal of vegetation and uprooting of valuable trees, such as redwood (*Sequoia sempervirens).*

**Biological Monitor, Lake Isabella Auxiliary Dam-Kern Canyon Fault Evaluation, Lake Isabella, CA, U.S. Army Corps of Engineers (USACE), 2008 – Present, $2.5M:** Conducted construction monitoring in Kern County during exploratory trench excavation and geomorphic mapping. Aided geologists in setting hydraulic shores to prevent the trench from caving in. Conducted safety audits while fulfilling duties as a biological monitor.

**Biological Monitor, Caldecott Tunnel, Alameda and Contra Costa Counties, CA, California Department of Transportation (Caltrans), 2010 $60K:** Conducted construction monitoring in Alameda and Contra Costa Counties during preparation for the fourth bore of the Caldecott Tunnel. Discovered and monitored a nesting killdeer throughout multiple construction phases and described movements and nesting success.

**Biologist, Old Lake Road to Dunne Lane Safety Improvement Project, Santa Clara County, CA, California Department of Transportation (Caltrans), 2008 – 2009, $40K:** Assisted in writing documents and authored permits such as Incidental Take Permits for this project.

**Biologist, Pullman Ditch Drainage Improvement Project, San Mateo County, CA, California Department of Transportation (Caltrans), 2010, $12K:** Authored a Caltrans Compliance Manual for the Caltrans Resident Engineer containing a summation of permits and regulations required by agencies for this project.

**Biologist, Old Niles Canyon Safety Widening Project, Alameda County, CA, California Department of Transportation (Caltrans), 2010, $8K:** Authored a Caltrans Compliance Manual for the Caltrans Resident Engineer containing a summation of permits and regulations required by agencies for this project.

# Melissa Newman

*Senior Biologist*

## Areas of Expertise

Environmental Impact Analysis
Endangered Species Act
Wildlife Biology Surveys
Habitat Assessment
Permitting

## Years of Experience

With URS: 6 Years
With Other Firms: 0 Years

## Education

M.S./Biology/2004/University of California, San Diego
B.S./General Biology/2002/University of California, San Diego

## Registration/Certification

CDFG Scientific Collecting Permit
Standard First Aid
Adult CPR
HAZWOPER 29 CFR 1910.120 (c)
BNLL Workshop, The Wildlife Society, 25 day credit towards CDFG Level II BNLL surveyor (David Germano) (2009)

## Overview

Ms. Newman has approximately nine years of experience in biological research studies; six of which have been in environmental consulting. She has managed the preparation of, and prepared, BAs for Section 7 consultation under the ESA with USFWS and NMFS, biological resources sections of CEQA/NEPA compliance documents, CDFG 1600 agreement notifications, and Section 404 and 401 permit applications, Caltrans Natural Environment Studies, Jurisdictional Delineation reports, and mitigation reports. Her field experience includes protocol surveys for blunt-nosed leopard lizard, California red-legged frog, vernal pool branchiopods, burrowing owl, California tiger salamander, valley elderberry longhorn beetle, raptors, and birds protected under the Migratory Bird Treaty Act. She also has experience coordinating and consulting with government resource agencies (e.g., USFWS, NMFS, and CDFG).

## Selected Project Experience

**Senior Biologist, Hydrogen Energy California Project, Buttonwillow, CA, Hydrogen Energy California, 2010-present, [Cost]:** Conducted protocol-level surveys for BNLL for proposed hydrogen-powered electrical energy generating facility.

**Senior Biologist, Lokern Habitat Conservation Plan EIR/EIS, Kern County, CA, Chevron Pipe Line Company, 2012-present, >$1 M:** Preparing the biological resources sections of the EIR/EIS for the implementation of the Lokern Habitat Conservation Plan.

**Task Manager/Senior Biologist, High Speed Train (Fresno to Bakersfield), Fresno, Kings, Tulare, and Kern Counties, High Speed Rail Authority, 2009-present, $1.02M:** Wildlife species issues include CRLF, SJKF, BNLL, BUOW, vernal pool branchiopods, kangaroo rats, CTS, birds of prey, VELB, fisheries, and wildlife movement corridors. Managed field teams and led survey crews for portions of the wildlife field surveys. Managed preparation, revisions, and/or prepare sections of the Biological Resources Technical Report and EIR/EIS.. Consulted with USFWS, NMFS, and CDFG.

**Wildlife Task Lead, High Speed Train (Bakersfield to Palmdale), Kern, and Los Angeles Counties, High Speed Rail Authority, 2010 - 2011, $812K:** Wildlife Task Lead for Bakersfield to Palmdale section of California High-Speed Train project. Section includes southern end of San Joaquin Valley, Tehachapi Mountains, and Mojave Desert. Wildlife species issues include desert tortoise, least Bell's vireo, Mojave ground squirrel, California condor, SJKF, BNLL, BUOW, birds of prey, and wildlife movement corridors. Organized and coordinated wildlife field surveys and managed integration of field data.

**Task Manager/Senior Biologist, SAPCO PIM Repairs, Monterey County, CA, Chevron Pipe Line Company, 2011, [Cost]:** Prepared

USFWS BA and oversaw preparation of the biological resource permit applications (i.e., USACE 404 NWP, RWQCB 401, CDFG 1600 Notification) for the proposed pipeline repair project.

**Biological Resources Task Manager, Tracy Combined Cycle Conversion – Solar Integration Project, Tracy, CA, GWF, 2009, $27K:** Coordinated the biological surveys (habitat assessment, rare plants, burrowing wildlife) for proposed solar power project.. Led the wildlife surveys and oversaw preparation of the Biological Resource Assessment report.

**Biologist, Willow Pass Generating Station, Pittsburg, CA, Mirant, 2009, [Cost]:** Prepared Biological Evaluation report and CDFG 1600 Notification for proposed generating station.

**Assistant Biological Resources Task Manager, Colusa Generating Station, Colusa County, CA, E&L Westcoast, LLC, 2006 –2008, $1.5M:** Prepared revised biological resources section of CEC AFC (EIR equivalent document) for proposed power plant site and associated bridge replacements. Prepared USFWS/NMFS BA, USACE 404 individual permit application, RWQCB 401 permit application, CDFG 1600 Notification, CEC Biological Resources Mitigation Implementation and Monitoring Plan. Consulted with agency personnel from the CEC, ACOE, USFWS, NMFS, CDFG, and EPA. Conducted surveys for BUOWs, amphibians, and rare plants. Mapped habitats and identified and delineated vernal pools, seasonal wetlands, and freshwater marsh wetlands. Conducted informal CTS habitat site assessment.

**Biologist, San Ardo to Coalinga Crude Oil Pipeline Alignment, Monterey and Fresno Counties, CA, Chevron Pipe Line Company, 2006 – 2008, $4.6M:** Conducted protocol surveys for raptors and BUOWs for 57-mile pipeline project. Co-wrote draft Mitigation Concept Plan for proposed off-site mitigation for wetlands and habitats for federally listed species.

## Chronology

01/10 – present: URS Corporation, Senior Biologist, Oakland, CA
05/06 – 12/09: URS Corporation, Biologist, Oakland, CA
09/01 – 06/03: Center for the Reproduction of Endangered Species, San Diego Zoo, Research Assistant, San Diego, CA
09/02 – 12/02: University of California, San Diego, Teaching Assistant for upper division course "Evolution", La Jolla, CA
01/01 – 08/01: University of California, San Diego, Field Biologist, La Jolla, CA

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# Robin Murray

*Staff Biologist*

## Overview

Ms. Murray is a biologist with three years experience with rare plant surveys within California. Her work in Northern California involved conducting rare plant surveys, organizing field crews, and training crews in the identification and habitat requirements for target species. Ms. Murray has extensive experience hiking and navigating in rough terrain and in the operation off-highway vehicles. She also has experience in the creation and care of herbarium collections.

## Areas of Expertise

Vegetation surveys
Plant identification
Habitat Assessment for sensitive plant species
Navigation in difficult terrain

## Years of Experience

With URS: <1 Year
With Other Firms: 2 Years

## Education

BS/Botany/Environmental Biology/2006/Humboldt State University

## Specialized Training

OSHA 40-Hour HAZWOPER
Wetland Delineation

## Project-Specific Experience

### Restoration Experience

- Delhi Sands Restoration for SCE, San Bernardino, CA – Assisted with restoration efforts on a half-acre site for the endangered Delhi Sands Flower-loving Fly (*Rhaphiomidas terminatus abdominalis*). March 2008 to present.

### Vegetation Survey Experience

- Johnson Valley Energy Project – Conducted over 250 hours of botanical surveys on portions of 8,000-acre project site looking for rare and sensitive plant species. March to June 2008.
- Timber Harvest Plan Surveys, Korbel and Scotia, CA– Coordinated three to four person crews for vegetation surveys including field training and plant identification training. Surveyed timber harvest plans for rare and sensitive plant species, monitored known populations of rare plants, assessed habitat suitability for rare plants, recorded and interpreted data, navigated and hiked in varying terrain and weather conditions, drove ATVs as well as 4x4 trucks. May to August 2006 and March to September 2007.

### Sensitive Species Experience

<u>Botanical Experience</u>

- Conducted over 250 hours of surveying for rare and/or listed desert plant species in Johnson Valley, CA.
- Identified and documented a large population (over 1,500 individuals) of desert polygala (*Polygala acanthoclada*).
- Identified and documented first two known populations of giant fawn lily (*Erythronium oregonum*) within California.
- Surveyed over 50 miles of logging roads for Howell's montia (*Montia howellii*) and identified over 50 populations.
- Identified and documented over 100 populations of running pine (*Lycopodium clavatum*).
- Identified and documented over 25 populations of robust false lupine (*Thermopsis robusta*).

- Surveyed for and identified populations of Bald Mountain milk-vetch (*Astragalus umbricatus*), small groundcone (*Boschniakia hookeri*), flaccid sedge (*Carex leptalea*), Meadow sedge (*Carex praticola*), Oregon goldthread (*Coptis laciniata*), coastal fawn lily (*Erythronium revolutum*), Pacific gilia (*Gilia capitata* ssp. *pacifica*), indian pipe (*Monotropa uniflora*), Siskiyou checkerbloom (*Sidalcea malviflora* ssp. *patula*), and coast checkerbloom (*Sidalcea oregana* ssp. *eximia*).

**Wildlife Experience**

**Blunt-nosed leopard lizard (*Gambelia sila*)**

- Four positive identifications under supervision of a Level II surveyor. California Valley, CA – Surveyed for blunt-nosed leopard lizards using the CA Department of Fish and Game Protocol.

**Desert tortoise (*Gopherus agassizii*)**

- Four positive contact hours. Johnson Valley Energy Project – Conducted protocol surveys on portions of 8,000-acre project site looking for desert tortoise, sign, tracks, scat, and burrows. Collectively, crew found fifteen individuals; each was passively measured and burrows were assessed.

## Specialized Training

- Wetland Delineation Training
  August 2008
- OSHA 40-Hour HAZWOPER
  June 2008
- Smith Systems Driver Training
  August 2008
- Loss Prevention System
  August 2008
- Certified ATV driver by the ATV Safety Institute,
  license # 122849
- 2007/First Aid/CPR/AED

## Chronology

3/08 - Present: URS Corporation, Staff Biologist, Santa Maria, CA
3/07 - 9/07: Green Diamond Resource Company, Botanical Crew Leader, Korbel, CA.
5/06 - 8/06: Pacific Lumber Company, Botanical Technician, Scotia, CA
6/05 - 8/05: Biological Sciences Department, Humboldt State University, Research Intern, Arcata, CA
6/03 - 8/03: Entomology Laboratory, Humboldt State University, Laboratory Assistant (Volunteer) Arcata, CA
5/02 -8/02: Joint Genome Institute- Lawrence Berkeley Laboratories, Laboratory Assistant and Microscope Technician, Walnut Creek, CA

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# Ronald R. Cummings

*Senior Wildlife Biologist*

## Overview

Ronald Cummings' educational and professional background provide an experience base in special status species surveys, habitat analysis, environmental impact assessment, NEPA analysis, and the management and logistics of survey field crews. Mr. Cummings is currently employed as a Senior Wildlife Biologist in the Santa Barbara office within the Central Coast Operations of URS Corporation.

Mr. Cummings has over twenty-one years of experience in wildlife and fisheries management, including 18 years as a wildlife biologist with USDA Forest Service and two years as a fresh water fishery volunteer with the Peace Corps in Ecuador, South America, and two years with URS Corporation. He has extensive experience in field surveys for various wildlife species; project and sub-watershed level NEPA analysis for determining effects and mitigations for species and habitats, including writing Biological Evaluations (BE), Biological Assessments (BA), and portions of Environmental Assessments (EA); and some experience writing portions of Environmental Impact Statements (EIS). Mr. Cummings has experience in writing habitat assessments; habitat improvement projects; wildlife surveys; program planning; employee supervision; ESA Section 7 Consultation with USDI FWS; cooperation with other agencies such as NPS, CDFG, BLM, Caltrans, PG&E, local Governments and private individuals. He has a general knowledge of West Coast habitats and species, with emphasis on the following Federally Listed species: Northern spotted owl, San Joaquin kit fox, giant kangaroo rat, blunt nosed leopard lizard, desert tortoise, and valley elderberry longhorn beetle. Mr. Cummings has experience with other wildlife species endemic to the Sierra Nevada range, the San Joaquin Valley, and Mojave Desert.

## Areas of Expertise

Wildlife field survey
NEPA Analysis
ESA Section 7 Consultation
Biological Evaluations
Biological Assessments
Habitat management

## Years of Experience

With URS: 2 Years
With Other Firms: 20 Years

## Education

BS/General Biology/1985/Oregon State University, Corvallis, OR

## Registration/Certification

Loss Prevention System (LPS)
HAZWOPER 40-hour
Shell Yellow Book Safety
Smith Driver Safety
PASSPORT Contractor Safety
e-RAILSAFE System
BNSF Contractor Orientation
Level II Surveyor: Blunt-nosed leopard lizard survey protocol.

## Project Specific Experience

**Wildlife Surveys: December 15, 2008 to present.**

- **California Valley Solar Ranch Project; SunPower Corporation, Systems; San Luis Obispo County, CA**: Participated in botanical surveys, wintering bird surveys, nesting bird surveys, burrow surveys, kit fox spotlighting, and blunt-nosed leopard lizard surveys on the 3,000 acre project site. Performed monitoring and detection of the San Joaquin kit fox via spotlight surveys (3 nights), burrow surveys (2 days), and automatic camera stations (5 weeks set up and take down). Assisted in the supervision of the survey crew of 12 to 24 biologists during 17 weeks of blunt-nosed leopard lizard surveys. Coordinated rental cars and hotel rooms, developed the survey schedule, performed safety briefings, and ensured data forms were filled out appropriately. Organized and summarized survey data on a weekly basis and at the end of the survey season. Responded and adapted to challenges such as last-minute personnel changes and weather events to complete the surveys on time and within protocol. Qualified as a Level II surveyor for blunt-nosed leopard lizard. May – Sept, 2009.

- **Santa Ynez Habit Mapping; Rincon Corporation; Santa Ynez, CA.** Performed a habitat assessment on a 1.1 acre parcel for a proposed gas station. Identified vegetation communities, general botanical and wildlife species present, and wrote the resulting Habitat Assessment and Sensitive Species Review. June, 2009.
- **HECA 2; Hydrogen Energy, California; Buttonwillow, CA**: Performed general wildlife surveys for sign of special-status species on the approximately 1,000-acre project site (January, 2009). Participated in protocol blunt-nosed leopard lizard surveys on a portion of the site, May – June, 2009, and again during the juvenile blunt-nosed leopard lizard survey season August-September, 2010.

## Special-Status Wildlife Species Experience:

**Blunt-nosed leopard lizard (*Gambelia sila*)**: 530 survey hours:

- Attended survey protocol training in Bakersfield, May, 2009. Level II BNLL survey qualified.
- California Valley Solar Ranch project: 400 surveys hours. Supervised the crew of 12-24 biologists during BNLL survey efforts in California Valley.
- HECA 2 project: 130 survey hours.
- Observed adult and juvenile BNLL in the field an estimated 8 times during training and at a reference site in the Carrizo Plains National Monument.

**Burrowing owl (*Athene cunicularia*):** 136 survey hours:

- Antelope Valley, Larsen Ranch Site: 40 dedicated survey hours.
- Calico Solar project site: 96 survey hours.
- Larsen Ranch Site, Calico Solar, Pacific Valley Solar, High Speed Train: 128 survey hours; observed burrowing owls during general bird/wildlife surveys.
- California Valley site: 400 survey hours; observed burrowing owls almost daily during blunt-nosed leopard lizard surveys.

**Swainson's hawk (*Buteo swainsoni*)**: 40 survey hours:

- Pacific Valley Solar (3 sites): 24 dedicated survey hours.
- High Speed Train: 16 hours.

**San Joaquin kit fox (*Vulpes macrotis mutica*)**: 34 survey hours:

- California Valley Solar: 18 hours spotlight surveys, 16 hours burrow surveys, and 5 weeks of motion-sensitive automatic camera station monitoring. Observed kit foxes (adults and young) and sign frequently during 400 hours of blunt-nosed leopard lizard surveys.
- Able to identify kit fox burrows, natal dens, scat, tracks, and suitable habitat.

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# Steve Zembsch, CPESCS

*Senior Hydrologist*

## Areas of Expertise

Stream Restoration
Wetland Mitigation/Creation
Erosion and Sediment Control
Road Removal/Downgrades to Trail
Revegetation/Pest Species Eradication

## Years of Experience

With URS: <1 Year
With Other Firms: 30+ Years

## Education

BS/Soil Resource Management/1979/University of California, Berkeley

## Registration/Certification

1994/CPESCS/#678
1980/General Engineering Contractor/CA/#390156

## Overview

Prior to joining URS this year, Mr. Zembsch was the founder and principal hydrologist of Watershed Science, a specialized stream restoration and wetland mitigation firm. He designed and/or implemented more than 100 projects throughout California in a wide variety of geomorphic settings for a diversity of clients. He also undertook many projects involving erosion and sediment control, non-native species eradication, native plant re-vegetation, golf course development, and water feature design and construction.

Mr. Zembsch is a firm believer in tailoring each project to function harmoniously with the natural channel forming factors. His greatest post-project satisfaction is when the project site is indistinguishable from its natural surroundings. And the finest compliment you can give him is to disbelieve that a stream restoration actually occurred at one of his many project sites.

## Project Specific Experience

### Stream Restoration Projects

**Designer/Installer, Wilder Creek Dam Removal and Channel Restoration, Santa Cruz, CA, CA Dept. of Parks and Recreation, 1999 – 2000, $160K:** Total project responsibility from concept through implementation, including major riparian reforestation and post-project monitoring. Project involved applying for SB 271 funds to remove a 100% barrier to salmon and steelhead migration and spawning. Project complications included designing and installing a new water source for park operations (infiltration gallery), and mitigating for loss of important Red-legged frog breeding and rearing habitat. Salmonid surveys conducted the first year after the project revealed the highest density of steelhead fry of all coastal San Mateo County streams and the presence of a few Coho fingerlings, the first salmon in this highly suitable habitat after nearly 50 years of absence. Some major project steps included:

- The dam and spillway were removed.
- Boulder cascades were placed 60 feet downstream of the former dam and continued upstream to create a grade similar to Wilder Creek's pre-dam channel.
- A 12-foot thick layer of sediment that had filled the reservoir created by the dam was removed and relocated to a stable site.

When Mr. Zembsch and his crew removed the impounded sediments half a century later they discovered that the pre-dam cobbles had been removed, crushed and were now incorporated into the asphalt! To complete the project properly, they had to extend the project upstream, all the way to the point of inflection (where the impacts of the dam was manifest as a flattened grade).

**Designer/Installer, Shekell Streambed and Streambank Rehabilitation, near Somis, Ventura County, CA, Ventura County Resource Conservation District (RCD), 1999 – 2003, $750K:** Mr. Zembsch's first foray into southern California was an eye opening experience. Agriculture (citrus and avocados) is king, and creeks seem to be viewed as agricultural "drains". The fact that the RCD and the individual landowners associated with this experimental project were willing to try something other than concrete and riprap is a remarkable tribute to their faith and trust in scientific approaches.

This was a surprisingly difficult project, despite the 2% valley slope. The bed and banks were coarse sand and the channel had been highly altered over the last half a century. The previous (and ongoing) bank erosion methodology was to back dump trucks up to the top of the banks and simply dump all sorts of construction debris and rubble. No thought was given to the hydrological effect of this practice, nor to the impact of this practice on the property owner on the other side.

Mr. Zembsch carefully surveyed the existing channel and found several stable reaches nestled in among the collapsing, debris-embedded banks and torrents of sandy bedload. He carefully surveyed and analyzed these sites and discovered the stable plan form for the majority of the project was a short wavelength, mildly sinuous channel with a well-defined cross-section and depositional features. The few existing (pre-project) stable banks along the meander bend, particularly from the beginning and through the apex of the meander, were stabile largely due to the dense riparian vegetation with embedded woody material, and/or large rocks. There was an ample supply of the latter two, and enough of a budget to purchase the young vegetation.

100,000 native grasses of various species were grown from seeds in a large agricultural nursery. Mr. Zembsch oversaw the planting in late April. The timing determined that the seedlings were very dependent on the adjacent property owners to take good care of them until their root systems were developed enough to survive without irrigation. Planting on this scale is better performed in October, but the landowners did a fair-good job of irrigating and there are areas of moderately dense plantings holding the banks.

Mr. Zembsch returned in December of 2003 to touch up a couple of spots where the entrance roads or citrus crops encroach on the channel and compromises had to be made in the design. The previous season's high water sounded a fair warning that such compromises would not be tolerated over the long haul, so he pulled the banks back as best we could and stabilized the incising, confined reach. It's up to the vegetation now.

**Designer, Restoration of Easkoot Creek, Stinson Beach, CA, Golden Gate National Recreation Area, National Park Service, 2000, 45K:** Located on a recently altered Holocene marine terrace, just a few hundred feet from the beach, the Easkoot Creek project presented several problems. Under pressure from the town, the park did not want to give up any visitor parking space to give the floodplain back to the creek or its adjacent wetlands. This seemed to be a strange concession at the time and an even stranger one today, 11 years later. The natural resources that the parking lots are displacing are not only disappearing fast from our national landscape, they are critical breeding and rearing habitat for several listed species.

Parking lots aside, there is another critical issue facing the natural resources that rely on the Stinson Beach parklands for critical habitat. Water extraction, both surface diversion and groundwater, result in a premature desiccation of Easkoot Creek and its wetlands. There are several simple solutions to this problem. A large storage reservoir, located upslope from the community, could be fed by excessive storm flow in the winter and combined with wise community use in the summer and fall, and would greatly reduce the need to extract surface and groundwater from the Easkoot Creek hydrologic basin.

**Designer/Installer, Apple Homes Development, Scotts Valley, CA, Apple Homes LLC, 2007 – 2011, $63K**: Mr. Zembsch designed and constructed three wetland basins to mitigate for the loss of existing wetlands caused by the construction activities. He also designed and constructed an additional wetland as a provisional wetland. The wetlands were plugged with several types of native obligate species that were salvaged and stockpiled from the existing wetlands before they were disturbed by the impending construction. He primarily used *Juncus* and *Carex* species because of their rapid growth and the development of thick, strong root masses. They quickly formed dense, fibrous root masses that successfully bound the channel stones and boulders together to withstand the tremendous erosional forces of an unusually severe fall storm the first year.

**Designer/Installer, Design and Implementation, Eradication of Eucalyptus Forests, Marin County, CA, Golden Gate National Recreation Area, 2004, $305K:** Two different post-removal treatments were provided- complete removal, roots and all (6 acres), and stump application of herbicide (using Garlon 4- 22 acres). The results were immediate and spectacular. The 6 acre complete removal was quickly planted with thousands of natives grown in the GGNRA nursery and the Eucalyptus seedlings were easily hand-pulled. The site transformed immediately from a monoculture dominated by the invasive, exotic pest tree into a beautiful glade dominated by a wide diversity of native flora. To the contrary, the 22 acre site is peppered with stumps and requires thousands of dollars a year in maintenance costs and hundreds of hours of volunteer labor to pull the sprouts.

**Designer/Installer, Periwinkle Eradication, Design/Implementation, Bothe-Napa Valley State Park, St. Helena, CA, CA Dept. of Parks and Recreation, 1986, 26K:** Mr. Zembsch took this project over from a State Park employee on leave. He quickly discovered that the application of herbicide in the spring was simply defoliating the rhizomonous Periwinkle, and there was enough energy in the stems and roots to re-leaf by mid-summer. The herbicide did kill adjacent vegetation, however, that was competing with the Periwinkle. So the target plant came back, more robust than ever. The solution was simple: let the plant re-leaf so it uses its stored energy and then hit it with herbicide again once the leaves are large enough to deliver the herbicide to the roots.

**Designer/Installer, Lombardi Creek Tule Removal Project, Wilder Ranch State Park, Near Santa Cruz, CA, California Department of Parks and Recreation, 2002, $40K:** The back-dune estuary had become choked with sediment and thickly vegetated with tules, limiting its value as a diverse native ecosystem and nursery for the sensitive amphibians and fish known to inhabit these coastal lagoons. Mr. Zembsch and his crew cleared the tules, enlarging the estuary in size and depth, greatly increasing its volume. This increase was critical for providing a salinity gradient, increasing oxygenation and decreasing the temperature of the water.

**Installer, Big Rock Ranch Revegetation Project, Near San Rafael, CA, LucasFilm LLC, 2001 – 2004, $96K:** The revegetation program has settled into a comfortable journey toward successful completion of the mitigation requirements. At issue was the hardening of the nursery stock prior to installation (the wetland plants went through Steve's boot camp, much to the client's and their landscape architect's dismay). Note that the Watershed Science plants quickly surpassed the adjacent contractor's beautiful nursery stock. An important horticultural consideration is to replicate the natural condition so we tap into the internal survival wiring. This means use native soil as a planting medium, without amendments (fertilizer, organic matter, etc.). It also means to irrigate in a way that mimics the natural condition, adjusting for the existing situation, such as the plant is in a container, not the wetland soil.

An ideal example would be to plant the plugs after the first good soaking rain of the fall and then leave them alone unless there is a protracted drought until the next fall/winter storm. Or, as in the case of LucasFilm, leave them in their containers in the summer, lightly water them to keep them alive while triggering root development and concomitant foliar suppression.

**Installer, Riparian Reforestation, Clear Creek, Redding, CA, Western Sotoyome Resource Conservation District, 2002, $76K:** Planting 7,000 riparian tree poles (1" to 3" diameter branches cut into a 6' length) in fluvial gravels in Redding in late March doesn't sound like fun. Guess what? It wasn’t. Mr. Zembsch and his crew had to drill a five-foot deep hole with a Bobcat and auger attachment and then immediately stick a pole in the hole before it caved in or the pole dried out. The job had a rigid sequence of species and a regimented appearance that is contrary to Mr. Zembsch’s design philosophies. The project was, however, a necessary step in converting this braided, deforested portion of Clear Creek into a stable, meandering C4 channel.

URS

# J. Wayne Vogler

*Senior Biologist*

## Areas of Expertise

Wetland Delineations
Construction Monitoring
Flora/Fauna Surveys
Mapping Services
HAZWOPER Trained

## Years of Experience

With URS: 2 Year
With Other Firms: 11 Years

## Education

BS/Biological Sciences/1994/
University of California, Irvine

## Registration/Certification

1997/U.S. Army Corps of Engineers Wetland Delineation Certification Program
2008/Level II Blunt-nosed Leopard Lizard Surveyor

## Overview

Mr. Vogler is a biologist with a well-balanced understanding of biological resources and project planning. Mr. Vogler has proved to be an asset in the planning of complex field efforts; developing strategies for performing surveys and collection data while maintaining critical data acquisition targets. Mr. Vogler's project experience has included working with federal, state , and local agencies to find consensus among several parties, often with conflicting interests, toward the successful completion of the project. Mr. Vogler developed an instituted monitoring protocols, developed restoration plans, and monitored one of the largest hydrocarbon remediation projects along the U.S. Western Coast. Wayne has maintained compliance with Health and Safety training requirements, including some specialized training, since 1996; he is fully-=versed in the health and safety culture.

## Project-Specific Experience

<u>**Sensitive Species Experience**</u>

**California Red-legged Frog (*Rana aurora draytonii*)** identified presence through eyeshine survey techniques for hundreds of individuals, pit-tagged dozens of individuals, identified and differentiated individuals from other amphibian species.

- San Luis Obispo and Santa Barbara County – Conducted presence/absence surveys for California red-legged frogs and mapped habitats. 1999 through present.
- Chevron Guadalupe Restoration Project - Permitted to survey, capture, handle, and relocate California red-legged frogs. Includes pit-tagging and radio-tracking of individuals to monitor relocation efforts. Adult surveys include quarterly census surveys, presence/absence, and construction site clearance surveys. Survey efforts for tadpoles, including dip-netting and use of minnow traps. 1999 through present.
- Chevron Wylie Remediation Project, Santa Maria, CA – Habitat assessment, clearance surveys of work areas, and consultations with regulatory agencies. October 2007 to present.
- Capture, Handling, and Pit Tagging Workshop, Grover Beach, CA - small group led by Galen Rathbun on techniques to safely capture and handle California red-legged frogs, using bullfrogs (*Rana catesbiana*) as surrogates. Hands-on use of pit tag equipment on live bullfrogs. Workshop conducted in support of obtaining U.S. Fish and Wildlife approval to conduct such activities under the Guadalupe Restoration Project Biological Opinion. 2000.

**Desert Tortoise (*Gopherus agassizii*)**

- Solar Energy Project, Johnson Valley, San Bernardino County, CA – habitat assessment and survey of 14 square miles. Protocol surveys for desert tortoise. Acted as survey crew leader. Other species commonly observed include desert horned lizard (*Phrynosoma platyrhinos*) and long-nosed leopard lizard (*Gambelia wislizenii*). March to June 2008.

- Solar Energy Project, Johnson Valley and Hector Valley, San Bernardino County, CA – survey area of over 20,000-acres for protocol surveys for desert tortoise. Surveyed project site and proposed transmission line corridors. Also conducted general habitat mapping, Waters of the U.S. delineations, rare plant surveys, and habitat surveys for the Mojave ground squirrel (*Spermophilus mohavenissi*). March to July 2007.

- Mojave Desert – Completion of the Desert Tortoise Council Annual Surveying, Monitoring, and Handling Techniques Workshop. Training included survey techniques for individuals and their sign, assessment of habitat, handling techniques, and burrow construction. 2003.

**Wetland Delineations**

- Performed the initial survey and subsequent update surveys to identify and delineate wetlands according to federal definitions at the 2,800-acre Guadalupe Restoration Project. Employed both routine and comprehensive survey methods with findings reviewed by USACE and NRCS. 1997 and 2004.

- Performed the initial survey and subsequent update surveys to identify and delineate wetlands according to California state definitions at the 2,800-acre Guadalupe Restoration Project. Developed specific analysis methods to satisfy CCC concerns. Findings reviewed by CDFG and CCC 1998 and 2003.

- Guadalupe-Nipomo Dunes – Conduct an identification survey of wetland habitats throughout the entire dunes complex. Developed identification and screening criteria, classification and descriptive identifiers, and survey methodology. Employed aerial photography interpretation for initial target identification. Mapped wetland habitats with sub-meter GPS unit for data to be incorporated into an existing GIS project. 2004 to present.

- Administrative Hearing with the Army Corps of Engineers for the Santa Maria Airport District. Presented to Hearing Officer in support of District's opinion that wetlands unfairly identified by ACOE personnel. Hearing resulted in no action taken by ACOE against District.

**General Vegetation Surveys, Wildlife Surveys, and Habitat Assessment**

- Conducted regimented surveys and mapping efforts for La Graciosa thistle (*Cirsium loncholepsis*), surf thistle (*Cirsium rhothopilum*), and beach spectacle-pod (*Dithyrea maritima*). Initial survey and mapping of presence. Annual censusing of populations. Monitoring of construction activities to ensure avoidance of disturbance to individuals and habitat. 1998 to present.

- Prepared biological sections for Application for Certification documents submitted to the California Energy Commission regarding power generating stations. September 2006 to present.

## J. Wayne Vogler

- Presence survey. Population mapping, and habitat assessment for Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) for a naturally vegetated 16-acres site at Vandenberg Air Force Base, California. June 2006.
- Habitat Inventory and Ecological Database (HIED) development for the 2,800-acre Guadalupe Restoration Project. Scope included the initial mapping of sensitive flora, sensitive fauna, weed infestation, habitat quality, and several other parameters. Data developed from aerial photograph interpretation, qualitative and quantitative surveys, and specific presence/absence surveys per species. Updated annually. 2002 to present.
- Pre-disturbance assessment and restoration monitoring surveys to determine habitat composition and quality. Developed protocols for photograph documentation efforts. Spring 1998 to present.
- Construction monitoring to ensure compliance with over 1,200 permit conditions. Work with contractors and construction personnel to minimize native habitat disturbance and avoid sensitive and listed flora and fauna. Spring 1998 to present.

### Specialized Training

- Annually/8-Hour HAZWOPER Annual Refresher
- 2006/Loss Prevention System Training, a Behavior Based Safety Program
- 2006/Smith System Advanced Driving Traffic Safety
- 2003/PADI Certified Open Water Diver
- 2001/Stormwater Pollution Prevention on Construction Sites, California State Water Resources Control Board
- 1996/40-Hour Hazardous Waste Workers' and 24-Hour First Responder Health and Safety Training

### Contact Information

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wayne_vogler@urscorp.com

# Appendix G

## Cultural Resources

## (Submitted Separately Under the Rules of Confidentiality)

**Appendix G-1**

**Cultural Resources Record Search**

**(Submitted Separately Under the Rules of Confidentiality)**

# Appendix G-2

# Native American Consultation

# (Submitted Separately Under the Rules of Confidentiality)

# Appendix G-3

## Archaeological Technical Report

## (Submitted Separately Under the Rules of Confidentiality)

**Appendix G-4**

**Historic Architecture Technical Report**

**(Submitted Separately Under the Rules of Confidentiality)**

# Appendix H

# Land Use

# Appendix H-1

## Assessor's Parcel Numbers and Owner Information Within 1,000 Feet of HECA Site

## Appendix H-1. Assessor's Parcel Numbers and Owner Information Within 1,000 Feet of HECA Site

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 15902016 | DICK DYKSTRA DAIRIES | 10129 SCHAEFER | ONTARIO CA | 91761 |
| 15904002 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904003 | BUENA VISTA WATER STORAGE DIST | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15904004 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904005 | BUENA VISTA WATER STORAGE DIST | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15904011 | HYDROGEN ENERGY CAL LLC | 1 WORLD TRADE CENTER STE 1600 | LONG BEACH CA | 90831 |
| 15904012 | BUENA VISTA WATER STORAGE DISTRICT | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15904016 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904017 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904018 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15905005 | BUENA VISTA WATER STORAGE DIST | | | |
| 15905006 | RICCOMINI LOUIS & SONS INC | 11501 BUFFINGTON ST | BAKERSFIELD CA | 93312 |
| 15905012 | CAUZZA JOHN B III & LAURA K | 1600 CORN CAMP RD | BUTTONWILLOW CA | 93206 |
| 15905018 | CAUZZA JOHN B III & LAURA KAY | 1600 CORN CAMP RD | BUTTONWILLOW CA | 93206 |
| 15913006 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15913007 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15913011 | DICK DYKSTRA DAIRIES | 10129 SCHAEFER | ONTARIO CA | 91761 |
| 15917010 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95811-7137 |
| 15919005 | RICCOMINI LOUIS & SONS INC | 11501 BUFFINGTON ST | BAKERSFIELD CA | 93312 |
| 15919006 | BUENA VISTA WATER STORAGE DISTRICT | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15919009 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15930001 | LANGER JAN H | 10900 RUNNING BUCK LN | AUSTIN TX | 78750 |
| 15930002 | MC CALLUM RETA E | 54747 BENECIA TL | YUCCA VALLEY CA | 92284 |
| 15930003 | KNAUSS D R & ALLEN J W ET UX | 2252 SAN BERNARDO AV | HEMET CA | 92545-2418 |
| 15930004 | LIND PHYLLIS K & ALDAHL JOHN V | 851 SW 6TH AV # 810 | PORTLAND OR | 97204 |
| 15930005 | HERSCHENSOHN JULIE ANN | 1918 NO 1ST AV | SEATTLE WA | 98109 |
| 15930006 | PLEBANEK DANIEL J | 9401 18TH ST | KENOSHA WI | 53144-7748 |
| 15930007 | HUBBARD FAMILY TRUST | 273 ROCKY POINT RD | PALOS VERDES CA | 90274 |

# Appendix H-2

## Assessor's Parcel Numbers and Owner Information Within 500 Feet of Potable Water/Transmission Linears

Appendix H-2. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Potable Water/Transmission Lines

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 15901002 | KERN WATER BANK AUTHORITY | 5500 MING AV STE 490 | BAKERSFIELD CA | 93309 |
| 15901006 | LAYSHOT FAMILY TRUST | 17543 HAVENRIDGE DR | BAKERSFIELD CA | 933148882 |
| 15902012 | WEST KERN WATER DIST | 800 KERN ST | TAFT CA | 93268 |
| 15902013 | WEST KERN WATER DIST | 800 KERN ST | TAFT CA | 93268 |
| 15902016 | DICK DYKSTRA DAIRIES | 10129 SCHAEFER | ONTARIO CA | 91761 |
| 15904016 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904017 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15904018 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15905008 | WEST KERN WATER DIST | 800 KERN ST | TAFT CA | 93268 |
| 15905009 | WEST KERN WATER DIST | 800 KERN ST | TAFT CA | 93268 |
| 15905012 | CAUZZA JOHN B III & LAURA K | 1600 CORN CAMP RD | BUTTONWILLOW CA | 93206 |

# Appendix H-3

## Assessor's Parcel Numbers and Owner Information Within 500 Feet of $CO_2$ Lines

Appendix H-3.  Assessor's Parcel Numbers and Owner Information Within 500 Feet of CO2 Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 15904012 | BUENA VISTA WATER STORAGE DISTRICT | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15904016 | HYDROGEN ENERGY INTERNAT LLC | 700  LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15913006 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15918012 | OCCIDENTAL OF ELK HILLS INC | P O BOX 27570 | HOUSTON TX | 77227-7570 |
| 15918013 | OCCIDENTAL OF ELK HILLS INC | P O BOX 27570 | HOUSTON TX | 77227-7570 |
| 15918014 | OCCIDENTAL OF ELK HILLS INC | P O BOX 27570 | HOUSTON TX | 772277-570 |
| 15918021 | CHEVRON USA INC | P O BOX 1392 | BAKERSFIELD CA | 93302-1392 |
| 15919006 | BUENA VISTA WATER STORAGE DISTRICT | P O BOX 756 | BUTTONWILLOW CA | 93206 |
| 15919009 | HYDROGEN ENERGY INTERNAT LLC | 700  LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15927001 | CHEVRON USA INC | P O BOX 1392 | BAKERSFIELD CA | 93302-1392 |
| 15927002 | OCCIDENTAL OF ELK HILLS INC | P O BOX 27570 | HOUSTON TX | 77227-7570 |
| 15930001 | LANGER JAN H | 10900  RUNNING BUCK LN | AUSTIN TX | 78750 |
| 15930002 | MC CALLUM RETA E | 54747  BENECIA TL | YUCCA VALLEY CA | 92284 |
| 15930003 | KNAUSS D R & ALLEN J W ET UX | 2252  SAN BERNARDO AV | HEMET CA | 92545-2418 |
| 15930004 | LIND PHYLLIS K & ALDAHL JOHN V | 851 SW 6TH AV # 810 | PORTLAND OR | 97204 |
| 15930007 | HUBBARD FAMILY TRUST | 273  ROCKY POINT RD | PALOS VERDES CA | 90274 |
| 15931001 | COLLIER AMOS J & LINDA J | 20845  RENFRO RD | BAKERSFIELD CA | 93314-8113 |
| 15932010 | WISE LILLIAN S TR | 1015  CARMEL ST | MORRO BAY CA | 93442-2608 |
| 15932011 | METHODIST CHR-SO CALIF AZ CONF | 9600  MING AV STE 300 | BAKERSFIELD CA | 93311 |
| 15933009 | LOPEZ JOHN | 2004  ZOLDER CT | EL CAJON CA | 92019-4183 |
| 15933010 | PLEBANEK DANIEL J | BOX 194 | SOMERS WI | 53171 |
| 15933011 | STUART DAVID THRIFT & MARY ELIZABETH TRUST | P O BOX 7517 | GOODYEAR AZ | 85338 |
| 15933017 | WILSON LINDA | P O BOX 6 | TUPMAN CA | 93276 |
| 15933018 | MILLS J | 346-D  AVE SEVILLA | LAGUNA HILLS CA | 92653 |
| 15934002 | WILKINS DEBORAH | 3209  NORFOLK ST | POMPANO BCH AL | 33062 |
| 15934006 | BOWELL CLARE ELIZABETH KROGMANN TRUST | 2114  FARM VIEW DR | CORAOPOLIS PA | 15108 |
| 15934007 | SELLICK BRENT L & JANET M | 819  MILLER AV | SO SN FRNCSCO CA | 94080 |
| 15934008 | WILKINS DEBORAH | 3209  NORFOLK ST | POMPANO BCH AL | 33062 |
| 15934009 | COUGHRAN FAMILY TRUST | 3812  FLICKER RD | LAKE ISABELLA CA | 93240-9413 |
| 15934010 | RYDER GARY A | 14507  COKE AV | PARAMOUNT CA | 90723 |
| 15934011 | WISE LILLIAN S TR | 1015  CARMEL ST | MORRO BAY CA | 93442-2608 |
| 15934015 | THONE JAMES C & LAVAUNDIA S | 4807  ISLANDS DR | BAKERSFIELD CA | 93312 |

# Appendix H-4

## Assessor's Parcel Numbers and Owner Information Within 500 Feet of Railroad Alignment/Natural Gas Lines

**(Submitted Separately Under the Rules of Confidentiality)**

# Appendix H-5

## Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Linear

## Appendix H-5.  Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 08632011 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 08632021 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 08632022 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 08633011 | LENTHE SUSIE KAY | 5505 W MOCKINGBIRD LN | DALLAS TX | 75209 |
| 08633012 | CAREY TR | 2  ISABELLA AV | ATHERTON CA | 94025 |
| 08634001 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09901006 | WEST STAR DAIRY | 26953  RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09901007 | WEST STAR DAIRY | 26953  RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09902004 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09902006 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09902008 | WEST STAR DAIRY | 26953  RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09902009 | WEST STAR DAIRY | 26953  RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09903003 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09903011 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09903012 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09903014 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09903016 | BLOEMHOF LAND & FARMING | P O BOX 747 | WASCO CA | 93280 |
| 09904001 | ROLLINS JOHN & VIVIAN LIVING TRUST | 1611  6TH AV | OROVILLE CA | 95965 |
| 09904002 | PACHOTE JIM & VALERIE | 102  LICHEN CT | FREMONT CA | 94538-2422 |
| 09904003 | KNAGGS ALBERT F | 1386 E LAKE DR. | PALM SPRINGS CA | 92262 |
| 09904004 | MILLER WYLIE R & CARRIE J | 798  JORDANNA RD | GRAND JUNCTION CO | 81506 |
| 09904005 | HOLLINGER NELL F TR | 1766  FLORES ST | SEASIDE CA | 93955 |
| 09904006 | BERNARD DIT LAFLECHE & EUGENIE LAFLECHE | 11984  OLD RIVER SCHOOL RD # 3 | DOWNEY CA | 90242 |
| 09904007 | GREER RALPH W | 676  BIANCO CT | DAVIS CA | 95616 |
| 09904008 | MOORE LIVING TRUST | 26515  MAZUR DR | RNCH PLS VRDS CA | 90275-2222 |
| 09904009 | ALONSO ANGEL | 6423 S OAKES | TACOMA WA | 98409 |
| 09904010 | SOLINSKY JANE L | P O BOX 262 | HOMEWOOD CA | 96141 |
| 09904011 | MILLER WYLIE R & CARRIE J | 1715  CHESTER AV | BAKERSFIELD CA | 93301 |
| 09904012 | FOWLER ILA C | 12027  ROCHESTER AV | LOS ANGELES CA | 90025 |
| 09904013 | ANDERSON MARCIA            ET AL | 1063  CLARK ST | SANTA ROSA CA | 95404-5146 |
| 09904014 | SWIDECKI JAMIE & LINDA | 124  MC DONALD WY | BAKERSFIELD CA | 93309 |
| 09904015 | LE MOINE FMLY TR | 135  TIVOLI LN | DANVILLE CA | 94506-4603 |
| 09904018 | ROBINSON FAMILY SURVIVORS TRUST | 9789 N MOHAWK DR | FRESNO CA | 93720 |
| 09904019 | BAKER MILDRED | 1287  VIEW DR | SAN LEANDRO CA | 94577 |
| 09904020 | REED WALTER E & CASEY AGNES | 50 SW 3RD AV # 408 | BOCA RATON FL | 33432 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 09904021 | SMITHEE FAMILY SURVIVORS TRUST | 209 ELECTRA AV | BAKERSFIELD CA | 93308-1321 |
| 09904022 | PFLUEGER LYNNE | 1100 UNION ST # 601 | SAN FRANCISCO CA | 94109-2019 |
| 09904023 | STRONG ELIZABETH HART | 879 OXFORD WY | BENICIA CA | 94510 |
| 09904024 | JAIME AUGUST A | 5221 W 102ND ST # 102L | LOS ANGELS CA | 90045 |
| 09904025 | WALKER CHAD D | 3407 RAINBOW LN | HIGHLAND CA | 92346-2560 |
| 09904026 | MC KEE RICHARD W & SANDRA J | 4081 APPLETON ST | SAN DIEGO CA | 92117-1102 |
| 09905002 | WESLEY LORRAINE | PO BOX 524 | WEST POINT CA | 95255-0524 |
| 09905020 | KELLY GRAHAM M FMLY SURV TR | 422 D AV | CORONADO CA | 92118 |
| 09905021 | KELLY GRAHAM M FMLY SURV TR | 422 D AV | CORONADO CA | 92118 |
| 09906206 | AMERICAN CANCER SOCIETY ET AL | P O BOX 2061 | OAKLAND CA | 94604 |
| 09906207 | HIGHWART JACK E & ROSELEE A | 4110 CARSON | TORRANCE CA | 90503 |
| 09906208 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95814 |
| 09908101 | EL KADDOUM ARISTOTALES F | 1453 VALENCIA AV | PASADENA CA | 91104 |
| 09908102 | HAWK BROOK A | 233 IRONWOOD ST | VACAVILLE CA | 95688-2732 |
| 09908103 | RICHARD JEFF L | 2362 SW 29TH ST | REDMOND OR | 97756-9473 |
| 09908105 | DUFF ROBERT W | P O BOX 10147 | COSTA MESA CA | 92627 |
| 09908106 | DUNCAN DARLENE Y | 2913 SUNVIEW DR | BAKERSFIELD CA | 93306 |
| 09908107 | COHEN NANCY | P O BOX 2036 | MURPHYS CA | 95247 |
| 09908108 | CAMPIS KATHLEEN G | 1149 MEREDITH | SAN JOSE CA | 95125 |
| 09908110 | VALOV WILLIAM | 2339 MONTERA | HACIENDA HTS CA | 91745 |
| 09908111 | BARKER CHARLES E DR | P O BOX 6708 | INCLINE VLG NV | 89450 |
| 09908120 | DIETRICH FREDERICK T & THERESA M FMLY TR | 24 LOS CERROS DR | GREENBRAE CA | 94904 |
| 09908121 | SILVA NORMAN F REV LIV TRUST | 38 MAPLE HILL DR | SAN RAFAEL CA | 94903 |
| 09908123 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95811-7117 |
| 09908124 | ALLER DANIEL JR & ELIZABETH TR | 2029 W VIA LE FONTANE | FRESNO CA | 93711 |
| 09908125 | SCIARONI BRIAN L | 1206 W STUART AV | FRESNO CA | 93711 |
| 09908126 | PHILPOTT SHERYL & NANNINI K E | 3195 LENARD PL | CASTRO VALLEY CA | 94546 |
| 09908127 | FRENCH R R | P O BOX 7983 | TAHO CITY CA | 96145 |
| 09908128 | ARREDONDO LYNNETTE GUTIERREZ | P O BOX 931 | CHINO CA | 91708 |
| 09908129 | JOHNSON E & STANBRO JANE | 4200 OAK SPRINGS CT | ARLINGTON TX | 76016-4555 |
| 09908130 | RATCLIFFE LIVING TRUST B | 938 E SALEM AV | FRESNO CA | 93720 |
| 09908201 | GRAY TESLA | P O BOX 538 | FALLBROOK CA | 92088 |
| 09908202 | COON JOHN W | 200 ALLISON ST | SAN FRANCISCO CA | 94112-4311 |
| 09908225 | SILVA NORMAN F & DOLORES J TRUST | 38 MAPLE HILL DR | SAN RAFAEL CA | 94903-1720 |
| 09921001 | CHICCA TR ET AL | PO BOX 665 | BUTTONWILLOW CA | 93206-0665 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 09921004 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09921005 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09921006 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09921007 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09922002 | BERRYMAN RAY I & ESTHER E | PO BOX 838 | NEWBERG OR | 97132-0838 |
| 09922003 | BUNDESEN CECIL | 64 CENTURY LN | PETALUMA CA | 94952-1218 |
| 09922004 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09922005 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09922006 | BURDICK JOHN K | 13705 FOXHILLS DR | NOVELTY OH | 44072 |
| 09922007 | WEST STAR DAIRY | 26953 RIVERSIDE ST | BUTTONWILLOW CA | 93206 |
| 09922008 | DOYLE KIMBERLY | 42330 SEVILLE CI | QUARTZ HILL CA | 93536 |
| 09922015 | RECTOR DENISE D & LISA DAWN | 15182 VIA MARAVILLA | CHINO HILLS CA | 91709 |
| 09922025 | BIBAYOFF MAXIMILIANO | 12165 CARON WY | MADERA CA | 93636-8520 |
| 09922026 | SPRAGUE PETER ZACHARY TR | 3413 JADE AV | BAKERSFIELD CA | 93306 |
| 09922027 | STATE OF CALIFORNIA | 1715 CHESTER AV | BAKERSFIELD CA | 93301 |
| 10006003 | CHICCA TR ET AL | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10006007 | CHICCA TR ET AL | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10006008 | CHICCA TR ET AL | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10019001 | CAUZZA JOHN B III & LAURA K | 1600 CORN CAMP RD | BUTTONWILLOW CA | 93206 |
| 10019004 | HOUCHIN WALLACE ET AL | PO BOX 98 | BUTTONWILLOW CA | 93206 |
| 10019007 | CHICCA TERRY | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10019008 | HARRELL ALICE | 3613 CANDLEWOOD DR | BAKERSFIELD CA | 93306 |
| 10019009 | HARRELL ALICE | 3613 CANDLEWOOD DR | BAKERSFIELD CA | 93306 |
| 10019010 | HARRELL ALICE | 3613 CANDLEWOOD DR | BAKERSFIELD CA | 93306 |
| 10019014 | HARRELL ALICE | 3613 CANDLEWOOD DR | BAKERSFIELD CA | 93306 |
| 10019017 | HOUCHIN WALLACE H | PO BOX 98 | BUTTONWILLOW CA | 93206 |
| 10020002 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95814 |
| 10020017 | CHICCA TERRY | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10020019 | CHICCA TERRY | P O BOX 665 | BUTTONWILLOW CA | 93206 |
| 10020020 | STATE OF CALIFORNIA | 801 K ST # 806 | SACRAMENTO CA | 95814-3500 |
| 10020021 | STATE OF CALIFORNIA | 801 K ST # 806 | SACRAMENTO CA | 95814-3500 |
| 10020023 | PAUL MICHAEL CHARLES | 25092 MODOC DR | LAGUNA HILLS CA | 92653 |
| 10020025 | KLEIN ANTHONY J & MARIANNE J | 1715 CHESTER AV | BAKERSFIELD CA | 93301-5210 |
| 10020026 | GANIERE JAMES W | P O BOX 60151 | BAKERSFIELD CA | 93306 |
| 10020027 | FITZGERALD MILDRED A REV TRUST | 3120 VILLA ESPANA | SPRING VALLEY CA | 91978-1124 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 10020028 | FISCHER GLEN A | 1223 CENTENNIAL AV | CAMARILLO CA | 93010 |
| 10020029 | SINDH FMLY TR | 4128 W 163RD ST | LAWNDALE CA | 90260 |
| 10201008 | HOUCHIN WALLACE ET AL | PO BOX 98 | BUTTONWILLOW CA | 93206 |
| 10201010 | TOY MARGARET H TRS | 13302 RED PLUM ST | CERRITOS CA | 90703 |
| 10201014 | CENTER FOR NATURAL LANDS MANAGEMENT | 215 WEST ASH ST | FALLBROOK CA | 92028-2904 |
| 10201015 | CENTER FOR NATURAL LANDS MANAGEMENT | 215 WEST ASH ST | FALLBROOK CA | 92028-2904 |
| 10201016 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95814 |
| 10201028 | YARD DOROTHY T | 9 THE TR | SEA GRIT NJ | 08750 |
| 10201029 | YARD DOROTHY T | 1715 CHESTER AV | BAKERSFIELD CA | 93301-5210 |
| 10203002 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95814 |
| 10203006 | LUNING ASSCS L P | 3300 S LAKESHORE RD | CHELAN WA | 98816 |
| 10203007 | MANSTON GREGG | P O BOX 343 | CLAREMONT CA | 91711 |
| 10203008 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95814 |
| 10203009 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10203010 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10203011 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10203012 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10203013 | COHEN NANCY | P O BOX 2036 | MURPHYS CA | 95247 |
| 10203014 | COHEN NANCY | P O BOX 2036 | MURPHYS CA | 95247 |
| 10203015 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10203016 | BIGGS EDWARD ALAN | 1300 W NICKERSON # 107 | SEATTLE WA | 98119 |
| 10204003 | HOUCHIN WALLACE ET AL | PO BOX 98 | BUTTONWILLOW CA | 93206 |
| 10204005 | HOUCHIN L H TR | 4045 STOCKDALE HY | BAKERSFIELD CA | 93309 |
| 10204006 | HOUCHIN WALLACE ET AL | PO BOX 98 | BUTTONWILLOW CA | 93206 |
| 10210001 | GHILARDUCCI FARMS INC | P O BOX 654 | BUTTONWILLOW CA | 93206 |
| 10210002 | GHILARDUCCI FARMS INC | P O BOX 654 | BUTTONWILLOW CA | 93206 |
| 10210007 | WILLOW CREEK RANCH | 5100 CALIFORNIA AV STE 120 | BAKERSFIELD CA | 93309 |
| 10210008 | TAZIOLI ROBERT & SUSAN REVOCABLE TRUST | 7901 CALLE TORCIDO | BAKERSFIELD CA | 93309 |
| 10210009 | PETRISSANS GEORGE & MARIE THERESE FMLY TRU | 15790 TWIN OAKS LN | CHINO HILLS CA | 91709-7853 |
| 10210010 | SOUTH CENTRAL FARMERS HEALTH & EDUCATION I | 1702 E 41ST ST | LOS ANGELES CA | 90058 |
| 10210011 | SOUTH CENTRAL FARMERS HEALTH & EDUCATION I | 1702 E 41ST ST | LOS ANGELES CA | 90058 |
| 10211007 | LA FLAME DELIA | 144 W FOREST AV | PAWTUCKET RI | 02860 |
| 10211008 | LA FLAME DELIA | 3412 SW 27TH AV | CAPE CORRAL FL | 33914 |
| 10211009 | MC ILROY RUFUS B TEST TR | 411 ORTH DR | CENTRAL POINT OR | 97502-7013 |
| 10211010 | MC ILROY RUFUS B TEST TR | 2180 POPLAR DR # 204 | MEDFORD OR | 97504-4602 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 10211011 | KAZERSKI STEVEN HAROLD | P O BOX 121458 | CHULA VISTA CA | 91912-6158 |
| 10211012 | SAZERSKI STEVEN HAROLD EST | P O BOX 121458 | CHULA VISTA CA | 91912 |
| 10211013 | RINGHOLM PHILLIP LLOYD ET AL | 566 SILVERADO DR | LAFAYETTE CA | 94549-5539 |
| 10211014 | RINGHOLM PHILLIP LLOYD ET AL | 7201 WILCOX PL | GRANITE BAY CA | 95746-9316 |
| 10211015 | WALKER FRANCIS J | 2723 HILLSIDE DR | OLYMPIA WA | 98501 |
| 10211016 | BEEMAN WILLIAM O | 301 S 19TH AV RM 395 | MINNEAPOLIS MN | 55455-4407 |
| 10212001 | HATCH ANN MC KEEVER REV TR | P O BOX 898 | REDDING CA | 96099 |
| 10212002 | WILLOW CREEK RANCH | 5100 CALIFORNIA AV STE 120 | BAKERSFIELD CA | 93309 |
| 10212004 | CENTER FOR NATURAL LANDS MANAGEMENT | 215 WEST ASH ST | FALLBROOK CA | 92028-2904 |
| 10212005 | YOSHIMOTO ZEMMAN | 4747 KNOLLCREST CT | ANTIOCH CA | 94509 |
| 10212006 | YOSHIMOTO ZEMMAN | 4747 KNOLLCREST CT | ANTIOCH CA | 94509 |
| 10213001 | PACIFIC GAS & ELECTRIC CO | P O BOX 770000 | SAN FRANCISCO CA | 94177 |
| 10213003 | CLARK RAY W & GLORIA TRS ET AL | 1715 CHESTER AV | BAKERSFIELD CA | 93301-5210 |
| 10213005 | CLARK RAY W & GLORIA TRS ET AL | 1715 CHESTER AV STE 100 | BAKERSFIELD CA | 93301 |
| 10213006 | POLLARD JAMES D & JUDY A | 460 TERRACE DR | TAFT CA | 93268 |
| 10213007 | POLLARD JAMES D & JUDY A | 460 TERRACE DR | TAFT CA | 93268 |
| 10213009 | NJAU JOHN N | 3827 GIRARD AV # 3 | CULVER CITY CA | 90232 |
| 10213010 | LI HUA | P O BOX 2726 | SUNNYVALE CA | 94087-0726 |
| 10213015 | PACIFIC GAS & ELECTRIC CO | P O BOX 770000 | SAN FRANCISCO CA | 94177 |
| 10213016 | PACIFIC GAS & ELECTRIC CO | P O BOX 770000 | SAN FRANCISCO CA | 94177 |
| 10213017 | MABBETT LORRAINE C | 24303 WOOLSEY CANYON # 132 | WEST HILLS CA | 91304 |
| 10213018 | BLANK DOROTHY B ETAL | 106 ROSE LN | BELMONT CA | 94002-3725 |
| 10213019 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95811-7137 |
| 10213020 | FERRIS MARCIA M LIV TR | 1715 CHESTER AV | BAKERSFIELD CA | 93301-5210 |
| 10214002 | YOUNG WM W JR | 100 DIAMOND ST | SAN FRANCISCO CA | 94114 |
| 10214003 | KAZERSKI STEVEN HAROLD | P O BOX 121458 | CHULA VISTA CA | 91912 |
| 10214004 | GRAND LODGE F & A M MICHIGAN | 233 E FULTON | GRAND RAPIDS MI | 49503 |
| 10214016 | WECKERLE ROSE B | 3687 WAMEGO RD | PLACERVILLE CA | 95667 |
| 10214017 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10214018 | PROTOPAPAS FAMILY TRUST | 11913 KETTERING DR | BAKERSFIELD CA | 93312-7089 |
| 10214019 | STUART DAVID THRIFT & MARY ELIZABETH REV TR | 3604 KENNEDY AV | BAKERSFIELD CA | 93309-6171 |
| 10214020 | CONNER ANTOINETTE M | 5847 ROUND UP WY | BAKERSFIELD CA | 93306 |
| 10214022 | WELCH JOHN F | 1102 SANTOLINA DR | NOVATO CA | 94945-1840 |
| 10214023 | WELCH JOHN F | 1102 SANTOLINA DR | NOVATO CA | 94945-1840 |
| 10214024 | SHERRELL BRIAN GENE | 7635 JENICA RD | BAKERSFIELD CA | 93314 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 10214025 | SHERRELL BRIAN GENE | 7635 JENICA RD | BAKERSFIELD CA | 93314 |
| 10220004 | PETRISSANS GEORGE & MARIE THERESE FMLY TRU | 15790 TWIN OAKS LN | CHINO HILLS CA | 91709-7853 |
| 10220005 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10221015 | MICHAELIS ADRIAN FRANCIS | 900 CARLSTON AV | OAKLAND CA | 94610 |
| 10221016 | SHERRELL BRIAN GENE | 7635 JENICA RD | BAKERSFIELD CA | 93314 |
| 10221017 | FAGERBURG MAUD | 15935 SPRING OAKS RD # 124 | EL CAJON CA | 92021 |
| 10221018 | STUBBS FAMILY TR | 11411 TALLADEGA CT | BAKERSFIELD CA | 93312 |
| 10221019 | LUNING ASSCS L P | 3300 S LAKESHORE RD | CHELAN WA | 98816 |
| 10221020 | CHANG CHRISTOPHER | 10024 VALLEY BL # 202 | EL MONTE CA | 91731 |
| 10221021 | GREEN PATRICIA A TRUST & ROBERT F | 2542 W HALLWOOD BL | MARYSVILLE CA | 95901 |
| 10221024 | STUBBS MAX B & ROASLIE | 212 GOODMAN ST | BAKERSFIELD CA | 93305-2904 |
| 10221025 | STUBBS FAMILY TR | 11411 TALLADEGA CT | BAKERSFIELD CA | 93312 |
| 10221026 | DE GABAIN COLET M | 1740 ROSEMARY LN | REDWOOD CITY CA | 94061-2617 |
| 10221027 | GANIERE JAMES W | P O BOX 60151 | BAKERSFIELD CA | 93306 |
| 10221028 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10221029 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10221030 | DAVIS MELVIN G TR | P O BOX 10926 | BAKERSFIELD CA | 93389 |
| 10221031 | DAVIS MELVIN G TR | P O BOX 10926 | BAKERSFIELD CA | 93389 |
| 10221032 | GEORGE FAMILY TRUST | 208 STONEWOOD CT | LAS VEGAS NV | 89107-3250 |
| 10221033 | GEORGE FAMILY TRUST | 208 STONEWOOD CT | LAS VEGAS NV | 89107-3250 |
| 10221034 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10221035 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10221036 | LOONEY ANNIE | 205 MAYWOOD WY | S SAN FRNCSCO CA | 94080 |
| 10221037 | GANIERE JAMES W | P O BOX 60151 | BAKERSFIELD CA | 93306 |
| 10221038 | BLANK DOROTHY B ETAL | 106 ROSE LN | BELMONT CA | 94002-3725 |
| 10221039 | HSU CHANEL | PO BOX 50052 | IRVINE CA | 92619-0052 |
| 10221040 | BERNAL ELIZABETH | P O BX 564 | BOULDER CREEK CA | 95006 |
| 10221041 | BERNAL ELIZABETH | 5018 THURBER LN | SANTA CRUZ CA | 95065 |
| 10221042 | ASSET HOLDING LLC | 8390 E VIA DE VENTURA STE F110 | SCOTTSDALE AZ | 85258-3128 |
| 10221043 | INTEGRITY PROP LLC | 8390 E VIA DE VENTURA STE F110 | SCOTTSDALE AZ | 85258-3128 |
| 10221044 | FRANTZ BARBARA | 148 SHIRLEY DR | MONACA PA | 15061-2442 |
| 10221045 | BLOUNT MICHAEL L | 4017 PENNSBURG CT | LAS VEGAS NV | 89122-3432 |
| 10221046 | FRANCESCHI GARY FAMILY TRUST | P O BOX 404 | BUTTONWILLOW CA | 93206 |
| 10221047 | FRANCESCHI GARY FAMILY TRUST | P O BOX 404 | BUTTONWILLOW CA | 93206 |
| 10221048 | FRANCESCHI GARY FAMILY TRUST | P O BOX 404 | BUTTONWILLOW CA | 93206 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 10221049 | FRANCESCHI GARY FAMILY TRUST | P O BOX 404 | BUTTONWILLOW CA | 93206 |
| 10221050 | BERNAL ELIZABETH | P O BX 564 | BOULDER CREEK CA | 95006 |
| 10221051 | BERNAL ELIZABETH | 5018 THURBER LN | SANTA CRUZ CA | 95065 |
| 10222001 | PETRISSANS GEORGE & MARIE THERESE FMLY TRU | 15790 TWIN OAKS LN | CHINO HILLS CA | 91709-7853 |
| 10222004 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222005 | RICCOMINI RICKY E & MELINDA | 11501 BUFFINGTON ST | BAKERSFIELD CA | 93312 |
| 10222007 | CHEVRON USA INC | P O BOX 1392 | BAKERSFIELD CA | 93302-1392 |
| 10222014 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222021 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222022 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222023 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222024 | FRANCESCHI MICHAEL | 8414 AILANTHUS CT | BAKERSFIELD CA | 93311 |
| 10222025 | ORNELAS JUANITA | P O BX 208 | BUTTONWILLOW CA | 93206 |
| 10222026 | ORNELAS JUANITA | P O BX 208 | BUTTONWILLOW CA | 93206 |
| 10223005 | RICCOMINI RICKY E & MELINDA | 11501 BUFFINGTON ST | BAKERSFIELD CA | 93312 |
| 10224002 | GUIDE DOGS FOR THE BLIND INC | P O BX 1200 | SAN RAFAEL CA | 94902 |
| 10224003 | MICHAELIS ADRIAN FRANCIS ET AL | 900 CARLSTON AV | OAKLAND CA | 94610-1735 |
| 10224004 | COLEMAN GEORGE | 2101 MERIDIAN #1 | APACHE JUNCTION AZ | 85220 |
| 10224005 | COTTER HARLEY VIRGIL & WONEVA JEAN | P O BOX 52 | ALPAUGH CA | 93201 |
| 10224006 | SANDHU SAM & SUMANJIT | 1998 BOX CAR DR | MONTECA CA | 95337 |
| 10224015 | MC ILROY RUFUS B TEST TR | 2180 POPLAR DR # 204 | MEDFORD OR | 97504-4602 |
| 10224016 | MC ILROY RUFUS B TEST TR | 411 ORTH DR | CENTRAL POINT OR | 97502-7013 |
| 10224017 | COLEMAN GEORGE | 2101 MERIDIAN #1 | APACHE JUNCTION AZ | 85220 |
| 10224018 | COLEMAN GEORGE | 2101 MERIDIAN #1 | APACHE JUNCTION AZ | 85220 |
| 10224019 | BROSE RAETHA A | 5395 NEW FARM WY | FLARENCE MT | 59833 |
| 10224020 | BROSE RAETHA A | 5395 NEW FARM WY | FLARENCE MT | 59833 |
| 10224021 | SWIDECKI JAMIE & LINDA | 124 MC DONALD WY | BAKERSFIELD CA | 93309 |
| 10224022 | BERRYMAN E E & BROSE R A | 610 MICHIGAN ST | EAST MISSOULA MT | 59801 |
| 10224023 | STONYBROOK CORP | P O BOX 62 | KEENE CA | 93531 |
| 10224024 | STONYBROOK CORP | P O BOX 62 | KEENE CA | 93531 |
| 10224025 | NEY HARRY & BETTY | P O BOX 51254 | SPARKS NV | 89435-1254 |
| 10224026 | NEY HARRY & BETTY | 1318 MCFARLANE LN | HAYWARD CA | 94544 |
| 10224027 | ZEDEK FRANK | 4543 AVONDALE CI | FAIRFIELD CA | 94533 |
| 10224028 | ZEDEK FRANK | 41 UNIONSTONE DR | SAN RAFAEL CA | 94903 |
| 10224029 | WILSON TANYA | 7320 MARGE CT APT B | ANCHORAGE AK | 99504 |

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| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 10224030 | WILSON TANYA | 7320 MARGE CT APT B | ANCHORAGE AK | 99504 |
| 15802001 | AUDELL DONNA M | 258 RIVERVIEW DR | BUELLTON CA | 93427 |
| 15802002 | RICCOMINI RICKY E & MELINDA | 11501 BUFFINGTON ST | BAKERSFIELD CA | 93312 |
| 15802003 | ZARGARYAN SEVAK | 2000 CHILTON DR | GLENDALE CA | 91201 |
| 15802011 | INDIGO MINERALS LLC | 600 TRAVIS ST # 4900 | HOUSTON TX | 77002-3009 |
| 15802012 | LUTTRELL TRENT & CHRISTOPHER ET AL | 3535 STINE RD SP 129 | BAKERSFIELD CA | 93309-6352 |
| 15802013 | SHEPHERD NORMAN C FAMILY TRUST | P O BOX 9 | BUTTONWILLOW CA | 93206-0009 |
| 15802014 | SHEPHERD NORMAN C FAMILY TRUST | P O BOX 9 | BUTTONWILLOW CA | 93206-0009 |
| 15802018 | SHEPHERD NORMAN C FAMILY TRUST | P O BOX 9 | BUTTONWILLOW CA | 93206 |
| 15802025 | SHEPHERD NORMAN C FAMILY TRUST | P O BOX 9 | BUTTONWILLOW CA | 93206 |
| 15803009 | TEXAS TEA LTD | 1626 W 3RD ST | PECOS TX | 79772-2628 |
| 15803011 | TAZIOLI JAMES REV TRUST | P O BOX 882 | BUTTONWILLOW CA | 93206-0882 |
| 15904016 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15908008 | DOUGLAS RANCHES LLC | P O BOX 98 | BUTTONWILLOW CA | 93206 |
| 15908011 | DOUGLAS RANCHES LLC | P O BOX 98 | BUTTONWILLOW CA | 93206 |
| 15908012 | JOHNSON SUSAN A | P O BOX 453 | BUTTONWILLOW CA | 93206 |
| 15909004 | ROMANINI JOHN | 8909 VERSAILLES | BAKERSFIELD CA | 93311 |
| 15909005 | DOUGLAS RANCHES LLC | P O BOX 98 | BUTTONWILLOW CA | 93206 |
| 15909010 | MARTINEZ ALBINO & TERESA | 5302 WASCO WY | BUTTONWILLOW CA | 93206 |
| 15909011 | DOUGLAS RANCHES LLC | P O BOX 98 | BUTTONWILLOW CA | 93206 |
| 15909012 | JOHNSON SUSAN A | P O BOX 453 | BUTTONWILLOW CA | 93206 |
| 15909017 | TAZIOLI JAMES TR | P O BOX 882 | BUTTONWILLOW CA | 93206-0882 |
| 15909018 | TAZIOLI JAMES | 396 THIRD ST | BUTTONWILLOW CA | 93206 |
| 15909019 | TAZIOLI JAMES TR | P O BOX 882 | BUTTONWILLOW CA | 93206-0882 |
| 15909020 | TAZIOLI JAMES | 12101 STONINGTON ST | BAKERSFIELD CA | 93312-5795 |
| 15909026 | LETT LILLIAN LEIBROCK TRUST | 413 STARMOUNT LN | BAKERSFIELD CA | 93309 |
| 15909027 | SHEPHERD NORMAN C FAMILY TRUST | P O BOX 9 | BUTTONWILLOW CA | 93206 |
| 15910001 | KOSAREFF JOE | 4714 DUNFORD RD | BUTTONWILLOW CA | 93206 |
| 15910002 | BIRCHIM FAMILY TRUST | 5115 ASTERIA ST | TORRANCE CA | 90503-2713 |
| 15910003 | MILLER DAISY L | 986 MEADOWCREST ST | NEWBURY PARK CA | 91320-5575 |
| 15910004 | ALMA INVESTMENT CO | 325 S CHESTER AV | BAKERSFIELD CA | 93304 |
| 15910005 | MILLER LIVING TRUST | 986 MEADOWCREST ST | NEWBURY PARK CA | 91320-5575 |
| 15910006 | PHAN XUAN HOANG | 7641 NANCY LN | STANTON CA | 90680 |
| 15910007 | HANNUM HELENA | 609 G ST | BAKERSFIELD CA | 93304 |
| 15910008 | MILLS J | 346-D AVE SEVILLA | LAGUNA HILLS CA | 92653 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 15911020 | STEWART LULA MAE | 2804 PECANGROVE DR | BAKERSFIELD CA | 93311-2313 |
| 15912003 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15912008 | HECK WENDELL & BESSIE | 5865 ADOHR RD | BUTTONWILLOW CA | 93206-9716 |
| 15912009 | ROMANINI FAMILY L P | 8909 VERSAILLES DR | BAKERSFIELD CA | 93311-1531 |
| 15912010 | DOUGLAS RANCHES LLC | 5100 CALIFORNIA AV # 120 | BAKERSFIELD CA | 93309 |
| 15912011 | DOUGLAS RANCHES LLC | 5100 CALIFORNIA AV # 120 | BAKERSFIELD CA | 93309 |
| 15913003 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15913006 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15913007 | ROBERTSON WILLIAM C & ROBERTA L REV TRUST | 351 E ROBERTS LN | BAKERSFIELD CA | 93308 |
| 15913011 | DICK DYKSTRA DAIRIES | 10129 SCHAEFER | ONTARIO CA | 91761 |
| 15914001 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15914002 | DRAKE CHARLEEN L | 8455 RANCHO REAL | GILRAY CA | 95020 |
| 15914003 | GROVES RYAN D | 10005 CPOA CABANA CT | BAKERSFIELD CA | 93312 |
| 15914004 | HONG SHIRLEY TRS | 427 COTTAGE HOME ST # 2 | LOS ANGELES CA | 90012-1438 |
| 15914005 | HERSCHENSOHN JULIE ANN | 1918 N 1ST AV | SEATTLE WA | 98109-2501 |
| 15914006 | MILLS J | 346-D AVE SEVILLA | LAGUNA HILLS CA | 92653 |
| 15915001 | STATE OF CALIFORNIA | 1807 13TH ST # 103 | SACRAMENTO CA | 95814-7117 |
| 15915002 | HARTLEY FRANCES ET AL | 679 GRAND AV | LONG BEACH CA | 90814 |
| 15915003 | BERRY PETROLEUM COMPANY | 1999 BROADWAY # 3700 | DENVER CO | 80202 |
| 15915004 | PLEBANEK DANIEL J | 1505 VALLEYVIEW DR | RACINE WI | 53144-7748 |
| 15915005 | MALINA CAROLINA INGRID | 8 MENDOSA AV | SAN FRANCISCO CA | 94116 |
| 15915007 | FANNING FAMILY TR | 601 BRIARWOOD DR | BREA CA | 92821 |
| 15915008 | GRIMAL ALEXANDER L | 1002 WIBLE RD # H | BAKERSFIELD CA | 93304-4137 |
| 15915009 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15916001 | FANNING FAMILY TR | 1018 EADINGTON DR | BREA CA | 92621 |
| 15916002 | GAUNA JOSE L & SUSANA A | 22126 CUBA LIBRE | CROSBY TX | 77532 |
| 15916003 | BOWELL CLARE ELIZABETH KROGMANN TRUST | 2114 FARM VIEW DR | CORAOPOLIS PA | 15108 |
| 15916004 | MANSTON ROSS | P O BOX 343 | CLAREMONT CA | 91711 |
| 15916005 | OLIVER JOSEPHINE | 16081 E KINGS CYN RD | SANGER CA | 93657 |
| 15916006 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15916007 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15916008 | ALMA INVESTMENT CO | 325 S CHESTER AV | BAKERSFIELD CA | 93304 |
| 15916009 | LIN YU-ZONG & BE JU | 18133 2ND ST | FOUNTAIN VLY CA | 92708 |
| 15917010 | STATE OF CALIFORNIA | 1807 13TH ST STE 103 | SACRAMENTO CA | 95811-7137 |
| 15919006 | BUENA VISTA WATER STORAGE DISTRICT | P O BOX 756 | BUTTONWILLOW CA | 93206 |

## Appendix H-5. Assessor's Parcel Numbers and Owner Information Within 500 Feet of Process Water Line

| Assessor's Parcel Number | Owner Name | Address | City, State | Zip Code |
|---|---|---|---|---|
| 15919009 | HYDROGEN ENERGY INTERNAT LLC | 700 LOUISIANA ST FLR 32 | HOUSTON TX | 77002 |
| 15930001 | LANGER JAN H | 10900 RUNNING BUCK LN | AUSTIN TX | 78750 |
| 15930002 | MC CALLUM RETA E | 54747 BENECIA TL | YUCCA VALLEY CA | 92284 |
| 15930003 | KNAUSS D R & ALLEN J W ET UX | 2252 SAN BERNARDO AV | HEMET CA | 92545-2418 |
| 15930004 | LIND PHYLLIS K & ALDAHL JOHN V | 851 SW 6TH AV # 810 | PORTLAND OR | 97204 |
| 15930005 | HERSCHENSOHN JULIE ANN | 1918 NO 1ST AV | SEATTLE WA | 98109 |
| 15930006 | PLEBANEK DANIEL J | 9401 18TH ST | KENOSHA WI | 53144-7748 |
| 15930007 | HUBBARD FAMILY TRUST | 273 ROCKY POINT RD | PALOS VERDES CA | 90274 |

# Appendix H-6

## Williamson Act Agreements for the Project Site

Williamson Act Contracts for Project Site, including:

1. Land Use Contract dated December 3, 1970 recorded on February 26, 1971 in Book 4495, Page 523 of Official Records of Kern County as amended by the following:

   a. Agreement dated May 13, 1971 and recorded May 14, 1971, Book 4525, Page 841 of Official Records

   b. Agreement dated June 28, 1997, recorded August 11, 1997, Instrument No. 0197104355 of Official Records

   c. Certificate of Cancellation recorded August 11, 1997, Instrument No. 0197104356 of Official Records

2. Land Use Contract recorded on February 28, 1969 in Book 4250 , page 496 of Official Records of Kern County

FEB-26-71 13062 •3277 D 18 FRK 9 10.00

RECORDED AT REQUEST OF: ... 93301

Recorded By RAY A. VERCAMMEN, Kern Co. Recorder

LAND USE CONTRACT

(California Land Conservation Act of 1965, and Open-Space Land Valuation Law of 1967.)

THIS CONTRACT, entered into this 3rd day of December 19 70 by and between the COUNTY OF KERN, a political subdivision of the State of California, herein referred to as "COUNTY," and

PALM FARMS, INC., a California corporation

hereinafter referred to as "OWNER,"

W I T N E S S E T H :

(a) WHEREAS, Owner is the owner of certain real property situate in the County of Kern, State of California, which is devoted to agricultural use and is located within an area which has been designated by the County as an agricultural preserve, and a description of said land, together with a reference to the map showing the location of said agricultural preserve, is set forth in Exhibit "A" attached hereto and incorporated herein by reference; and

(b) WHEREAS, both Owner and County desire to limit the use of such land for the purposes of preserving it pursuant and subject to the conditions set forth in this Contract and in the California Land Conservation Act of 1965, as amended, in order to preserve a maximum amount of the limited supply of agricultural land and to thereby conserve the State's economic resources, to maintain the agricultural economy of the State, and to assure an adequate, healthful and nutritious food for future residents of this State and nation; and

(c) WHEREAS, the Owner desires to have the benefits of Article XXVIII of the California Constitution and of Sections 421 through 429, inclusive, of the Revenue and Taxation Code and other provisions of law relating to the valuation and assessment of open-space land subject to enforceable restrictions, as are now or may be from time to time in effect;

NOW, THEREFORE, the parties hereto, in consideration of the mutual covenants and conditions set forth herein and the substantial public benefits to be derived therefrom, do hereby agree as follows:

1. TERM OF CONTRACT; AUTOMATIC EXTENSION; NOTICE OF INTENT NOT TO RENEW:

(a) This Contract shall be effective as of the 28th day of February next succeeding the date of this Contract, to wit, the date which is first mentioned herein, and shall remain in effect for an initial term of ten (10) years from and including such date and during renewals of this Contract.

(b) Each 28th day of February of each year during which this Contract shall be in effect shall be deemed to be the annual renewal date of this Contract, as mentioned in Sections 51244 and 51245 of the Act. On said annual renewal date a year shall be added automatically to the initial term aforementioned, and the term of this Contract shall be thereby renewed and extended, unless notice of nonrenewal has been given as provided in Section 51245 of the Act.

(c) If the County or Owner gives notice of intent in any year not to renew this Contract, the Contract shall remain in effect for the balance of the term or extended term remaining since the original execution or the last renewal of the Contract, as the case may be.

2. CONTRACT MADE PURSUANT TO LAND CONSERVATION ACT:

This Contract is made and entered into pursuant to the California Land Conservation Act of 1965 (Chapter 7 of Part 1 of Division 1 of Title 5 of the California Government Code commencing with Section 51200) sometimes referred to herein as the "Land Conservation Act" or "Act," and is subject to all of the provisions thereof.

3. ENFORCEABLE RESTRICTION:

(a) It is mutually agreed that this Contract is and shall be an enforceable restriction within the meaning and for the purposes of Article XXVIII of the Constitution of the State of California, said Land Conservation Act, and said Sections 421 through 429, inclusive, of the Revenue and Taxation Code as are now or may be from time to time in effect; and it is contemplated that this Contract shall be enforced and administered by the County in such a manner as to accomplish the purposes of said Article of the California Constitution and the aforementioned statutes.

(b) It is mutually understood that the County may bring any action in court necessary to enforce this Contract, including, but not limited to, an action to enforce this Contract by specific performance or injunction.

4. CONTRACT MADE IN CONFORMITY WITH UNIFORM RULES ADOPTED BY COUNTY:

(a) This Contract is also made and entered into pursuant to the provisions of the Uniform Rules adopted by the Board of Supervisors of the County governing the administration of agricultural preserves, including but not confined to the land use restrictions and enumeration and definition of compatible uses therein contained.

(b) It is expressly understood and agreed that during the term of this Contract or any renewals thereof the Board of Supervisors of the County may add to those agricultural and compatible uses specified in the Resolution or Resolutions prescribing Uniform Rules governing the administration of the agricultural preserve within which the land described in this Contract is located or may otherwise modify said Uniform Rules, provided, however, that the subsequent elimination or reduction in scope of a compatible use which is so enumerated or defined, or the subsequent imposition of any land use restriction which is not set forth, in said Uniform Rules as of the date of this Contract, shall not be deemed to effect the land described in this Contract unless and except with the written consent of the Owner.

(c) The Uniform Rules which are applicable to the agricultural preserve in which the land herein described is situated are incorporated herein by reference, including those Uniform Rules as are in effect at the date of this Contract and, subject to the limitations aforementioned in this Article, those amendments or additions thereto which may be subsequently adopted from time to time.

5. EXCLUSION OF USES OTHER THAN AGRICULTURAL AND COMPATIBLE USES:

(a) During the term of this Contract or any renewals thereof the herein described land shall not be used for any purpose other than agricultural uses and those uses compatible with agricultural uses.

(b) As used in this Contract, the following terms shall have these respective meanings:

(1) "Agricultural uses" shall mean the use of land for the purpose of producing an agricultural commodity for commercial purposes.

(2) "Agricultural commodity" shall mean any and all plant and animal products produced in this state for commercial purposes.

(3) "Compatible uses" shall mean those uses enumerated in the Uniform Rules, or as determined by the Land Conservation Act.

(4) "Uniform Rules" shall mean the Uniform Rules adopted by the Board of Supervisors of the County governing the administration of agricultural preserves, as more fully described in Article 3 hereinabove.

6. LIMITATION ON STRUCTURES:

During the term of this Contract or any renewals thereof no structure shall be erected upon said land except such structures as may be directly related to agricultural uses and those uses compatible with agricultural uses.

7. EFFECT ON PLANNING AND ZONING POWERS:

It is mutually understood and agreed that neither the provisions of this Contract nor of any Uniform Rule adopted by the Board of Supervisors of the County shall in any manner effect, limit or supersede the planning and zoning powers of the County.

8. CONTRACT RUNS WITH LAND; EFFECT OF DIVISION OF LAND:

(a) All provisions of this Contract shall run with the land described herein.

(b) This Contract shall be binding upon, and inure to the benefit of, all successors in interest of the owner.

(c) Whenever land under this Contract is divided, the Owner of any parcel of such divided land may exercise, independent of any other Owner of any other portion of such divided land, any of the rights of the Owner in the original Contract, including the right to give notice of nonrenewal and to petition for cancellation. The effect of any such action by the Owner of a parcel created by such division of land under this Contract shall not be imputed to the Owners of the remaining parcels and shall have no effect on the Contract as it applies to the remaining parcels of the divided land.

9. ANNEXATION TO CITY:

In event of annexation by a city of any land under this Contract, such city shall succeed to all rights, duties and powers of the County under this Contract, except as otherwise provided in the Land Conservation Act.

10. OWNER TO FURNISH INFORMATION:

(a) Owner agrees to furnish the County with such information as the County shall require in order to enable it to determine the continuing eligibility of the land herein described with respect to the terms of the Act, the provisions of this Contract, and under the Uniform Rules relating to the preserve in which said land is situated, from time to time when requested by the County.

(b) Owner agrees that a copy of this Contract may be recorded by the County, and agrees to properly acknowledge all signatures required of Owner herein for such purpose.

11. WAIVER OF PAYMENTS:

Owner hereby waives any obligation of County to make any payments to Owner under this Contract and Owner shall not receive any payment from County in consideration of the obligations imposed hereunder, it being recognized and agreed that the consideration for the execution of the within Contract is the substantial public benefit to be derived therefrom and the advantage which will accrue to Owner as a result of the effect on the method of determining the assessed value of land described herein and any reduction therein due to the imposition of the limitations on its use contained in this Contract.

12. CANCELLATION:

This Contract may only be cancelled in accordance with the provisions of Sections 51280-51285 of the Act.

13. EFFECT OF REMOVAL OF LAND FROM AGRICULTURAL PRESERVE:

It is agreed that removal of any land under this Contract from an agricultural preserve shall be equivalent of notice of non-renewal by the County, for the purposes of Section 426 of the Revenue and Taxation Code, as now in effect or as it may from time to time be amended, and applicable provisions of the Land Conservation Act,

14. EFFECT OF EMINENT DOMAIN OR OTHER ACQUISITION OF LAND:

(a) When any action in eminent domain for the condemnation of the fee title of the entire parcel of land herein described is filed, or when such land is acquired in lieu of eminent domain for a public improvement by a public agency or person or whenever there is any such action or acquisition by the federal government or any person, instrumentality or agency acting under authority or power of the federal government, this Contract shall be deemed null and void as to the land actually being condemned or so acquired as of the date the action is filed, and upon the termination of such a proceeding, this Contract shall be null and void for all land actually taken or acquired.

(b) When such an action to condemn or acquire less than all the entire parcel land herein described is commenced, this Contract shall be deemed null and void as to the land actually so condemned or acquired.

(c) The land actually taken by the means aforementioned in this Article shall be removed from this Contract. Under no circumstances shall land be removed from this Contract that is not actually taken by the means aforementioned, except as otherwise provided in the Land Conservation Act, as now in effect or as it may from time to time be amended.

15. INCORPORATION OF PROVISIONS OF ACT BY REFERENCE; SUBSEQUENT AMENDMENTS:

(a) The provisions of the Land Conservation Act, including any amendments enacted on or before the date of this Contract, are incorporated herein and made a part of this Contract by reference, and all of the provisions of this Contract shall be subordinate thereto and construed harmoniously therewith.

(b) Any provision contained in any amendments to the Land Conservation Act enacted from time to time subsequent to the date of this Contract and which is procedural or remedial in effect shall also be deemed incorporated herein and made a part of this Contract by reference.

(c) Any provision contained in any amendments to the Land Conservation Act enacted from time to time subsequent to the date of this Contract which has the effect of altering a substantive right or obligation of the Contract shall not be deemed incorporated herein, unless with the mutual consent of the parties hereto or unless otherwise provided in this Contract. Such substantive right or obligation shall include, but is not limited to, the following: increasing or decreasing the term of the Contract; eliminating or altering the right to or grounds for nonrenewal or cancellation of the Contract; or eliminating, adding, or modifying any land use restriction or compatible use of land.

(d) Any provision of any amendments to the Land Conservation Act enacted from time to time subsequent to the date of this Contract which is incorporated by reference herein as provided in this Article shall be substituted in place of any corresponding provision of this Contract and all other provisions of this Contract shall be construed harmoniously therewith.

(e) In event any sections of the Land Conservation Act referred to herein are renumbered, any references to sections herein shall be deemed renumbered accordingly.

16. AMENDMENT BY MUTUAL AGREEMENT:

This Contract may be amended at any time and from time to time by mutual agreement in writing of the parties hereto endorsed hereon or attached hereto, subject to any express provisions to the contrary contained in this Contract or in the Land Conservation Act.

17. NOTICES, MANNER OF GIVING:

(a) Notices to be given to Owner pursuant to this Contract, or as may otherwise be required by law in connection with the administration of this Contract, may be sent by first-class United States Mail addressed to Owner at the address shown below Owner's signature hereinbelow, and the Owner expressly waives any other method of giving notice to him.

(b) Notices to be given to County pursuant to this Contract may be sent by first-class United States Mail addressed to Board of Supervisors, County of Kern, Kern County Courts and Administration Building, 1415 Truxtun Avenue, Bakersfield, California.

(c) Such notices may also be given by one party to the other by personal service.

(d) By the means mentioned in this Article a party may give to the other notice of a new address, after which notices to be given to such party shall be sent by the means indicated in this Article to such party at such new address.

IN WITNESS WHEREOF, the parties hereto have executed the within Contract the day and year first above written.

COUNTY OF KERN

By [signature]
VICE Chairman, Board of Supervisors

ATTEST:

Vera K. Gibson, County Clerk and ex-Officio Clerk of the Board of Supervisors

By [signature]
Deputy

OWNER PALM FARMS, INC., a California Corp.

By [signature]
Fred J. Banducci, President

[signature]
Jim Banducci, Secretary

Address:

4016 Stockdale Highway

Bakersfield, California 93309

ACKNOWLEDGMENTS

County of Kern

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this [illegible] day of [illegible], in the year 19[illegible], before me, [illegible], Deputy Clerk, Board of Supervisors of the County of Kern, personally appeared [illegible], known to me to be the Vice Chairman of the Board of Supervisors of the County of Kern, and known to me to be the person who executed the within instrument on behalf of said County, and acknowledged to me that such County executed the same.

WITNESS my hand and Official Seal of the Kern County Board of Supervisors.

VERA K. GIBSON
Clerk, Board of Supervisors

By [illegible]
Deputy Clerk

Owner(s)

STATE OF CALIFORNIA,
County of Kern } ss.

ON December 3, 1970, before me, the undersigned, a Notary Public in and for said County and State, personally appeared Fred J. Banducci & Jim Banducci known to me to be the President & Secretary of the Palm Farms, Inc. the Corporation that executed the within Instrument, known to me to be the person who executed the within Instrument, on behalf of the Corporation, therein named, and acknowledged to me that such Corporation executed the same.

OFFICIAL SEAL
VIOLA GROSSMAN
NOTARY PUBLIC CALIFORNIA
KERN COUNTY

WITNESS my hand and official seal.

Viola Grossman
Notary Public in and for said County and State.
Exp. 3/2/71

ACKNOWLEDGMENT—CORPORATION—WOLCOTTS FORM 222—REV. 5-57 70090

EXHIBIT "A"

DESCRIPTION OF LAND SUBJECT TO CONTRACT, AND IDENTIFICATION OF PRESERVE

The land herein described is situated in Preserve No. 389 the location of which is shown by map adopted by the Board of Supervisors of Kern County by Resolution No. 68-92 ~~68-120~~ on 1-30-68. and by Resolution No. 71-121 71-122 on 2-23-71

The real property which is subject to the foregoing Contract is in the County of Kern, State of California, is approximately ~~2167~~ 1841 acres, bears Assessor's Parcel Number(s) 159-130-01, and is more particularly described as follows:

ALL LYING WLY OF C/L EASTSIDE CANAL EXC RD EXCL OF 50% INT M.R. 511A
SEC 09 T 30 R 24

Parcel Number: 159-040-01
ALL EXC E1/2 OF SE1/4 SUBJ TO CANAL EASEMENT & EXC RD EXCL OF 50% INT M.R. 554A SEC 10 T 30 R 24

[redacted]

Parcel Number: 159-190-01
ALL LYING NLY OF C/L OUTLET CANAL EXC RD EXCL OF 50% INT M.R. 326A
SEC 15 T 30 R 24

Parcel Number: 159-030-06
S1/2 SUBJ TO CANAL EASEMENT EXC RD EXCL OF 50% INT M.R. 314A
SEC 03 T 30 R 24

Parcel Number: 159-050-01
NW1/4 LYING WLY OF C/L EASTSIDE CANAL EXC CANAL R/W 4.27A & EXC RD EXCL OF 50% INT M.R. 83A SEC 11 T 30 R 24

Parcel Number: 159-020-06
SW1/4 LYING WLY OF C/L EASTSIDE CANAL EXCL OF 50% INT M.R. 65A
SEC 02 T 30 R 24

RECORDERS MEMO. POOR RECORDED REPRODUCTION DUE TO QUALITY OF PRINT OR TYPE ON ORIGINAL DOCUMENT.



END OF DOCUMENT

RECORDED AT REQUEST OF:
AND RETURN TO:
CLERK OF THE BOARD
CIVIC CENTER - ROOM 600
BAKERSFIELD, CALIF. - 93301

BOOK 4525 PAGE 841

# AMENDMENT TO LAND USE CONTRACT

THIS AMENDMENT, made and entered into this 13th day of May, 1971, by and between the COUNTY OF KERN, a political subdivision of the State of California, hereinafter referred to as "COUNTY", and

Palm Farms, Inc., a California Corporation

hereinafter referred to as "OWNER".

3.60

WHEREAS, the parties hereto entered into Land Use Contract pursuant to the California Land Conservation Act of 1965 and the Open-Space Land Valuation Law of 1967, dated Feb. 26, 1971 and recorded in Book 4495, Page 523 O. R. of Kern County; and

WHEREAS, the Owner wished to have included in said Contract, and there was described in the Contract form originally submitted to the County on or before December 4, 1970, the parcel or parcels of land hereinafter described, but reference thereto was deleted from said Contract, as approved by the Board of Supervisors, solely for the reason the same was not then within an agricultural preserve;

WHEREAS, said parcel has since been and now is included within an agricultural preserve of the County of Kern, and meets the requirements of Chapter 13 of Statutes of 1971, extending the time for signing, accepting and recording Land Use Contracts.

NOW, THEREFORE, IT IS MUTUALLY AGREED between the County and the Owner that the aforementioned Contract is hereby amended by including therein, and making subject to all of the terms and provisions thereof, the parcel of land described in Exhibit "A" which is attached hereto and incorporated herein by reference; and said Contract is hereby ratified and reaffirmed and made a part of this instrument by reference.

IN WITNESS WHEREOF, the Parties have executed this Amendment to Land Use Contract, this 13th day of May, 1971.

COUNTY OF KERN

By [signature]
Chairman, Board of Supervisors

PALM FARMS, INC.,

[signature]
Fred J. Banducci, President

[signature]
Jim Banducci, Secretary
Owner(s)

ATTEST:
Vera K. Gibson, County Clerk
and ex-officio Clerk of the
Board of Supervisors

By [signature]
Deputy Clerk

MAY-14-71 33710 •3153 • D 18 FBK 9 3.60

W-13

Recorded By RAY A. VERCAMMEN, Kern Co. Recorder

ACKNOWLEDGMENTS

County of Kern

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this ______ day of MAY 14 1971 ____________, in the year 19___, before me, ____________, Deputy Clerk, Board of Supervisors of the County of Kern, personally appeared ____________ LEROY M. JACKSON ______, known to me to be the Chairman of the Board of Supervisors of the County of Kern, and known to me to be the person who executed the within instrument on behalf of said County, and acknowledged to me that such County executed the same.

WITNESS my hand and Official Seal of the Kern County Board of Supervisors.

VERA K. GIBSON
Clerk, Board of Supervisors

By ____________
Deputy Clerk

Owner(s)

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this ______ day of ____________, in the year 19___, before me, the undersigned, a Notary Public in and for the State of California, with principal office in the County of Kern, duly com-

State of California )
)ss.
County of Kern )

On May 13, 1971 before me, the undersigned, a Notary Public in and for said State, personally appeared FRED J. BANDUCCI, known to me to be the President, and JIM BANDUCCI, known to me to be the Secretary of the corporation, PALM FARMS, INC., that executed the within Instrument, known to me to be the persons who executed the within Instrument on behalf of the corporation therein named, and acknowledged to me that such corporation executed the within instrument pursuant to its by-laws or a resolution of its board of directors.

WITNESS my hand and official seal.

Marie B. Hughes
My commission expires May 31, 1972.

OFFICIAL SEAL
MARIE B. HUGHES
NOTARY PUBLIC - CALIFORNIA
KERN COUNTY
My Commission Expires May 31, 1972
430 Golden Drive, Bakersfield, Calif. 93306

EXHIBIT "A"

DESCRIPTION OF LAND SUBJECT TO AMENDMENT TO LAND USE CONTRACT, AND IDENTIFICATION OF PRESERVE

The land herein described is situated in Preserve No. 3 referred to in Resolution No. 71-338 adopted by the Board of Supervisors of Kern County on May 11, 1971.

The real property which is subject to the foregoing Amendment to Land Use Contract is in the County of Kern, State of California, is approximately 326 acres, bears Assessor's Parcel Number(s) and is more particularly described as follows:

AP No. 159-190-01

All lying Nly of C/L outlet canal Exc. Rd. Excl. of 50' Tib. R.R.
326 Acres    Sec. 15, 30, R24

5/1006

PLEASE COMPLETE THIS INFORMATION

RECORDING REQUESTED BY:

County of Kern
Clerk of the Board

WHEN RECORDED MAIL TO:

**CLERK, BOARD OF SUPERVISORS**
KERN COUNTY ADMINISTRATIVE CENTER
1115 TRUXTUN AVENUE, 5TH FLOOR
BAKERSFIELD, CALIFORNIA 93301

James Maples, Assessor-Recorder
Kern County Official Records
DOCUMENT #:0197104355

PATTI
Pages: 8
8/11/1997
14:00:00

Fees . . 28.00
Taxes...
Other..
TOTAL PAID.. 28.00

Stat Types: 1

THIS SPACE FOR RECORDER'S USE ONLY

# CONTRACT AMENDING LAND USE CONTRACT

**THIS CONTRACT** is entered into this 28th day of July, 1997, by and between the COUNTY OF KERN, a political subdivision of the State of California, hereinafter referred to as "County," and PALM FARMS, INC. hereinafter referred to as "Owner."

**WITNESSETH:**

(a) **WHEREAS,** Owner holds title to those certain adjacent parcels of land, hereinafter referred to as Parcel A and Parcel B, situated in the County of Kern, State of California, more particularly described as follows:

SEE EXHIBIT "A"

(b) **WHEREAS,** said parcels are subject to a certain Land Use Contract, made pursuant to the California Land Conservation Act of 1965 and the Open Space Valuation Law of 1967, dated the 26 day of FEBRUARY, 1971, between the County and PALM FARMS, INC, recorded in Book 4495, page 523, Official Records of Kern County, and are located in Agricultural Preserve No. 3; and

(c) **WHEREAS**, said Land Use Contract also describes other lands which are not affected by this Contract; and

(d) **WHEREAS**, said parcels are situated in an Exclusive Agriculture District under the provisions of the Zoning Ordinance of Kern County, which prescribes a minimum lot size of twenty (20) acres for the location of one single-family dwelling; and

(e) **WHEREAS**, Parcel A is less than twenty (20) acres; and

(f) **WHEREAS**, Owner proposes to transfer title to Parcel A; and

(g) **WHEREAS**, Owner has applied to the County for a variance from the requirements of Section 19.12.050 of the Zoning Ordinance to allow a single-family dwelling on Parcel A; and

(h) **WHEREAS**, such variance has been granted by the Hearing Officer of a Director's Hearing of the County of Kern, Notice of Decision No. 4-97, subject to certain conditions therein set forth; and

(i) **WHEREAS**, the making of this Contract amending said Land Use Contract is necessary for the purposes of conforming to the conditions to which said variance is subject; and

(j) **WHEREAS**, it is mutually understood and intended by the parties hereto that the restrictions imposed upon Parcel B are in the public interest and are necessary for the continuation and proper administration of the Land Conservation Program in the County of Kern and the proper administration of the Zoning Ordinance of Kern County, and in particular those provisions of said Zoning Ordinance relating to Exclusive Agriculture Districts limiting the density of residential uses upon land in such districts, and that the said restrictions imposed upon Parcel B are beneficial to both Parcel A and Parcel B and should run with the land and be binding for the period of time hereinafter specified; and

(k) **WHEREAS**, Owner proposes to file with the County a petition for cancellation of said

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Land Use Contract with respect to Parcel A, to pay the fee heretofore fixed by the Board of Supervisors for the filing of such petitions, and to pay in addition the cancellation fee computed in accordance with the Land Conservation Act in event such cancellation is approved.

**NOW, THEREFORE,** the parties hereto covenant and agree as follows:

1. The certain Land Use Contract dated the 26 day of FEBRUARY, 19 71, recorded in Book 4495, page 523, Official Records of Kern County, is hereby amended, but only with respect to Parcel B, hereinabove described, by incorporating therein the provisions of this Contract.

2. Owner covenants and agrees that during such time as said Land Use Contract shall remain in force and effect with respect to said Parcel B, whether during the original term or any renewal thereof, no dwelling house shall be constructed upon or moved onto said Parcel B.

3. Owner covenants and agrees that in the event any dwelling house to be constructed upon or moved onto said Parcel B contrary to the provisions of this Contract, in addition to any other remedy which it may have at law or in equity, after ten (10) days written notice from the County to Owner, Owner shall undertake and diligently pursue the removal of all persons and chattels from said dwelling house and shall undertake and diligently pursue the demolition of said dwelling house or removal of said dwelling house to other lands where the same may be lawfully located and used, all pursuant to the provisions of the Zoning Ordinance and the ordinances relating to the relocation of building, all of which shall be fully completed within ninety (90) days from the day such notice has been given, at the sole expense of Owner.

4. Owner further covenants and agrees that in the event any dwelling house to be constructed upon or moved onto said Parcel B contrary to the provisions of this Contract, and unless Owner shall diligently and timely perform the covenants of the preceding paragraph, in addition to any other remedy which it may have at law or in equity, after ten (10) days written notice from the County to Owner, the County may in the exercise of its sole discretion enter upon said Parcel B and cause

removal of all persons and chattels from said dwelling house, and/or cause demolition of said dwelling house, and/or cause removal of said dwelling house from said Parcel B, each and all at the sole expense of Owner.

Owner hereby designates and appoints as his agent and attorney-in-fact for the performance of the acts aforementioned such officer of the County of Kern as the Board of Supervisors may from time to time nominate for such purposes, which appointment shall be deemed to be one coupled with an interest.

5. Owner covenants and agrees promptly to reimburse the County on demand for any and all expenses which the County may incur, including the sum of ten percent (10%) of all actual cash outlays on account of its administrative expenses, in the performance by the County of any act mentioned in paragraph 4 above. Owner further covenants and agrees that in the event the County brings any action at law or proceeding in equity for the enforcement of this Contract, or for injunction, or for declaratory relief with respect to the provisions of this Contract or to recover any sum which may become payable to the County under the provisions of this Contract, Owner shall pay the County its costs and reasonable attorney fees incurred therein. Any sum to which the County may become entitled under this paragraph shall bear interest at the rate of seven percent (7%) per annum from the time the County incurs such expense to the date of payment thereof.

6. Owner covenants and agrees to waive any damage or injury which may be caused to any chattel within or about any such dwelling house, to said dwelling house, or to any tree, shrub, crop, structure, pipe, or other improvement on said Parcel B arising from performance of any act mentioned in paragraph 4 above.

7. Owner covenants and agrees to hold harmless, indemnify, and defend the County, its governing board, officers, agents, and employees from any claim, suit, or judgment by any person who may assert ownership of any such dwelling house or any part thereof or anything in or on the same or the right to occupy the same or to occupy any land on which the same may be situated, for any damages

or obligation alleged to arise or result from any act of the County, its governing board, officers, agents, or employees in the performance of any act mentioned in paragraph 4 above.

8. Owner covenants and agrees that the period for commencing any legal proceeding mentioned in paragraph 5 is waived effective for a period of four (4) years from the date of expiration of the time limited for the commencement of such legal proceedings by the Code of Civil Procedure.

9. Owner covenants and agrees that no extension of time for the performance of any act herein required to be done or caused by owner shall be valid unless in writing and approved by the Board of Supervisors of the County.

10. Owner covenants and agrees that any notice required to be given by the County under the provisions of this Contract may be served in person or by ordinary United States mail, postage prepaid, addressed to Owner at the address set forth hereinbelow, or such other address of Owner or any successor in interest as may be shown in a document lodged with the Clerk of the Board of Supervisors requesting a change of such address and making reference to this Contract.

11. Owner covenants and agrees that each and all of the covenants of Owner herein contained shall run with the land herein described as Parcel B and be binding upon the heirs, personal representatives, trustees, successors, and assigns of Owner having or claiming any interest in said Parcel B.

12. It is mutually agreed that the provisions of the Contract shall become operative only at such time as the Board of Supervisors of the County of Kern may have adopted a resolution giving tentative approval of cancellation of said Land Use Contract with respect to said Parcel A and fixing the amount of cancellation fee, and said cancellation fee has been paid in full within the time prescribed in said resolution, and a Certificate of Final Cancellation of the Clerk of the Board of Supervisors has been filed for record. Nothing in this Contract shall be construed as authorizing or implying approval of cancellation of said Land Use Contract with respect to said Parcel A. If the Board of Supervisors determines not to approve cancellation of said Contract with respect to said Parcel A, the County agrees

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to enter into a recordable agreement for the purposes of cancellation of this Contract if so requested by Owner.

13. This Contract may be amended by mutual agreement of the parties hereto.

14. It is mutually agreed that this Contract shall be filed for record forthwith.

**IN WITNESS WHEREOF**, the parties hereto have executed the within Contract the day and year first above written.

ATTEST:

SUE DAVIS
Clerk of the Board of Supervisors

By Kaaren Shatswell
Deputy

COUNTY OF KERN

By Steve A. Perez
Chairman, Board of Supervisors

OWNER Palm Farms, Inc. HERBERT G. WALKER

Herbert G. Walker

Address: 4801 STOCKDALE HWY
BAKERSFIELD, CA 93309

Approved:

Ted James
TED JAMES, AICP, Director
Planning Department

**CERTIFICATE OF DELIVERY OF DOCUMENT**

I am employed by the County of Kern as a Deputy Clerk II of the Board of Supervisors. On 8/4/97 , I delivered a copy of the document entitled Contract Amending Land Use Contract to the Chairperson of the Kern County Board of Supervisors.

Kaaren Shatswell
Deputy Clerk

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**ACKNOWLEDGEMENT**
(County of Kern)
All Purpose

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this 4th day of August, in the year 1997, before me, Sue Davis, the undersigned, personally appeared Kaaren Shatswell, personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year in this Certificate first above written.

SUE DAVIS
COMM. #1034511
NOTARY PUBLIC • CALIFORNIA
KERN COUNTY
My Comm. Exp. Jul. 31, 1998

Sue Davis
Notary Public in and for the State of California

---

**ACKNOWLEDGEMENT**
(Owner(s))
All Purpose

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this 27th day of February, in the year 1997, before me, Brynia J. Castellon, the undersigned, personally appeared Herbert J. Walker, personally known to me (or proved to me on the basis of satisfactory evidence) to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year in this Certificate first above written.

Brynia J. Castellon
Comm. #1036471
NOTARY PUBLIC - CALIFORNIA
KERN COUNTY
Comm. Exp. Feb. 25, 2000

Brynia J. Castellon
Notary Public in and for the State of California

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FORM93.PDS (10/95)

## EXHIBIT "A"
## PARCEL A

ALL THAT PORTION OF PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94 IN THE UNINCORPORATED AREA OF THE COUNTY OF KERN, STATE OF CALIFORNIA, AS PER CERTIFICATE OF COMPLIANCE RECORDED JANUARY 20, 1995 AS INSTRUMENT NO. 007612 OF OFFICIAL RECORDS, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF SECTION 10, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M.; THENCE N 89° 23' 30" W ALONG THE NORTH LINE OF SECTION 9 TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M., A DISTANCE OF 41.00 FEET TO THE WEST LINE OF SAID PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94; THENCE S 00° 46' 41" W ALONG SAID WEST LINE, A DISTANCE OF 640.93 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING ALONG SAID WEST LINE, A DISTANCE OF 420.01 FEET TO THE SOUTH LINE OF SAID PARCEL A; THENCE S 89° 14' 01" E ALONG THE SAID SOUTH LINE, A DISTANCE OF 444.00 FEET; THENCE N 00° 46' 41" E, A DISTANCE OF 419.92 FEET; THENCE N 89° 13' 19" W, A DISTANCE OF 444.00 FEET MORE OR LESS TO THE POINT OF BEGINNING.

CONTAINING 4.28 ACRES MORE OR LESS.

## PARCEL B

ALL THAT PORTION OF PARCEL A OF LOT LINE ADJUSTMENT ND. 63-94 IN THE UNINCORPORATED AREA OF THE COUNTY OF KERN, STATE OF CALIFORNIA, AS PER CERTIFICATE OF COMPLIANCE RECORDED JANUARY 20, 1995 AS INSTRUMENT NO. 007612 OF OFFICIAL RECORDS, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF SECTION 10, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M.; THENCE N 89° 23' 30" W ALONG THE NORTH LINE OF SECTION 9, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M., A DISTANCE OF 41.00 FEET TO THE WEST LINE OF SAID PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94; THENCE S 00° 46' 41" W ALONG SAID WEST LINE, A DISTANCE OF 1060.94 FEET TO THE SOUTH LINE OF SAID PARCEL A; THENCE S 89° 14' 01" E ALONG THE SOUTH LINE, A DISTANCE OF 444.00 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING ALONG SAID SOUTH LINE, A DISTANCE OF 761.04 FEET; THENCE N 00° 23' 43" W, A DISTANCE OF 58.24 FEET; THENCE S 89° 51' 55" E, A DISTANCE OF 369.39 FEET; THENCE N 00° 58' 27" W, A DISTANCE OF 359.53 FEET; THENCE S 54° 20' 18" E, A DISTANCE OF 1215.43 FEET; THENCE N 84° 12' 24" E, A DISTANCE OF 75.09 FEET; THENCE N 02° 38' 35" E, A DISTANCE OF 70.34 FEET; THENCE N 53° 45' 12" W, A DISTANCE OF 1138.62 FEET; THENCE N 89° 13' [illegible]" W, A DISTANCE OF 1250.93 FEET; THENCE S 00° 46' 41" W, A DISTANCE OF 489.27 FEET MORE OR LESS TO THE POINT OF BEGINNING.

CONTAINING 15.72 ACRES MORE OR LESS.

96-839/Exapca.lgl
4/3/97

James Maples, Assessor-Recorder
Kern County Official Records

DOCUMENT #:0197104356

PATTI
Pages: 3
8/11/1997
14:00:00

Fees. . .
Taxes. .
Other
TOTAL
PAID. .

Stat Types: 1

Record at the request of
and return to:
County of Kern
Clerk of the Board
1115 Truxtun Ave. 5th Floor
Bakersfield CA 93301

CERTIFICATE OF CANCELLATION
WITH RESPECT TO LAND UNDER CONTRACTUAL RESTRICTIONS
(LAND CONSERVATION ACT OF 1965)

NOTICE IS HEREBY GIVEN TO WHOM IT MAY CONCERN:

1. The Board of Supervisors of the County of Kern has given tentative approval of the petition of PALM FARMS INC. BY PORTER-ROBERTSON for cancellation of contractual restrictions contained in a contract recorded February 26, 1971 in Book 4495, Page 523, as to the land hereinafter more fully described, entered into under the Land Conservation Act of 1965, and which land is located in Agricultural Preserve No. 3 in the County of Kern, after public hearing duly noticed and held.

2. The name of the owner of the land herein mentioned, at the time of the tentative cancellation was PALM FARMS INC.

3. In giving such tentative approval, said Board prescribed the conditions and contingencies, including payment of a cancellation fee, to be satisfied prior to issuance and recordation of a certificate of cancellation of said contractual restrictions.

4. Said conditions and contingencies have been satisfied, and said contractual restrictions shall henceforth be deemed cancelled as to the real property in the County of Kern, State of California, as described in the attached Exhibit A:

Dated this 4th day of August, 1997.

SUE DAVIS
Clerk of the Board of Supervisors
County of Kern, State of California

By: Karen Shatswell
Deputy Clerk

ACKNOWLEDGMENT

STATE OF CALIFORNIA )
) ss.
COUNTY OF KERN )

On this 4th day of August, in the year 1997, before me, Sue Davis, a Notary Public in and for said County and State, personally appeared Kaaren Shatswell, personally known to me (or proved to me on the basis of satisfactory evidence) to be the person whose name is subscribed to the within instrument and acknowledged to me that, she executed the same in her authorized capacity as Deputy Clerk of the Board in the County of Kern, and that by her signature on the instrument the person or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

Sue Davis

Notary Public in and for the
State of California

SUE DAVIS
COMM. #1034511
NOTARY PUBLIC • CALIFORNIA
KERN COUNTY
My Comm. Exp Jul. 31, 1998

# EXHIBIT "A"

LEGAL DESCRIPTION
FOR
CANCELLATION #97-3

CONTRACT AMENDING LAND USE CONTRACT
AND
CANCELLATION

ALL THAT PORTION OF PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94 IN THE UNINCORPORATED AREA OF THE COUNTY OF KERN, STATE OF CALIFORNIA, AS PER CERTIFICATE OF COMPLIANCE RECORDED JANUARY 20, 1995 AS INSTRUMENT NO. 007612 OF OFFICIAL RECORDS, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF SECTION 10, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M.; THENCE N 89° 23' 30" W ALONG THE NORTH LINE OF SECTION 9 TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M., A DISTANCE OF 41.00 FEET TO THE WEST LINE OF SAID PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94; THENCE S 00° 46' 41" W ALONG SAID WEST LINE, A DISTANCE OF 640.93 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING ALONG SAID WEST LINE, A DISTANCE OF 420.01 FEET TO THE SOUTH LINE OF SAID PARCEL A; THENCE S 89° 14' 01" E ALONG THE SAID SOUTH LINE, A DISTANCE OF 444.00 FEET; THENCE N 00° 46' 41" E, A DISTANCE OF 419.92 FEET; THENCE N 89° 13' 19" W, A DISTANCE OF 444.00 FEET MORE OR LESS TO THE POINT OF BEGINNING.

CONTAINING 4.28 ACRES MORE OR LESS.

CONTRACT AMENDING LAND USE CONTRACT ONLY

ALL THAT PORTION OF PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94 IN THE UNINCORPORATED AREA OF THE COUNTY OF KERN, STATE OF CALIFORNIA, AS PER CERTIFICATE OF COMPLIANCE RECORDED JANUARY 20, 1995 AS INSTRUMENT NO. 007612 OF OFFICIAL RECORDS, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHWEST CORNER OF SECTION 10, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M.; THENCE N 89° 23' 30" W ALONG THE NORTH LINE OF SECTION 9, TOWNSHIP 30 SOUTH, RANGE 24 EAST, M.D.M., A DISTANCE OF 41.00 FEET TO THE WEST LINE OF SAID PARCEL A OF LOT LINE ADJUSTMENT NO. 63-94; THENCE S 00° 46' 41" W ALONG SAID WEST LINE, A DISTANCE OF 1060.94 FEET TO THE SOUTH LINE OF SAID PARCEL A; THENCE S 89° 14' 01" E ALONG THE SOUTH LINE, A DISTANCE OF 444.00 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING ALONG SAID SOUTH LINE, A DISTANCE OF 761.04 FEET; THENCE N 00° 23' 43" W, A DISTANCE OF 58.24 FEET; THENCE S 89° 51' 55" E, A DISTANCE OF 369.39 FEET; THENCE N 00° 58' 27" W, A DISTANCE OF 359.53 FEET; THENCE S 54° 20' 18" E, A DISTANCE OF 1215.43 FEET; THENCE N 84° 12' 24" E, A DISTANCE OF 75.09 FEET; THENCE N 02° 38' 35" E, A DISTANCE OF 70.34 FEET; THENCE N 53° 45' 12" W, A DISTANCE OF 1138.62 FEET; THENCE N 89° 13' 9" W, A DISTANCE OF 1250.93 FEET; THENCE S 00° 46' 41" W, A DISTANCE OF 489.27 FEET MORE OR LESS TO THE POINT OF BEGINNING.

CONTAINING 15.72 ACRES MORE OR LESS.

FEB-28-69 12609 •4.00 • D 18 FBk 6.80

RECORDED AT REQUEST OF:
AND RETURN TO:
CLERK OF THE BOARD
CIVIC CENTER - ROOM 600
BAKERSFIELD, CALIF. - 93301

Recorded By RAY A. VERCAMMEN, Kern Co. Recorder

# LAND USE CONTRACT

(Pursuant to California Land Conservation Act of)
(1965 and Open-Space Land Valuation Law of 1967 )

THIS CONTRACT, made and entered into this 27TH day of FEBRUARY, 1969, by and between the COUNTY OF KERN, a political subdivision of the State of California, hereinafter referred to as "COUNTY", and 6.80

MARTIN SNOW, JR.

______________________, hereinafter referred to as "OWNER",

W I T N E S S E T H :

WHEREAS, Owner is the owner of certain real property situate in the County of Kern, State of California, which is presently devoted to agricultural use, which property is particularly identified and described in Exhibit "A" attached hereto and by this reference incorporated herein and made a part of this Contract; and

WHEREAS, said property is classified as "prime agricultural land" as defined in Section 51201(c) of the Government Code and is located in Agricultural Preserve number 3 heretofore established by Resolution of the Board of Supervisors of the County of Kern, which Preserve contains not less than 100 acres; and

WHEREAS, both Owner and County desire to limit the use of said property to agricultural uses in order to continue in existence a maximum of prime agricultural lands for the production of food and fiber and to discourage premature and unnecessary conversion of such land from agricultural uses, recognizing that such land has definite public value as open space, and that the preservation of such land in agricultural production constitutes an important physical, social, esthetic and economic asset to County and is necessary for the maintenance of the agricultural economy of County and the State of California, and Owner desires to take advantage of the provisions of Chapter 1711, Statutes of 1967; and

WHEREAS, the placement of said property in an Agricultural Preserve and the execution and approval of this Contract is deemed to be a determination by all parties concerned that the highest and best use of the property during the term of this Contract and all renewals thereof is for the production of agricultural commodities for commercial purposes;

NOW, THEREFORE, the parties, in consideration of the mutual covenants and conditions set forth herein and the substantial public benefits to be derived therefrom, do hereby agree as follows:

1. This Contract is made and entered into pursuant to the California Land Conservation Act of 1965 (Chapter 7 of Part 1 of Division 1 of Title 5 of the California Government Code commencing with Section 51200) and is subject to all the provisions thereof and by this reference the provisions of said Act are incorporated herein and made a part hereof.

2. During the term of this Contract or any renewals thereof the above-described land shall not be used for any purpose other than the production of agricultural commodities for commercial purposes and compatible uses in accordance with the land use restrictions included in the Resolution prescribing uniform rules for the administration of the Agricultural Preserve within which the land is located, which uniform rules and land use restrictions are by this reference incorporated in and made a part of this Contract. No structures shall be erected upon said land except such structures as may be directly related to authorized uses of the land. Pursuant to the provisions of Section 423 of the Revenue and Taxation Code (Chapter 1711, Statutes of 1967) it is understood by the parties that the uses of the lands which are the subject of this Contract contemplated by County and legally available to Owner are those uses herein specified to which uses Owner agrees to devote the said land during the period of this Contract.

3. During the term of this Contract, and extensions thereof, the Board of Supervisors of County may add to those agricultural and compatible uses specified in the Resolution prescribing uniform rules for the administration of the Preserve within which the land is located

or otherwise modify said uniform rules and land use restrictions after calling a hearing thereon and publishing notice pursuant to Section 6061 or the Government Code; provided, however, said Board shall not eliminate a permitted compatible use during the term of this Contract without the written consent of Owner. It is understood that neither the provisions of this Contract nor of any Resolution defining the land uses permitted hereunder can limit or supersede the planning and zoning powers of County.

4. Upon the filing of any action in eminent domain for the condemnation of the fee title of any land described herein, or of less than a fee interest which will prevent said land being used for any authorized agricultural or compatible use, or upon the acquisition in lieu of condemnation of the fee title of any land described herein or such acquisition of less than a fee interest which will prevent the land being used for any authorized use, this Contract is null and void upon such filing or acquisition as to the portion of the land described herein so taken or acquired, and also as to such portion of the herein-described land as is severed by such taking or acquisition in such a manner as to prevent continued use of the severed portion for authorized agricultural or compatible uses, and the condemning agency shall proceed as if this Contract never existed.

5. This Contract shall be effective as of the 28th day of February next succeeding the date which is first mentioned herein, and shall remain in effect for an initial term of ten (10) years therefrom and during renewals of this Contract. Each 28th day of February of each year during which this contract shall be in effect shall be deemed to be the annual renewal date of this Contract, as mentioned in Sections 51244 and 51245 of the Government Code. On said annual renewal date a year shall be added automatically to the initial term aforementioned unless notice of nonrenewal is given as provided in Section 51245 of the Government Code.

6. Owner hereby waives any obligation of County to make any payments to Owner under this Contract and Owner shall not receive any payment from County in consideration of the obligations imposed hereunder, it being recognized and agreed that the consideration for the execution of the within Contract is the substantial public benefit to be derived therefrom and the advantage which will accrue to Owner as a result of the effect on the method of determining the assessed value of land described herein and any reduction therein due to the imposition of the limitations on its use contained herein.

7. The within Contract shall "run with the land" described herein, and shall be binding upon and inure to the benefit of the heirs, executors, administrators, trustees, successors and assigns of the parties hereto.

8. This Contract may not be cancelled by either Owner or County acting unilaterally and may only be cancelled on the mutual agreement of all parties to the Contract, and the State, proceeding in accordance with the provisions of Section 51280 through Section 51286 of the Government Code.

9. It is agreed that removal of any land under this Contract from an Agricultural Preserve, either by change of boundaries of the preserve or disestablishment of the preserve, shall be deemed the equivalent of a notice of nonrenewal by County for purposes of Section 422 of the Revenue and Taxation Code.

10. Notices to be given to Owner pursuant to this Contract may be sent by U. S. Mail addressed to Owner at the address shown below Owner's signature hereinbelow. Notices to County may be sent by U. S. Mail addressed to Board of Supervisors, County of Kern, Kern County Civic Center, 1415 Truxtun Avenue, Bakersfield, California.

By the means mentioned in this paragraph a party may give notice of a new address, after which notices to be given to such party shall be sent by U. S. Mail addressed to such party at such new address.

IN WITNESS WHEREOF, the parties hereto have executed the within Contract the day and year first above written.

COUNTY OF KERN

By John Holt
Chairman, Board of Supervisors

ATTEST:
Vera K. Gibson, County
Clerk and ex-Officio Clerk
of the Board of Supervisors

By E.F. Kimbriel
Deputy

OWNER

Martin Jason, Jr.

Address: RTE 1, Box 41
BUTTONWILLOW

## ACKNOWLEDGMENTS

### County of Kern

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this ______ day of FEB 28 1969, in the year 19___, before me, E. F. Kimbriel, Deputy Clerk, Board of Supervisors of the County of Kern, personally appeared JOHN HOLT, known to me to be the Chairman of the Board of Supervisors of the County of Kern, and known to me to be the person who executed the within instrument on behalf of said County, and acknowledged to me that such County executed the same.

WITNESS my hand and Official Seal of the Kern County Board of Supervisors.

VERA K. GIBSON
Clerk, Board of Supervisors

By E. F. Kimbriel
Deputy Clerk

### Owner(s)

STATE OF CALIFORNIA )
) ss
COUNTY OF KERN )

On this 27th day of February, in the year 1969, before me, the undersigned, a Notary Public in and for the State of California, with principal office in the County of Kern, duly commissioned and sworn, personally appeared Martin Snow, Jr. known to me to be the person__ described in, whose name is, _____ subscribed to and who executed the within instrument, and acknowledged that he executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day and year in this Certificate first above written.

Marella Williams
Notary Public in and for the State of California.

MARELLA WILLIAMS
NOTARY PUBLIC - CALIFORNIA
PRINCIPAL OFFICE IN
KERN COUNTY
Commission Exp. Aug. 23, 1972

BOOK 4250 PAGE 502

# EXHIBIT "A"

## Identification and Description of Real Property

PARCEL 159-050-04-01 95 ACRES
S½ LYING WLY OF C/L OF EASTSIDE CANAL, SECS 10/11 T30 R24

PARCEL 159-040-02 73 ACRES
E½ OF SE¼ SECS 10/11 T30 R24

FILED
BOOK
PAGE
FEB 20 11 45 AM 1969
CLERK
DEPUTY

W-35

# Appendix H-7

# Certificate of Tentative Cancellation and Related Documents

6-29-10 #4 p.m.

Clerk of the Board

COPY
KERN COUNTY

JUL 13 2010

ANN K. BARNETT
AUDITOR CONTROLLER-COUNTY CLERK
BY ______________ DEPUTY

# NOTICE OF EXEMPTION
## (CALIFORNIA ENVIRONMENTAL QUALITY ACT OF 1970)

TO WHOM IT MAY CONCERN:

1. The Board of Supervisors of the County of Kern has approved the following described project in the County of Kern, State of California:

   a. Applicant or sponsoring agency or department: Hydrogen Energy California, LLC, by Manatt, Phelps, and Phillips, LLP;

   b. Name of Project: Cancellation of Land Use Restrictions, Land Conservation Act, Agricultural Preserve No. 3 (Zoning Map No. 120) and Contract Amending Land Use Contract;

   c. Location of Project: South side of Adohr Road, west of Tupman Road, northwest of Tupman;

   d. Description of Project: Cancellation of approximately 491 acres a acre parcel of a Land Use Contract.

2. The form of such approval and the date thereof is:

   Resolution No.: 2010-168 Adopted: June 29, 2010

3. The Board of Supervisors of the County of Kern has determined that pursuant to Section 15271 of the State CEQA Guidelines, said project is Statutorily Exempt from the requirements of the Environmental Quality Act of 1970, and no environmental documents are required or need be considered in connection with such action.

COPY

Dated this 9th day of July, 2010.

KATHLEEN KRAUSE
Clerk of the Board of Supervisors
County of Kern, State of California

Judy A. Denny
Deputy Clerk

Telephone No. 868-3585

BD/kjw
#194719

Notice of Environmental Document
Posted by County Clerk on 7/13/10
and for 30 days thereafter, Pursuant to
Section 21152(C), Public Resources Code

1089

CERTIFICATE OF TENTATIVE CANCELLATION
WITH RESPECT TO LAND UNDER CONTRACTUAL RESTRICTIONS
(LAND CONSERVATION ACT OF 1965)

NOTICE IS HEREBY GIVEN TO WHOM IT MAY CONCERN:

1. The Board of Supervisors of the County of Kern has given tentative approval of the petition of Hydrogen Energy California, LLC, by Manatt, Phelps, and Phillips, LLP, for cancellation of contractual restrictions contained in a contract recorded on February 26, 1971, in Book, 4495, Page 523, as to the land hereinafter more fully described, entered into under the Land Conservation Act of 1965, and which land is located in Agricultural Preserve No. 3 in the County of Kern, after public hearing duly noticed and held.

2. The name of the owner of the land herein mentioned, at the time of cancellation was John B. Cauzza, III; Laura B. Cauzza; and Jomistro Properties, LLC.

3. The amount of the cancellation fee determined by said Board to be paid as deferred taxes upon such cancellation, in accordance with paragraph (b) of section 51283 of the Government Code, and certified by said Board as being due pursuant to said Act, is the sum of $306,969.

4. Pursuant to the provisions of Government Code section 51283.4, the Board has established the following conditions and contingencies, and has declared that a Certificate of Cancellation of said contract with respect to said parcel of land will be issued and recorded within thirty (30) days after being notified by the landowner that each and all of said conditions and contingencies is satisfied:

(a) Payment in full of the cancellation fee hereinabove mentioned;

(b) Unless said cancellation fee is fully paid, or a Certificate of Cancellation is issued, within one year from the date of recordation of the Certificate of Tentative Cancellation, such fee shall be recomputed as of the date the landowner notifies this Board that he has satisfied the conditions and contingencies, as provided in subdivision (b) of Government Code section 51283.4, and the landowner shall pay any additional fee arising from such re-computation as a further condition to issuance of a Certificate of Cancellation; provided, however, that the landowner shall not be entitled to refund of any cancellation fee previously paid even if the recomputed fee is less;

(c) Landowner shall obtain all permits, if any, necessary to commence the project of the proposed alternative use; and

(d) The cancellation shall not become effective until the California Energy Commission issues a permit based on its environmental review for Project Docket No. O8-AFC-8.

5. Pursuant to subdivision (c) of Government Code section 51283.4, if any landowner has been unable to satisfy the foregoing conditions or contingencies, he shall notify this Board of the particular conditions or contingencies he is unable to satisfy; and within thirty (30) days after receipt of such notice, and upon a determination by this Board that the landowner is unable to satisfy the foregoing conditions or contingencies, this Board shall execute a Certificate of Withdrawal of said tentative approval of the cancellation of contract and cause the same to be recorded; however, the landowner shall not be entitled to the refund of any cancellation fee previously paid.

6. The real property to which the foregoing tentative cancellation proceedings applies is situated in the County of Kern, State of California, and is described in Exhibit "A" attached hereto and made a part hereof by this reference.

Dated this 29th day of June, 2010, by order of the Board of Supervisors of the County of Kern.

KATHLEEN KRAUSE
Clerk of the Board of Supervisors
County of Kern, State of California

Karen L Winn
Deputy Clerk

BDkjw
#194717
10.2750

## ACKNOWLEDGMENT

STATE OF CALIFORNIA )<br>
) ss.<br>
COUNTY OF KERN )

On this 13th day of July, 2010, before me, Judy Denny, Notary Public, personally appeared Karen L. Winn, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that she executed the same in her authorized capacity, and that by her signature on the instrument the person or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Judy Denny

JUDY DENNY
Commission # 1750852
Notary Public - California
Kern County
MyComm. Expires Jun 17, 2011

# LEGAL DESCRIPTION

## EXHIBIT "A"

## FOR CANCELLATION OF A LAND USE CONTRACT

**Parcel 1:**

That portion of Parcel B of Certificate of Compliance, in the County of Kern, State of California, recorded January 20, 1995 as Instrument No. 007612, Official Records of said county, being described as those portions of Sections 9 and 10, Township 30 South, Range 24 East, Mount Diablo Meridian, described as follows:

**Commencing** at the Point of Beginning (P.O.B.) of said Parcel B, as depicted on Exhibit "B", Attachment "A"; thence along the northerly line of said Parcel B South 89°21'55" East 451.37 feet (L1) to the **True Point of Beginning (T.P.O.B.)**; thence along the northerly and easterly lines of said Parcel B the following five courses:

1) South 89°21'55" East 1263.39 feet (L2) to the north quarter corner of said Section 10;
2) Thence South 89°21'45" East 2643.65 feet to the northeast corner of said Section 10;
3) Thence South 00°45'43" West 2640.11 feet to the east quarter corner of said Section 10;
4) Thence North 89°24'15" West 1321.11 feet (L3);
5) Thence South 00°44'00" West 2359.90 feet to a point on a line parallel with and 280.00 feet northerly of the southerly line of said Section 10;

thence leaving said easterly line of Parcel B North 89°27'40" West 3160.86 feet; thence North 44°27'40" West 1196.25 feet to a point on the southerly prolongation of that certain course described as "North 00°46'41" East 1108.72 feet" in Parcel B of said Certificate of Compliance; thence along said course and its southerly prolongation North 00°46'41" East 3100.91 feet; thence along the southerly line of said Parcel A the following two courses:

6) South 89°14'01" East 1205.04 feet (L4);
7) Thence North 00°23'43" West 56.24 feet (L5);

thence along said southerly line of Parcel A and its easterly prolongation South 89°51'55" East 539.75 feet (L6); thence North 00°00'00" East 233.53 feet (L7) to its intersection with a point on the Southwesterly line of Parcel A described in said Instrument No. 007612 as "North 54°20'18" West, 1215.43 feet" said point of intersection being referred to hereafter as Point "A" for this description;

thence along the southwesterly, southeasterly and northeasterly lines of said Parcel A the following three courses:

8) South 54°20'18" East 998.71 feet (L8);

9) Thence North 64°12'24" East 75.09 feet (L9);

10) Thence North 02°38'35" West 70.34 feet (L10);

thence North 53°45'12' West 1085.95 feet (L11) to its intersection with the northerly prolongation of the aforementioned line described as "North 00°00'00' East 233.53 feet (L7)"; thence along said prolongation North 00°00'00" East 482.28 feet (L12); thence North 67°30'00" West 333.64 feet (L13) to the **True Point of Beginning**.

Contains 488.067 acres.

See Exhibit "B", Attachment "A" attached hereto and made a part hereof.

**Parcel 2:**

That portion of Parcel A of Certificate of Compliance, in the County of Kern, State of California, recorded January 20, 1995 as Instrument No. 007612, Official Records of said county, being described as those portions of Sections 9 and 10, Township 30 South, Range 24 East, Mount Diablo Meridian, describes as follows:

**Beginning** at the aforementioned Point "A" as described hereinabove and depicted on Exhibit "B", Attachment "B"; thence along the southwesterly, southeasterly and northeasterly lines of said Parcel A the following three courses:

1) South 54°20'18" East 998.71 feet (L8);

2) Thence North 64°12'24" East 75.09 feet (L9);

3) Thence North 02°38'35" West 70.34 feet (L10);

thence North 53°45'12' West 1085.95 feet (L11) to its intersection with the northerly prolongation of the aforementioned line described as "North 00°00'00' East 233.53 feet (L7)" of Parcel 1 hereinabove described; thence along said prolongation South 00°00'00" West 162.77 (L14) feet to the **Point of Beginning.**

Contains 3.081 acres.

See Exhibit "B", Attachment "B" attached hereto and made a part hereof.

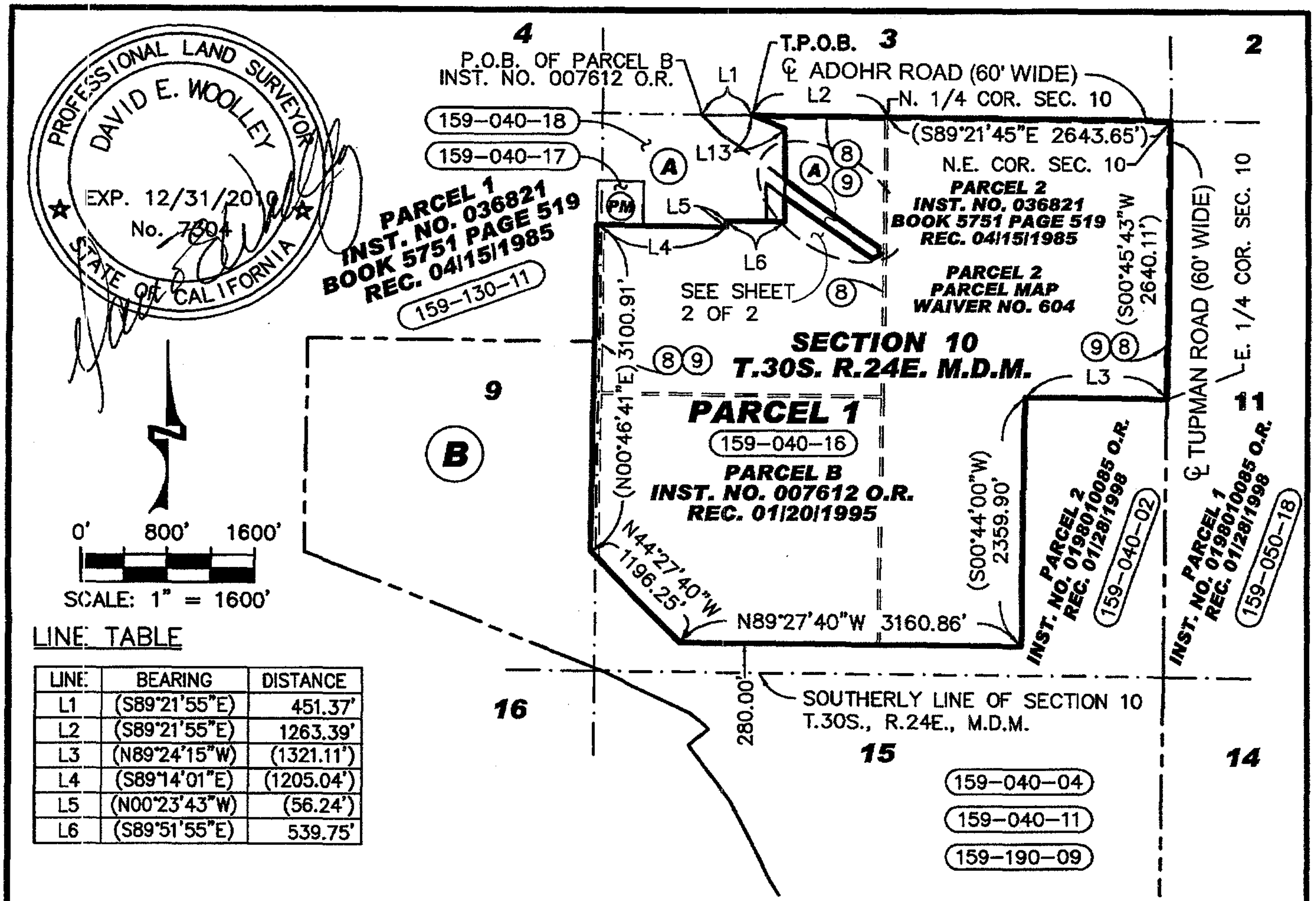
This legal description is not intended for use in the division and /or conveyance of land in violation of the Subdivision Map Act of the State of California.

This legal description has been prepared by me or under my direction:

07/12/2010

David E. Woolley, P.L.S. 7304 Date

PROFESSIONAL LAND SURVEYOR
DAVID E. WOOLLEY
EXP 12-31-10
NO. 7304
STATE OF CALIFORNIA




LINE TABLE

| LINE | BEARING | DISTANCE |
|---|---|---|
| L1 | (S89°21'55"E) | 451.37' |
| L2 | (S89°21'55"E) | 1263.39' |
| L3 | (N89°24'15"W) | (1321.11') |
| L4 | (S89°14'01"E) | (1205.04') |
| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |

RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

LEGEND

(A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995

(B) PARCEL B OF INST. NO. 007612 O.R., REC. 01/20/1995

(PM) PARCEL MAP NO. 10341, P.M.B. 49/7-8

**10** SECTIONAL NUMBER OF T30S, R24E, M.D.M.

(159-040-16) ASSESSORS PARCEL NUMBER

——— LAND USE BOUNDARY LINE

—— - - —— PROPERTY LINE

- · — · — · — · - SECTION LINE

— — — — — AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

EASEMENT NOTES

BY: FIRST AMERICAN TITLE COMPANY
9201 CAMINI MEDIA, SUITE 100
BAKERSFIELD, CA 93311
(661) 617-1468

COMMITMENT NO. 1003-3112060
TITLE OFFICER - TONY DAMO
DATED: JULY 22, 2008

THE FOLLOWING ITEMS WERE FOUND IN SAID COMMITMENT AND ARE REFERENCED ON THIS MAP. PLOTTABLE ITEMS ARE INDICATED HEREON.

(8)— PROPERTY AND PROPERTY RIGHTS IN FAVOR OF MILLER & LUX, INC., A CORPORATION, DATED JULY 30, 1936, RECORDED OCTOBER 10, 1936 IN BOOK 666, PAGE 250, OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

(9)— EASEMENT FOR PUBLIC ROADS AND INCIDENTAL PURPOSES, RECORDED MAY 16, 1939 IN BOOK 871, PAGE 98 OF OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

ITEM #'S SHOWN HEREON ARE STATED AS EXCEPTIONS ON ABOVE REFERENCED COMMITMENT. NO RESPONSIBILITY FOR THE COMPLETENESS, ACCURACY, OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP. ALL EASEMENTS NOT AFFECTED, NON PLOTTABLE AND BLANKET, CONTAINED IN THE ABOVE REFERENCED REPORT ARE NOT SHOWN OR INDICATED HEREON.

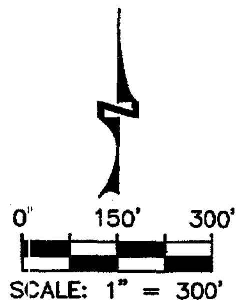
Sections 9 and 10, T30S, R24E, Mount Diablo Meridian
County of Kern, State of California

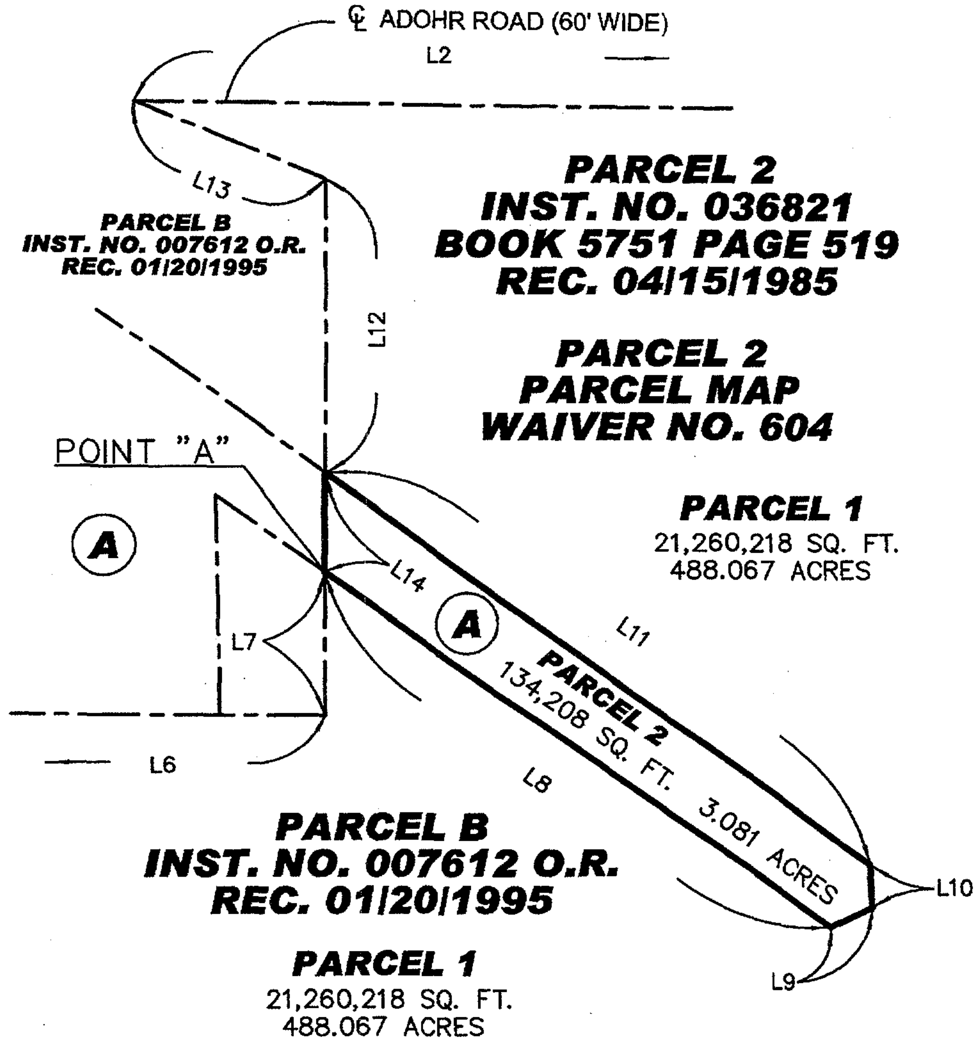
**HECA PROJECT**

EXHIBIT "B", ATTACHMENT "A"
FOR CANCELLATION OF A LAND USE CONTRACT

| | |
|---|---|
| Scale: | 1' = 1600' |
| Date: | 02/17/10 |
| Drafted: | BJM |
| Reviewed: | DEW |
| Task No. | DWA-8255 |
| Sheet: | 1 of 2 |

*D. Woolley & Associates*
2832 Walnut Avenue, Suite A
Tustin, California 92780
(714) 734-8462 www.dwoolley.com

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| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |
| L7 | N00°00'00"E | 233.53' |
| L8 | S54°20'18"E | 998.71' |
| L9 | N64°12'24"E | (75.09') |
| L10 | N02°38'35"W | (70.34') |
| L11 | N53°45'12"W | 1085.95' |
| L12 | N00°00'00"E | 482.28' |
| L13 | N67°30'00"W | 333.64' |
| L14 | S00°00'00"W | 162.77' |

RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

LEGEND

(A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995

SECTIONAL NUMBER OF T30S, R24E, M.D.M.

LAND USE BOUNDARY LINE

PROPERTY LINE

SECTION LINE

AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

PROFESSIONAL LAND SURVEYOR
DAVID E. WOOLLEY
EXP. 12/31/2010
No. 7304
STATE OF CALIFORNIA

| | | | |
|---|---|---|---|
| Sections 9 and 10, T30S, R24E, Mount Diablo Meridian County of Kern, State of California | **HECA PROJECT** | Scale: | 1' = 300' |
| | | Date: | 02/17/2010 |
| *D. Woolley & Associates*<br>2832 Walnut Avenue, Suite A<br>Tustin, California 92780<br>(714) 734-8462 www.dwoolley.com | EXHIBIT "B", ATTACHMENT "B"<br>FOR CANCELLATION OF A LAND USE CONTRACT | Drafted: | BJM |
| | | Reviewed: | DEW |
| | | Task No. | DWA-8255 |
| | | Sheet: | 2 of 2 |

**NOTICE OF DECISION ON TENTATIVE CANCELLATION OF CONTRACTUAL RESTRICTIONS ON LAND UNDER WILLIAMSON ACT CONTRACT**

**(LAND CONSERVATION ACT OF 1965)**

**NOTICE IS HEREBY GIVEN TO WHOM IT MAY CONCERN:**

1. On June 29, 2010, at the hour of 2:00 p.m., the Board of Supervisors of the County of Kern, in its chambers located at 1115 Truxtun Avenue in the City of Bakersfield, gave tentative approval of the petition of Hydrogen Energy California, LLC, by Manatt, Phelps,and Phillips, LLP, for cancellation of contractual restrictions as to a parcel of land consisting of approximately 491 acres of a Land Use Contract recorded on February 26, 1971, in Book 4495, Page 523, which contractual restrictions were entered into under the Land Conservation Act of 1965, after public hearing duly noticed and held.

2. The name of the owner of the land herein mentioned, at the time of tentative cancellation, was John B. Cauzza, III; Laura B. Cauzza; and Jomistro Properties, LLC.

3. The real property to which the foregoing tentative cancellation proceedings applies is situated in the County of Kern, State of California, and is described in Exhibit "A" attached hereto and made a part hereof by this reference.

4. Pursuant to the provisions of subdivision (a)(2) of Government Code section 51282, the Board found and determined that the proposed cancellation was in the public interest, and further found and determined:

(a) Other public concerns, which include public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, substantially outweigh the objectives of the Williamson Act Land Use Contract;

(b) There is no available and suitable proximate noncontracted land for the use proposed on the contracted land and the site was selected based upon the proximity to a carbon dioxide storage reservoir, existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed power generation.

The petitioner asked for such cancellation on the grounds for the purpose of allowing approval and construction of an integrated gasification combined cycle power generating facility by the applicant. This cancellation action is not be become effective until the California Energy Commission issues a permit based on its environmental review for Project Docket No. 08-AFC-8.

Dated this 29th day of June, 2010, by order of the Board of Supervisors of the County of Kern.

KATHLEEN KRAUSE
Clerk of the Board of Supervisors
County of Kern, State of California

Judy A. Denny
Deputy Clerk

BD/kjw
#194718
10.2750

EXHIBIT "A"

The parcel of land as to which such cancellation is asked consists of approximately 491 acres, located at the south side of Adohr Road, west of Tupman Road, northwest of Tupman, California.

# BEFORE THE BOARD OF SUPERVISORS
## COUNTY OF KERN, STATE OF CALIFORNIA

**In the matter of:** **Resolution No. 2010-168**

**TENTATIVE CANCELLATION OF LAND USE RESTRICTIONS, LAND CONSERVATION ACT (WILLIAMSON ACT) (GOV. CODE § 51282); (HYDROGEN ENERGY CALIFORNIA, LLC by MANATT, PHELPS, AND PHILLIPS, LLP)**

**I, KATHLEEN KRAUSE, Clerk of the Board of Supervisors of the County of Kern, State of California, do hereby certify that the following resolution, on motion of Supervisor Maben, seconded by Supervisor Rubio, was duly passed and adopted by said Board of Supervisors at an official meeting hereof this 29th day of June, 2010, by the following vote, to wit:**

**AYES:** **McQuiston, Maben, Maggard, Watson, Rubio**

**NOES:** **None**

**ABSENT:** **None**

**KATHLEEN KRAUSE**
Clerk of the Board of Supervisors
County of Kern, State of California

Deputy Clerk

# RESOLUTION

Section 1. WHEREAS:

(a) Hydrogen Energy California, LLC, by Manatt, Phelps, and Phillips, LLP, has filed with this Board a petition for cancellation of contractual land use restrictions contained in a contract recorded on February 26, 1971, in Book 4495, Page 523, which restrictions were entered into under the Land Conservation Act of 1965 (Williamson Act)

#2010-168

on the land herein described, located in Agricultural Preserve No. 3 under authority of Government Code section 51282; and

(b) The parcel of land as to which such cancellation is asked consists of approximately 491 acres, located at the south side of Adohr Road, west of Tupman Road, northwest of Tupman, California; and

(c) The Planning and Community Development Department has investigated possible environmental impacts of the cancellation and found the cancellation to be Statutorily Exempt from the requirements for preparation of environmental documents pursuant to Section 15271 of the State CEQA Guidelines; and

(d) The petitioner asks such cancellation on the grounds or for the purposes following: The proposed cancellation is being sought in order to facilitate approval and construction of an integrated gasification combined cycle power generating facility by the applicant; and

(e) Notice of hearing on said matter has been duly given in accordance with law and section 51284 of the Government Code, including sending a copy of the hearing notice and landowner's petition for cancellation to the Director of Conservation for the State of California, and said hearing has been duly conducted and evidence having been received, and all persons desiring to be heard in said matter having been given an opportunity to be heard; and

(f) No owner of any property located in the County of Kern has protested the proposed cancellation; and

(g) Pursuant to the provisions of section 51283 of the Government Code, the County Assessor has determined the full cash value of the parcel of land with respect to which cancellation is requested, as though it were free of the contractual restriction, and has certified to this Board that the amount thereof is $2,455,750 and that the most recently announced County assessment ratio is 100%, and that the cancellation fee is 12.5% of this value, or $306,969, and has certified that there are no additional deferred taxes under Government Code section 51283; and

(j) Staff has recommended that the cancellation shall not become effective until the California Energy Commission issues a permit following its environmental review for Project Docket No. O8-AFC-8.

Section 2. NOW, THEREFORE, IT IS HEREBY RESOLVED by the Board of Supervisors of the County of Kern, State of California, as follows:

1. This Board finds the facts recited herein are true, further finds that this Board has jurisdiction to consider, approve, and adopt the subject of this Resolution, and hereby incorporates and makes all the findings recommended by Staff, whether verbally or in their written reports pertaining hereto.

2. This Board finds and determines that the applicable provisions of the California Environmental Quality Act of 1970, the State CEQA Guidelines and the Kern County Guidelines have been duly observed in conjunction with said hearing and the considerations of this project and all of the previous proceedings related hereto.

3. This Board finds and determines that this project is Statutorily Exempt under Section 15271 of the State CEQA Guidelines.

4. In accordance with subdivision (e) of Government Code section 51282, the petition for cancellation was accompanied by a proposal for a specified alternative use of the land, as mentioned in recital (d) above.

5. Pursuant to the provisions of subdivision (a) (2) of Government Code section 51282, this Board finds and determines that the proposed cancellation is consistent with the purposes of sections 51280 et seq. and further finds and determines:

(a) Other public concerns, which include public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, substantially outweigh the objectives of the Williamson Act Land Use Contract;

(b) There is no available and suitable proximate noncontracted land for the use proposed on the contracted land and the site was selected based upon the proximity to a carbon dioxide storage reservoir, existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed power generation.

As used in this section, "proximate, noncontracted land" means land not restricted by contract pursuant to the Williamson Act, which is sufficiently close to the contracted land that it can serve as a practical alternative for the use which is proposed for the contracted land; "suitable for the proposed use" means that the salient features of the proposed use can be served by land not restricted by contract pursuant to the Williamson Act, whether a single parcel or a combination of contiguous or discontiguous parcels; and "contracted land" means the land subject to the proposed cancellation.

6. This Board does hereby determine that the amount of the cancellation fee which the owner shall pay to the County Treasurer as deferred taxes upon such cancellation, in accordance with paragraph (b) of section 51283 of the Government Code,

is the sum of $306,969.00 and does hereby certify said sum to the County Auditor; and finds and determines there are no additional deferred taxes due under section 51283.1 of the Government Code.

7. Pursuant to the provisions of Government Code section 51283.4, this Board does hereby establish the following conditions and contingencies, and declares that a certificate of cancellation of contract with respect to said parcel of land will be issued and recorded within thirty (30) days after being notified by the landowner that each and all of said conditions and contingencies is satisfied:

(a) Payment in full of the cancellation fee hereinabove mentioned;

(b) Unless said cancellation fee is fully paid, or a certificate of cancellation is issued, within one year from the date of recordation of the certificate of tentative cancellation, such fee shall be recomputed as of the date the landowner notifies this Board that he has satisfied the conditions and contingencies, as provided in subdivision (b) of Government Code section 51283.4, and the landowner shall pay any additional fee arising from such re-computation as a further condition to issuance of a certificate of cancellation; provided, however, that the landowner shall not be entitled to refund of any cancellation fee previously paid even if the recomputed fee is less;

(c) Landowner shall obtain all permits necessary to commence the project of the proposed alternative use, including a permit issued by the California Energy Commission following its environmental review for Project Docket No. O8-AFC-8.

8. Pursuant to subdivision (c) of Government Code section 51283.4, if the landowner has been unable to satisfy the foregoing conditions and contingencies, he shall notify this Board of the particular conditions or contingencies he is unable to satisfy; and within thirty (30) days after receipt of such notice, and upon a determination by this Board that the landowner is unable to satisfy the foregoing conditions and contingencies, this Board shall execute a certificate of withdrawal of said tentative approval of the cancellation fee previously paid.

9. Pursuant to subdivision (a) of Government Code section 51283.4, this Board may, at the request of the landowner, amend the tentatively approved specified alternative use mentioned in paragraph 3 above, if it finds that such amendment is consistent with all findings made pursuant to subdivision (2) of Government Code subsection 51282(a).

10. The real property to which the foregoing tentative cancellation proceedings applies is situated in the County of Kern, State of California, and is described in Exhibit "A" attached hereto and made a part hereof by this reference.

11. The Clerk of this Board shall execute the form of the Certificate of Tentative Cancellation prepared by County Counsel, and cause it to be filed for record, all in accordance with subdivision (a) of Government Code section 51283.4.

12. The Clerk of this Board shall cause a Notice of Exemption as required by CEQA, prepared by County Counsel, to be filed with the County Clerk upon request.

13. The Clerk of this Board shall publish a Notice of Decision as required by Government Code section 51284, and send a copy of the published Notice of Decision to the California State Director of Conservation at 801 "K" Street, Sacramento, California 95814.

14. The Clerk of this Board shall also transmit copies of this Resolution to the following:

(a) Assessor
(b) Auditor-Controller
(c) Treasurer
(d) Director of Planning Department
(e) County Counsel
(f) Hydrogen Energy California, LLC
(g) Manatt, Phelps, and Phillips, LLP

BD/kjw
#194711v2
10.2750

COPIES FURNISHED:
See above
7-13-10 Jd

# LEGAL DESCRIPTION

## EXHIBIT "A"

## FOR CANCELLATION OF A LAND USE CONTRACT

**Parcel 1:**

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thence leaving said easterly line of Parcel B North 89°27'40" West 3160.86 feet; thence North 44°27'40" West 1196.25 feet to a point on the southerly prolongation of that certain course described as "North 00°46'41" East 1108.72 feet" in Parcel B of said Certificate of Compliance; thence along said course and its southerly prolongation North 00°46'41" East 3100.91 feet; thence along the southerly line of said Parcel A the following two courses:

6) South 89°14'01" East 1205.04 feet (L4);
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thence along said southerly line of Parcel A and its easterly prolongation South 89°51'55" East 539.75 feet (L6); thence North 00°00'00" East 233.53 feet (L7) to its intersection with a point on the Southwesterly line of Parcel A described in said Instrument No. 007612 as "North 54°20'18" West, 1215.43 feet" said point of intersection being referred to hereafter as Point "A" for this description;

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Contains 488.067 acres.

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Contains 3.081 acres.

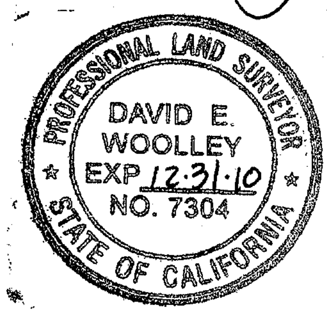
See Exhibit "B", Attachment "B" attached hereto and made a part hereof.

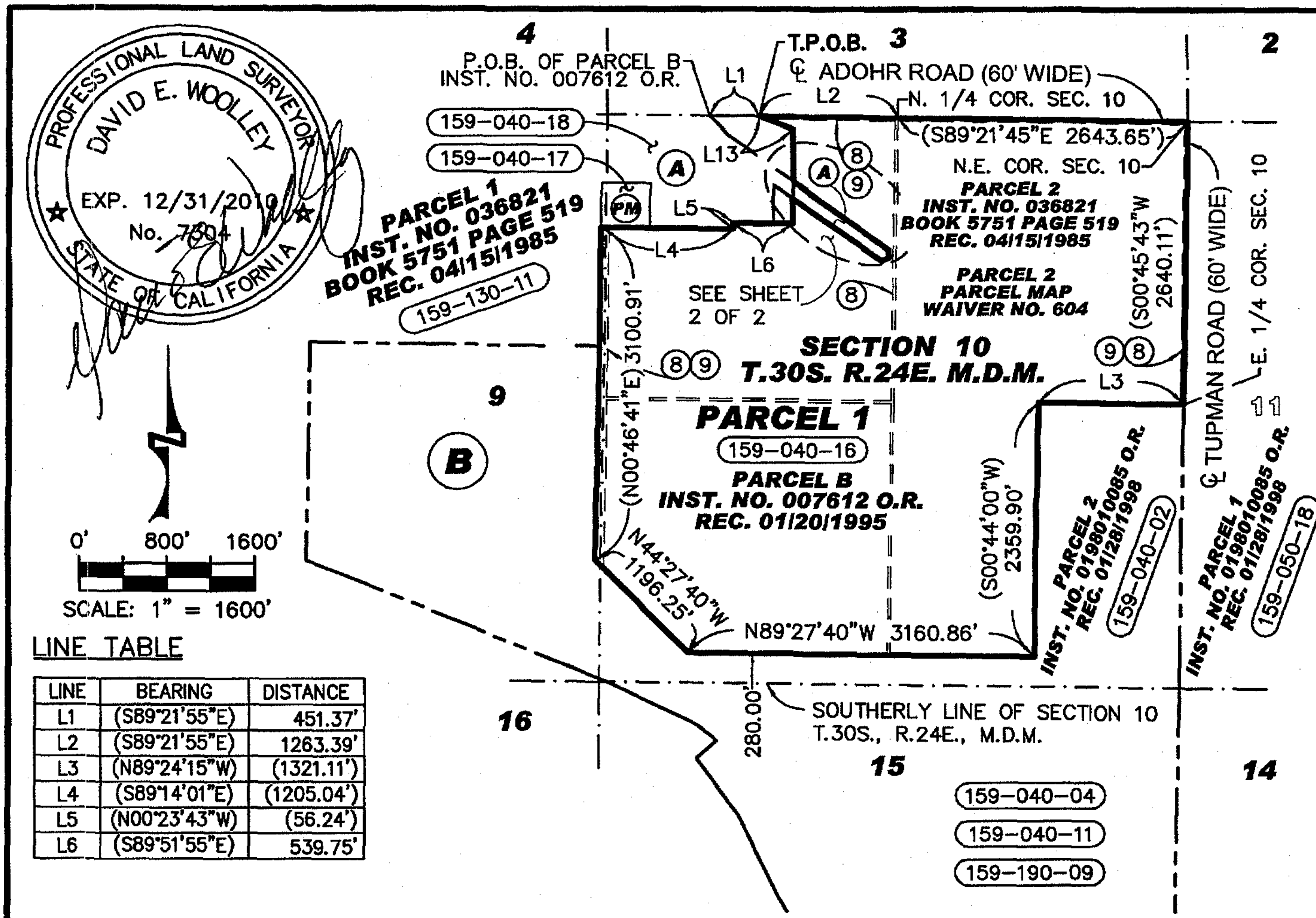
This legal description is not intended for use in the division and /or conveyance of land in violation of the Subdivision Map Act of the State of California.

This legal description has been prepared by me or under my direction:

David E. Woolley, P.L.S. 7304

Date 07/12/2010






## LINE TABLE

| LINE | BEARING | DISTANCE |
|---|---|---|
| L1 | (S89°21'55"E) | 451.37' |
| L2 | (S89°21'55"E) | 1263.39' |
| L3 | (N89°24'15"W) | (1321.11') |
| L4 | (S89°14'01"E) | (1205.04') |
| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |

## RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

## LEGEND

- (A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995
- (B) PARCEL B OF INST. NO. 007612 O.R., REC. 01/20/1995
- (PM) PARCEL MAP NO. 10341, P.M.B. 49/7-8
- **10** SECTIONAL NUMBER OF T30S, R24E, M.D.M.
- (159-040-16) ASSESSORS PARCEL NUMBER
- LAND USE BOUNDARY LINE
- PROPERTY LINE
- SECTION LINE
- AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

## EASEMENT NOTES

BY: FIRST AMERICAN TITLE COMPANY
9201 CAMINI MEDIA, SUITE 100
BAKERSFIELD, CA 93311
(661) 617-1468

COMMITMENT NO. 1003-3112060
TITLE OFFICER - TONY DAMO
DATED: JULY 22, 2008

THE FOLLOWING ITEMS WERE FOUND IN SAID COMMITMENT AND ARE REFERENCED ON THIS MAP. PLOTTABLE ITEMS ARE INDICATED HEREON.

(8) PROPERTY AND PROPERTY RIGHTS IN FAVOR OF MILLER & LUX, INC., A CORPORATION, DATED JULY 30, 1936, RECORDED OCTOBER 10, 1936 IN BOOK 666, PAGE 250, OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

(9) EASEMENT FOR PUBLIC ROADS AND INCIDENTAL PURPOSES, RECORDED MAY 16, 1939 IN BOOK 871, PAGE 98 OF OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

ITEM #'S SHOWN HEREON ARE STATED AS EXCEPTIONS ON ABOVE REFERENCED COMMITMENT. NO RESPONSIBILITY FOR THE COMPLETENESS, ACCURACY, OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP. ALL EASEMENTS NOT AFFECTED, NON PLOTTABLE AND BLANKET, CONTAINED IN THE ABOVE REFERENCED REPORT ARE NOT SHOWN OR INDICATED HEREON.

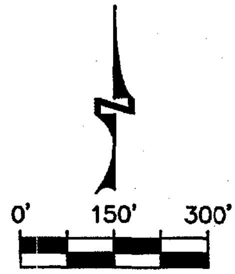
Sections 9 and 10, T30S, R24E, Mount Diablo Meridian
County of Kern, State of California

**HECA PROJECT**

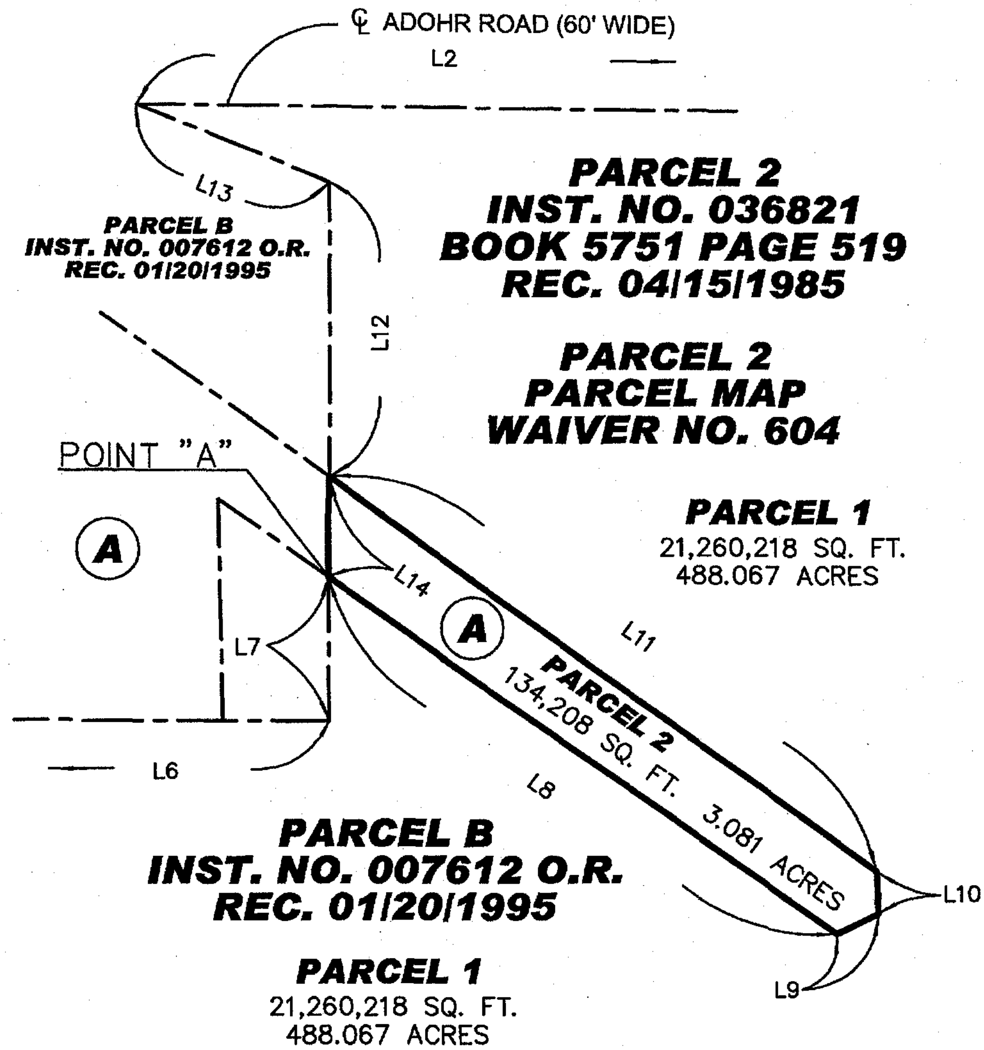
*D. Woolley & Associates*
2832 Walnut Avenue, Suite A
Tustin, California 92780
(714) 734-8462 www.dwoolley.com

**EXHIBIT "B", ATTACHMENT "A"**
FOR CANCELLATION OF A LAND USE CONTRACT

| | |
|---|---|
| Scale: | 1' = 1600' |
| Date: | 02/17/10 |
| Drafted: | BJM |
| Reviewed: | DEW |
| Task No. | DWA-8255 |
| Sheet: | 1 of 2 |




SCALE: 1" = 300'

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| L4 | (S89°14'01"E) | (1205.04') |
| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |
| L7 | N00°00'00"E | 233.53' |
| L8 | S54°20'18"E | 998.71' |
| L9 | N64°12'24"E | (75.09') |
| L10 | N02°38'35"W | (70.34') |
| L11 | N53°45'12"W | 1085.95' |
| L12 | N00°00'00"E | 482.28' |
| L13 | N67°30'00"W | 333.64' |
| L14 | S00°00'00"W | 162.77' |

RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

LEGEND

(A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995

SECTIONAL NUMBER OF T30S, R24E, M.D.M.

——— LAND USE BOUNDARY LINE

—— — — —— PROPERTY LINE

- · — · — · - SECTION LINE

— — — — — AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

PROFESSIONAL LAND SURVEYOR
DAVID E. WOOLLEY
EXP. 12/31/2010
No. 7304
STATE OF CALIFORNIA

| | | | |
|---|---|---|---|
| Sections 9 and 10, T30S, R24E, Mount Diablo Meridian<br>County of Kern, State of California | **HECA PROJECT** | Scale: | 1' = 300' |
| | | Date: | 02/17/2010 |
| *D. Woolley & Associates*<br>2832 Walnut Avenue, Suite A<br>Tustin, California 92780<br>(714) 734-8462 www.dwoolley.com | EXHIBIT "B", ATTACHMENT "B"<br>FOR CANCELLATION OF A LAND USE CONTRACT | Drafted: | BJM |
| | | Reviewed: | DEW |
| | | Task No. | DWA-8255 |
| | | Sheet: | 2 of 2 |

**PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT**
**Lorelei H. Oviatt, AICP, Director**
2700 "M" STREET, SUITE 100
BAKERSFIELD, CA 93301-2323
Phone: (661) 862-8600
FAX: (661) 862-8601 TTY Relay 1-800-735-2929
E-Mail: planning@co.kern.ca.us
Web Address: www.co.kern.ca.us/planning

***DEVELOPMNET SERVICES AGENCY***
***Ted James, AICP, DSA DIRECTOR***
Planning and Community Development Department
Engineering, Survey and Permit Services Department
Roads Department

# FAXSIMILE TRANSIMITTAL SHEET

FAX SERVICE FROM: **KERN COUNTY PLANNING and COMMUNITY DEVELOPMENT DEPARTMENT**

SENT BY: Kathe Malouf (661) 862-8948
Name of Sender

*************************************************************************

Date: 6-4-10

FAX NO. (650) 213-4602

TO: Manatt, Phelps Phillips
Company

ATTN: Camas Steinmetz

4 TOTAL PAGES **(Including this cover sheet)**

COMMENTS: Comment letter from Department of Conservation. Please call if you have questions

I:\adm\jvb\planning\faxsht.

NATURAL RESOURCES AGENCY ARNOLD SCHWARZENEGGER, GOVERNOR

# DEPARTMENT OF CONSERVATION

## DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814
PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

May 27, 2010

**VIA FACSIMILE (661) 862-8601**
Ms. Kathe Malouf, Supervising Planner
Kern County, Planning Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2323

Dear Ms Malouf:

SUBJECT: Cancellation of Land Conservation (Williamson Act) Contract; Landowner: Clifford & Brown; Applicant: Hydrogen Energy California LLC; APN 159-040-16, -18

The Department of Conservation (Department) monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act. The Department has reviewed the application submitted by the Kern County Planning Department (County) regarding the referenced cancellation and offers the following recommendations.

**Project Description**

The petition proposes to cancel 491.15 acres of agricultural land subject to Williamson Act Contract in order to build an Integrated Gasification Combined Cycle power generating facility (project) by Hydrogen Energy California LLC. The project will produce low-carbon baseload electricity by capturing carbon dioxide ($CO_2$) and transporting it for enhanced oil recovery (EOR) and sequestration (permanent storage). The applicant's application is now pending before the California Energy Commission (CEC) to construct the project.

The Project will gasify petroleum coke ("*petcoke*"), or blends of petcoke and coal, as needed, to produce hydrogen to fuel a combustion turbine operating in combined cycle mode. The gasification block feeds a 390-gross-megawatt (MW) combined cycle plant. The net electrical generation output from the Project will provide California with approximately 250 MW of low carbon, baseload power to the grid. The gasification block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for $CO_2$ EOR and sequestration.

The project site is located in a sparsely populated agricultural area near the Elk Hills Oil Field. The site is located on land that lacks irrigation supplies, consists of poor soils and receives minimal rainfall in an average year. The land is not currently in agricultural production. The Project Site is contiguous land bound by Adohr Road to the north, Tupman Road to the east, an irrigation canal to the south, and the Dairy Road right-of-way to the west. The projected is located within Kern County.

**Cancellation Findings**

Government Code (GC) section 51282 states that tentative approval for cancellation may be granted only if the local government makes either of the following findings:

1) Cancellation is **consistent** with purposes of the Williamson Act, ***or***
2) Cancellation is in the **public interest**.

The Department has reviewed the petition, and offers the following comments with regards to the submitted public interest findings:

2) Cancellation is in the Public Interest

   For the cancellation to be in the public interest, the Board must make **both** of the following findings:

   1) Other public concerns substantially outweigh the objectives of the Williamson Act, and

   2) There is no proximate noncontracted land which is available and suitable for the use proposed on the contracted land, or, development of the contracted land would provide more contiguous patterns of urban development than development of proximate noncontracted land.

**Department Comments on Cancellation Public Interest Findings:**

a) Other public concerns substantially outweigh the objectives of the Williamson Act:
   The petition states that the public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, and the economy substantially outweigh the objectives of the Williamson Act. Based on these points, plus the fact that the site is located on land that lacks irrigation supplies, consists of poor soils, receives minimal rainfall, and is not currently in agricultural production, the Department concurs with this particular finding.

b) There is no available and suitable proximate noncontracted land for the use proposed on the contracted land:
   According to the petition, the project site was selected based upon, among other things, the available land, proximity to a carbon dioxide storage reservoir, and the existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed 250 MW of baseload low-carbon power generation. The project site was also chosen for its

reasonable proximity to the Interstate 5, State Routes (SR) 58 &119, and Stockdale Highway. The geology in the vicinity of the project site makes it one of the premier locations in the United States for $CO_2$, EOR and sequestration. The Department concurs with this particular finding.

Based on the facts presented the cancellation application appears to meet the public interest findings, and the Department would have no objection to its approval by the Kern County Board of Supervisors.

Thank you for the opportunity to provide comments on the proposed cancellation. Please provide our office with a copy of the Notice of the Public Hearing on this matter ten (10) working days before the hearing and a copy of the published notice of the Board's decision within 30 days of the tentative cancellation pursuant to GC section 51284. If you have any questions concerning our comments, please contact Sharon Grewal, Environmental Planner at (916) 327-6643.

Sincerely,

Dan Otis
Program Manager

CC: Kern County Farm Bureau
801 South Mount Vernon Avenue
Bakersfield, CA 93307-2888

California Energy Commission
Siting, Transmission and Environmental Protection Division
1516 Ninth Street,
Sacramento, CA 95814-5512

# KERN COUNTY PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT

**Board of Supervisors**

**STAFF REPORT**

**Date:** June 29, 2010

FILE: Cancellation #10-1
Map #120
S.D.: #4 - Watson

**TITLE:** Cancellation of Land Use Restrictions, Land Conservation Act, Agricultural Preserve No. 3 (Zoning Map No. 120) and Contract Amending Land Use Contract

**PROPOSAL:** Cancellation of a an approximate 491-acre portion of a Land Use Contract within Agricultural Preserve No. 3

**APPLICANT:** Hydrogen Energy California, LLC by Manatt, Phelps, and Phillips, LLP (PP09271)

**LAND OWNERS:** John B. Cauzza, III; Laura B. Cauzza; Jomistro Properties, LLC

**PROJECT SIZE:** Approximately 491 acres

**LOCATION:** South side of Adohr Road, west of Tupman Road, northwest of Tupman

**GENERAL PLAN DESIGNATION:** 8.1 (Intensive Agriculture)

**SURROUNDING LAND USE/ZONING:** North, East, and West - Irrigated crops/A (Exclusive Agriculture); South - Irrigated crops and Westside Canal/A

**PROJECT ANALYSIS:** The land owners and applicant are requesting the cancellation of an approximate 491-acre portion of a Williamson Act Land Use Contract that was recorded on February 26, 1971, in Book 4495, at Page 523 of Official Records. This petition for cancellation is being sought in order to facilitate approval and construction of an integrated gasification combined cycle power generating facility by the applicant. As proposed, the facility will produce low-carbon baseload electricity by capturing carbon dioxide ($CO_2$) and transporting it for enhanced oil recovery and $CO_2$ sequestration. The applicant, is a direct affiliate and successor-in-interest to Hydrogen Energy International, LLC, which has an option to purchase the project site from the land owners, along with an additional 628 adjacent acres, and currently has an application (application for Certification 08-AFC-8) pending before the State of California Energy Commission to seek approval of the project.

The project will gasify petroleum coke (petcoke), or blends of petcoke and coal, as needed, to produce hydrogen to fuel a combustion turbine operating in combined cycle mode. The gasification block feeds a 390 (gross) megawatt combined cycle plant. The net electrical generation output from the project would provide California with approximately 250 megawatts of low-carbon, baseload power to the grid. The gasification block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for $CO_2$ enhanced oil recovery and sequestration.

The project site is bound by Adohr Road to the north, Tupman Road to the east, an irrigation canal to the south, and the Dairy Road right-of-way to the west.

Approvals for this facility are currently being sought, by the applicant, through the State of California Energy Commission (CEC). Staff had originally intended to wait until all State approvals had been granted before presenting this case in front of your Board; however, CEC staff has asked that the County adopt a decision on the cancellation prior to the State hearing. A project level Environmental Impact Report is being prepared by CEC staff for the facility request.

Section 51282 of the California Government Code states that your Board may grant a tentative approval for cancellation of a contract only if one of the following findings can be made:

(1) That the cancellation is consistent with the purposes of Chapter 7.

(2) That cancellation is in the public interest.

The applicant states that approval of this project would be in the public interest and, therefore, according to Section 51282(a)(2)(c), must offer adequate justification for your Board to also find:

(1) Other public concerns substantially outweigh the objectives of Chapter 7.

(2) There is no proximate noncontracted land which is both available and suitable for the use to which it is proposed the contracted land be put, or that development of the contracted land would provide more contiguous patterns of urban development than development of proximate noncontracted land.

**APPLICANT'S JUSTIFICATION FOR SUPPORTING THE CANCELLATION**

The applicant asserts that the public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, and the economy substantially outweigh the objectives of the Williamson Act Land Use Contract. Specifically the applicant cites the following with regards to the first finding:

The project will demonstrate a first of a kind combination of proven technologies at commercial scale that can provide baseload low-carbon power that will make an essential contribution to addressing each of these concerns. Furthermore, the applicant states, the project's production of low-carbon energy and its associated benefits may serve as a model to be implemented elsewhere in the world. The applicant states that the project will advance public interest on a variety of levels, including:

- **Supplying electricity** – The project will provide approximately 250 megawatts of new, baseload low-carbon generating capacity, enough to power more than 150,000 homes. The CEC estimates that the State will need to add more than 9,000 megawatts of capacity between 2008 and 2018 to meet demand.

- **Capturing Greenhouse Gas Emissions** – The project will prevent the release of more than two million tons per year of greenhouse gases to the atmosphere by sequestering them underground. Existing conventional power plants release carbon dioxide into the atmosphere, rather than capturing and sequestering it. The project will employ state-of-the-art emission control technology to achieve near zero sulfur emissions and avoid flaring during steady-state operations. This will help the State to meet its important greenhouse gas reduction targets as established by AB 32, AB 1925, and SB 1368. The applicant further states that the project is designed to support Executive Order S-3-05 which sets a State target of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050.

- **Water Supply and Agricultural Production** – The project will conserve fresh water sources by using brackish groundwater for its water needs. The brackish groundwater will be supplied by Buena

Vista Water Storage District, a water district with impaired groundwater sources not suitable for agricultural or drinking use. Project consumption of the sources is expected to benefit local agriculture by removing salts from the groundwater sourcing the Buena Vista Water Storage District which will result in an improved groundwater quality. As a result, the project will facilitate efforts by the Water District to improve local groundwater quality and agriculture in localized areas.

- **Protecting Energy Security and Domestic Energy Supplies** – The project will conserve domestic energy supplies by using petcoke, a local energy source that is currently exported overseas for fuel. Conservation of this domestic energy supply will enhance energy security. The project will also reduce stress on the United States natural gas supplies by using petcoke to generate electricity. Petcoke is a byproduct from the oil refining process and is abundantly available. In addition, the project will produce additional energy from existing California oilfields by injecting $CO_2$ for enhanced oil recovery which could increase field reserves by up to 25 percent.

- **Promoting Hydrogen Infrastructure** – The project will increase the supply of hydrogen available to support the State's goal of energy independence as expressed in California Executive Order S-7-04 which mandates the development of a hydrogen infrastructure and hydrogen transportation in California. The project is poised to supplement the quantities of hydrogen necessary for these future energy and transportation technologies, and support California's roles as a world leader in clean energy.

- **Stimulating the Local and California Economy** – The project will boost the local and California economy with an estimated 1,500 jobs associated with construction and approximately 100 permanent positions associated with project operations. In addition, estimated indirect and induced effects of construction that will occur within Kern County could result in more than 4,000 jobs, representing a long-term economic benefit to Kern County.

The project has been awarded federal funds by the State Department of Energy and the study of the project has the financial support of Southern California Edison Company. The California Public Utilities Commission has determined that the project is consistent with a variety of State policies.

Given these public concerns that will be addressed by the project, the applicant asserts that there is substantial evidence to support the finding set forth in Government Code Section 51282(c)(1) that "other public concerns substantially outweigh the objects of the Williamson Act Land Use Contract."

Regarding the second finding, there is no proximate noncontracted land which is both available and suitable for the use to which it is proposed the contract land be put, the applicant states that the project site is located in a sparsely populated agricultural area near the Elk Hills Oil Field. The project site is contiguous land bounded by Adohr Road to the north, Tupman Road to the east, an irrigation canal to the south, and the Dairy Road right-of-way to the west. There are only a few homes within a mile of the project site and the unincorporated community of Tupman is 1.5 miles from the site. Primary access will be from Interstate 5, to Stockdale Highway west to Diary Road then south to Adohr Road. The topography of the project site is flat.

The applicant asserts that the project site was selected based upon the available land, proximity to a carbon dioxide storage reservoir and the existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed 250 megawatts of baseload low-carbon power generation. The site was also selected for its reasonable proximity to Interstate 5, State Route 58, State Route 119, and Stockdale Highway.

There is no noncontracted land proximate to the project site which is both available and suitable for the project. As such, the finding set forth in Government Code Section 51282(c)(2) is satisfied. With regard to availability, the applicant maintains that virtually all land in the proximity of the project site is either under Williamson Act Land Use Contracts or in the Tule Elk Reserve State Park. With regard to suitability, the applicant states that there are no alternative sites that meet the highly specific site selection requirements of the project. The applicant states that prior to selecting the current project site, they submitted an initial application for certification in July, 2008, for which a different location was proposed, the applicant decided to move the project when it was discovered that the first site had undisclosed sensitive biological resources on the original site. Subsequently, the applicant was required to conduct an alternative site analysis to identify an alternative site which ultimately became the current project site. Other sites were considered in the vicinity of Buttonwillow and Tupman; however, the alternative sites were rejected for various reasons, including topography, distance from the proposed carbon dioxide custody transfer point, sensitive environmental receptors, and/or land availability. Additionally, each of the alternative sites, with one exception were encumbered by a Williamson Act Land Use Contract. The applicant asserts that, in summary, no alternative sites were identified on either contracted or noncontracted land that were both available and suitable for the project.

## COMMENTS OF THE STATE DEPARTMENT OF CONSERVATION

The petition for cancellation was submitted to the State Department of Conservation, and in a response letter dated May 27, 2010 (attached), the State Department of Conservation states that, based on the facts presented in the cancellation application, it appears to meet the public interest findings and the Department stated that it would have no objection to approval by your Board. The Department notes that the petition states that the public concerns of energy supply, energy security, water supply, hydrogen infrastructure, and economy substantially outweigh the objectives of the Williamson Act Land Use Contract. Based on the applicant's points, the State Department of Conservation concurred with the finding.

Additionally, the Department concurred with the applicant's points regarding the second finding that there is no available and suitable proximate noncontracted land for the use proposed on the contracted land.

## PLANNING DEPARTMENT'S CONCLUSION

It is Staff's opinion that there is adequate justification for your Board to find that the public interests that will be furthered by the implementation of the project outweigh the objectives of preserving the site for agricultural use under the Williamson Act Land Use Contract. The siting of facilities to provide an alternative low-carbon source of power will protect the health and safety of the State's expanding population. The project site will not be converted to urban use, therefore, approval of this request should not affect urban development patterns. Because the employees at the proposed facility should not require new commercial amenities near the project site, surrounding agricultural land and uses should not be disrupted.

Staff has reviewed the request with regard to conformance with State and local requirements of the Agricultural Preserve program and confirms that the project complies with all noted provisions. Staff notes that the CEC is the Lead Agency (for licensing thermal power plants 50 megawatts and larger) under the California Environmental Quality Act (CEQA) and has a certified regulatory program under CEQA. Under its certified program, the CEC is exempt from having to prepare an Environmental Impact Report (EIR). Its certified program, however, does require environmental analysis of the project, including an analysis of alternatives and mitigation measures to minimize any significant adverse effect the project may have on the environment.

For the purposes of complying with CEQA, Staff is utilizing Section 15271, in your Board's consideration of the cancellation request. Section 15271 is an exemption for certified State regulatory programs which states in part:

> "CEQA does not apply to actions undertaken by a public agency relating to any thermal power plant site or facility, including the expenditure, obligation, or encumbrance of funds by a public agency for planning, engineering, or design purposes, or for the conditional sale or purchase of equipment, fuel, water (except groundwater), steam, or power for such a thermal power plant, if the thermal power plant site and related facility will be the subject of an EIR or Negative Declaration or other document or documents prepared pursuant to a regulatory program certified pursuant to Public Resource Code Section 21080.5, which will be prepared by:
>
> (1) The State Energy Resources Conservation and Development Commission.
> (2) The Public Utilities Commission.
> (3) The city or County in which the power plant and related facility would be located."

The Kern County Assessor's Office has reviewed this request and has calculated the required cancellation fee based upon the site's fair market value. This cancellation will not become effective until the applicant has submitted the required cancellation fee of $306,969 to the Clerk of the Board.

**PUBLIC INQUIRY OR CORRESPONDENCE:** Kern County Assessor's Office; State Department of Conservation

**CEQA ACTION:** Statutory Exempt, Section 15271

**DEPARTMENT RECOMMENDATION:** Adopt resolution approving cancellation subject to payment of cancellation fee; direct Clerk of the Board to issue a Tentative Certificate of Cancellation which requires the payment of cancellation fees; issue a Certificate of Cancellation subject to the payment of cancellation fees

**BASIS FOR APPROVAL AND RECOMMENDED FINDINGS:**

(1) Based on facts presented by the applicant, this Board finds that other public concerns, which include public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, substantially outweigh the objectives of the Williamson Act Land Use Contract.

(2) Based on facts presented by the applicant, there is no available and suitable proximate noncontracted land for the use proposed on the contracted land and the site was selected based upon the proximity to a carbon dioxide storage reservoir, existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed power generation.

(3) This Board has found the project to be statutory exempt from the requirement for preparation of environmental documents pursuant to, Section 15271 of the State CEQA Guidelines.

SFC:KM:sc
Attachments

JAMES W. FITCH
ASSESSOR-RECORDER

ANTHONY ANSOLABEHERE
Assistant Assessor

JEANI SMITH
Assistant Recorder

ASSESSOR'S OFFICE
Telephone (661) 868-3485
1115 Truxtun Avenue
Bakersfield, CA 93301-4639

RECORDER'S OFFICE
Telephone (661) 868-6400
1655 Chester Avenue
Bakersfield, CA 93301-5232

April 14, 2010

Board of Supervisors
Administration Building
1115 Truxtun Avenue
Bakersfield, California 93301

**Re: Cancellation of Land Use Contract**
Applicant: Hydrogen Energy California LLC
Assessor's Parcel Number: Portion of 159-040-16 (488.07 Acres)
Portion of 159-040-18 ( 3.08 Acres)
Williamson Act Cancellation: 10-1

**Honorable Board:**

In accordance with provisions of Section 51283 of the Government Code, the Assessor certifies the fair market value and cancellation fee for the above property or a portion thereof.

| CANCELLATION VALUE | CANCELLATION FEE |
|---|---|
| $2,455,750 | $306,969 |

The Department of Conservation and or owner may request a formal review from the Assessor of the certified value as specified in Section 51203 of the Government Code. Any request must be made within 45 days of the date of this notice.

Sincerely,

JAMES W. FITCH
Kern County Assessor-Recorder

Jerel E. Hansen, Senior Appraiser
Agricultural Division

cc: Department of Conservation
cc: Camas Steinmetz
cc: Hydrogen Energy California LL
cc: Property Landowners
cc: County Planning Department

NATURAL RESOURCES AGENCY ARNOLD SCHWARZENEGGER, GOVERNOR

# DEPARTMENT OF CONSERVATION

DIVISION OF LAND RESOURCE PROTECTION

801 K STREET • MS 18-01 • SACRAMENTO, CALIFORNIA 95814
PHONE 916 / 324-0850 • FAX 916 / 327-3430 • TDD 916 / 324-2555 • WEBSITE conservation.ca.gov

May 27, 2010

**VIA FACSIMILE (661) 862-8601**
Ms. Kathe Malouf, Supervising Planner
Kern County, Planning Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2323

Dear Ms Malouf:

SUBJECT: Cancellation of Land Conservation (Williamson Act) Contract; Landowner: Clifford & Brown; Applicant: Hydrogen Energy California LLC; APN 159-040-16, -18

The Department of Conservation (Department) monitors farmland conversion on a statewide basis and administers the California Land Conservation (Williamson) Act. The Department has reviewed the application submitted by the Kern County Planning Department (County) regarding the referenced cancellation and offers the following recommendations.

## Project Description

The petition proposes to cancel 491.15 acres of agricultural land subject to Williamson Act Contract in order to build an Integrated Gasification Combined Cycle power generating facility (project) by Hydrogen Energy California LLC. The project will produce low-carbon baseload electricity by capturing carbon dioxide ($CO_2$) and transporting it for enhanced oil recovery (EOR) and sequestration (permanent storage). The applicant's application is now pending before the California Energy Commission (CEC) to construct the project.

The Project will gasify petroleum coke ("*petcoke*"), or blends of petcoke and coal, as needed, to produce hydrogen to fuel a combustion turbine operating in combined cycle mode. The gasification block feeds a 390-gross-megawatt (MW) combined cycle plant. The net electrical generation output from the Project will provide California with approximately 250 MW of low carbon, baseload power to the grid. The gasification block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for $CO_2$ EOR and sequestration.

The project site is located in a sparsely populated agricultural area near the Elk Hills Oil Field. The site is located on land that lacks irrigation supplies, consists of poor soils and receives minimal rainfall in an average year. The land is not currently in agricultural production. The Project Site is contiguous land bound by Adohr Road to the north, Tupman Road to the east, an irrigation canal to the south, and the Dairy Road right-of-way to the west. The projected is located within Kern County.

**Cancellation Findings**

Government Code (GC) section 51282 states that tentative approval for cancellation may be granted only if the local government makes **either** of the following findings:

1) Cancellation is **consistent** with purposes of the Williamson Act, ***or***
2) Cancellation is in the **public interest.**

The Department has reviewed the petition, and offers the following comments with regards to the submitted public interest findings:

2) Cancellation is in the Public Interest

   For the cancellation to be in the public interest, the Board must make **both** of the following findings:

   1) Other public concerns substantially outweigh the objectives of the Williamson Act, and

   2) There is no proximate noncontracted land which is available and suitable for the use proposed on the contracted land, or, development of the contracted land would provide more contiguous patterns of urban development than development of proximate noncontracted land.

**Department Comments on Cancellation Public Interest Findings:**

a) Other public concerns substantially outweigh the objectives of the Williamson Act:
   The petition states that the public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, and the economy substantially outweigh the objectives of the Williamson Act. Based on these points, plus the fact that the site is located on land that lacks irrigation supplies, consists of poor soils, receives minimal rainfall, and is not currently in agricultural production, the Department concurs with this particular finding.

b) There is no available and suitable proximate noncontracted land for the use proposed on the contracted land:
   According to the petition, the project site was selected based upon, among other things, the available land, proximity to a carbon dioxide storage reservoir, and the existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed 250 MW of baseload low-carbon power generation. The project site was also chosen for its

reasonable proximity to the Interstate 5, State Routes (SR) 58 &119, and Stockdale Highway. The geology in the vicinity of the project site makes it one of the premier locations in the United States for $CO_2$, EOR and sequestration. The Department concurs with this particular finding.

Based on the facts presented the cancellation application appears to meet the public interest findings, and the Department would have no objection to its approval by the Kern County Board of Supervisors.

Thank you for the opportunity to provide comments on the proposed cancellation. Please provide our office with a copy of the Notice of the Public Hearing on this matter ten (10) working days before the hearing and a copy of the published notice of the Board's decision within 30 days of the tentative cancellation pursuant to GC section 51284. If you have any questions concerning our comments, please contact Sharon Grewal, Environmental Planner at (916) 327-6643.

Sincerely,

Dan Otis
Program Manager

CC: Kern County Farm Bureau
801 South Mount Vernon Avenue
Bakersfield, CA 93307-2888

California Energy Commission
Siting, Transmission and Environmental Protection Division
1516 Ninth Street,
Sacramento, CA 95814-5512

# APPLICANT'S PETITION
# FOR CANCELLATION

# LEGAL DESCRIPTION

## EXHIBIT "B"

### FOR CANCELLATION OF A LAND USE CONTRACT

**Parcel 1:**

That portion of Parcel B of Certificate of Compliance, in the County of Kern, State of California, recorded January 20, 1995 as Instrument No. 007612, Official Records of said county, being described as those portions of Sections 9 and 10, Township 30 South, Range 24 East, Mount Diablo Meridian, described as follows:

**Commencing** at the Point of Beginning (P.O.B.) of said Parcel B, as depicted on Exhibit "B", Attachment "A"; thence along the northerly line of said Parcel B South 89°21'55" East 451.37 feet (L1) to the **True Point of Beginning (T.P.O.B.)**; thence along the northerly and easterly lines of said Parcel B the following five courses:

1) South 89°21'55" East 1263.39 feet (L2) to the north quarter corner of said Section 10;
2) Thence South 89°21'45" East 2643.65 feet to the northeast corner of said Section 10;
3) Thence South 00°45'43" West 2640.11 feet to the east quarter corner of said Section 10;
4) Thence North 89°24'15" West 1321.11 feet (L3);
5) Thence South 00°44'00" West 2359.90 feet to a point on a line parallel with and 280.00 feet northerly of the southerly line of said Section 10;

thence leaving said easterly line of Parcel B North 89°27'40" West 3160.86 feet; thence North 44°27'40" West 1196.25 feet to a point on the southerly prolongation of that certain course described as "North 00°46'41" East 1108.72 feet" in Parcel B of said Certificate of Compliance; thence along said course and its southerly prolongation North 00°46'41" East 3100.91 feet; thence along the southerly line of said Parcel A the following two courses:

6) South 89°14'01" East 1205.04 feet (L4);
7) Thence North 00°23'43" West 56.24 feet (L5);

thence along said southerly line of Parcel A and its easterly prolongation South 89°51'55" East 539.75 feet (L6); thence North 00°00'00" East 233.53 feet (L7) to its intersection with a point on the Southwesterly line of Parcel A described in said Instrument No. 007612 as "North 54°20'18" West, 1215.43 feet" said point of intersection being referred to hereafter as Point "A" for this description;

thence along the southwesterly, southeasterly and northeasterly lines of said Parcel A the following three courses:

8) South 54°20'18" East 998.71 feet (L8);

9) Thence North 64°12'24" East 75.09 feet (L9);

10) Thence North 02°38'35" West 70.34 feet (L10);

thence North 53°45'12' West 1085.95 feet (L11) to its intersection with the northerly prolongation of the aforementioned line described as "North 00°00'00' East 233.53 feet (L7)"; thence along said prolongation North 00°00'00" East 482.28 feet (L12); thence North 67°30'00" West 333.64 feet (L13) to the **True Point of Beginning.**

Contains 488.067 acres.

See Exhibit "B", Attachment "A" attached hereto and made a part hereof.

**Parcel 2:**

That portion of Parcel A of Certificate of Compliance, in the County of Kern, State of California, recorded January 20, 1995 as Instrument No. 007612, Official Records of said county, being described as those portions of Sections 9 and 10, Township 30 South, Range 24 East, Mount Diablo Meridian, describes as follows:

**Beginning** at the aforementioned Point "A" as described hereinabove and depicted on Exhibit "B", Attachment "B"; thence along the southwesterly, southeasterly and northeasterly lines of said Parcel A the following three courses:

1) South 54°20'18" East 998.71 feet (L8);

2) Thence North 64°12'24" East 75.09 feet (L9);

3) Thence North 02°38'35" West 70.34 feet (L10);

thence North 53°45'12' West 1085.95 feet (L11) to its intersection with the northerly prolongation of the aforementioned line described as "North 00°00'00' East 233.53 feet (L7)" of Parcel 1 hereinabove described; thence along said prolongation South 00°00'00" West 162.77 (L14) feet to the **Point of Beginning.**

Contains 3.081 acres.

See Exhibit "B", Attachment "B" attached hereto and made a part hereof.

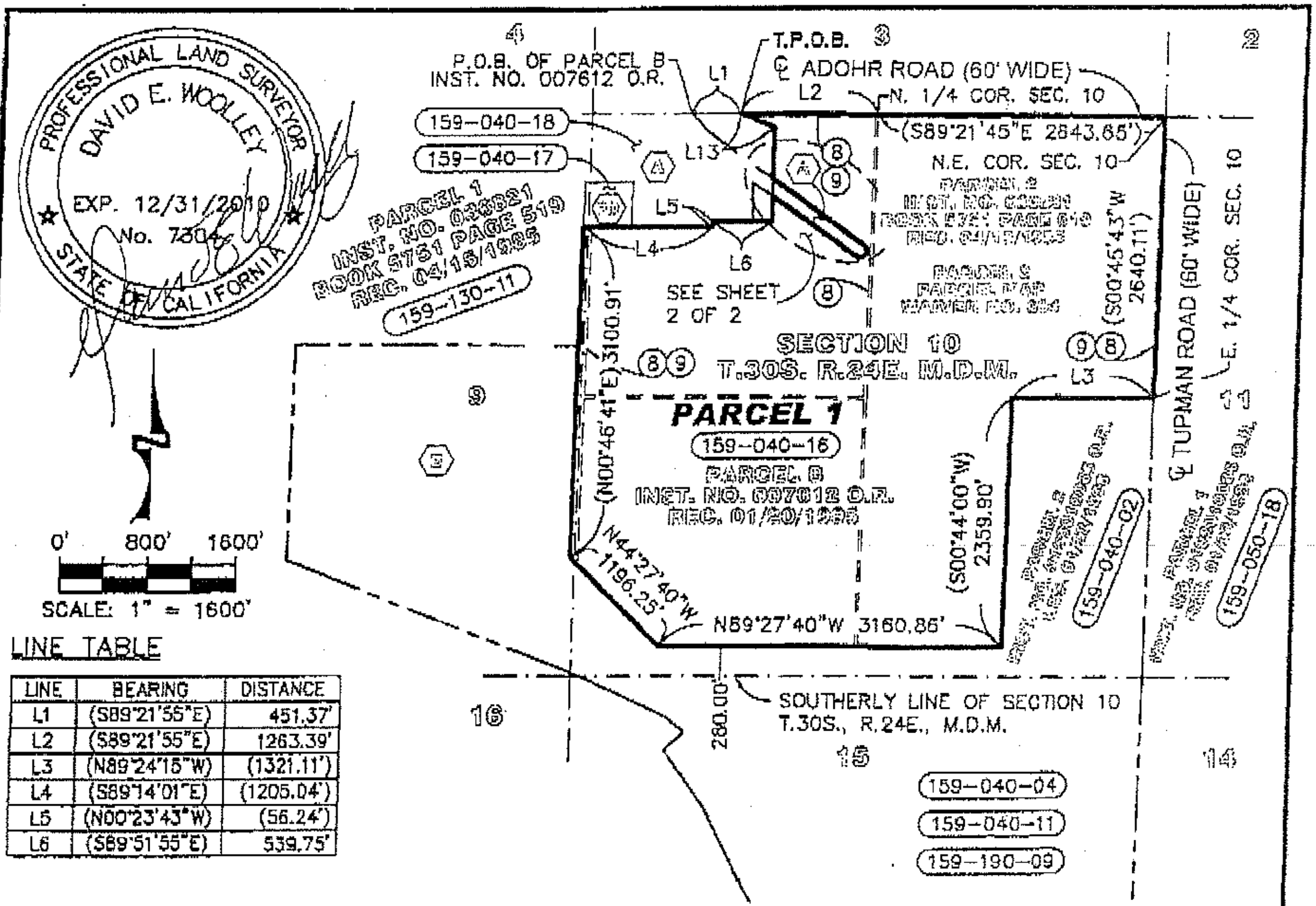
This legal description is not intended for use in the division and /or conveyance of land in violation of the Subdivision Map Act of the State of California.

This legal description has been prepared by me or under my direction:

DAVID E. WOOLLEY EXP 12-31-2010 NO 7304

David E. Woolley, P.L.S. 7304

02-16-2010
Date




LINE TABLE

| LINE | BEARING | DISTANCE |
|---|---|---|
| L1 | (S89°21'55"E) | 451.37' |
| L2 | (S89°21'55"E) | 1263.39' |
| L3 | (N89°24'15"W) | (1321.11') |
| L4 | (S89°14'01"E) | (1205.04') |
| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |

RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

LEGEND

(A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995

(B) PARCEL B OF INST. NO. 007612 O.R., REC. 01/20/1995

PARCEL MAP NO. 10341, P.M.B. 49/7-8

10 SECTIONAL NUMBER OF T30S, R24E, M.D.M.

(159-040-16) ASSESSORS PARCEL NUMBER

LAND USE BOUNDARY LINE

PROPERTY LINE

SECTION LINE

AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

EASEMENT NOTES

BY: FIRST AMERICAN TITLE COMPANY
9201 CAMINI MEDIA, SUITE 100
BAKERSFIELD, CA 93311
(661) 617-1458

COMMITMENT NO. 1003-3112060
TITLE OFFICER – TONY DAMO
DATED: JULY 22, 2008

THE FOLLOWING ITEMS WERE FOUND IN SAID COMMITMENT AND ARE REFERENCED ON THIS MAP. PLOTTABLE ITEMS ARE INDICATED HEREON.

(8) PROPERTY AND PROPERTY RIGHTS IN FAVOR OF MILLER & LUX, INC., A CORPORATION, DATED JULY 30, 1936, RECORDED OCTOBER 10, 1936 IN BOOK 666, PAGE 250, OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

(9) EASEMENT FOR PUBLIC ROADS AND INCIDENTAL PURPOSES, RECORDED MAY 16, 1939 IN BOOK 871, PAGE 98 OF OFFICIAL RECORDS. THIS ITEM AFFECTS THE SUBJECT PROPERTY AND IS PLOTTED HEREON.

ITEM #'S SHOWN HEREON ARE STATED AS EXCEPTIONS ON ABOVE REFERENCED COMMITMENT. NO RESPONSIBILITY FOR THE COMPLETENESS, ACCURACY, OR CONTENT OF SAID REPORT IS ASSUMED BY THIS MAP. ALL EASEMENTS NOT AFFECTED, NON PLOTTABLE AND BLANKET, CONTAINED IN THE ABOVE REFERENCED REPORT ARE NOT SHOWN OR INDICATED HEREON.

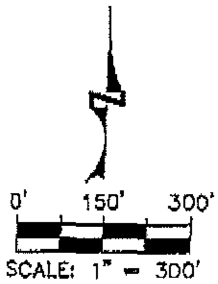
Sections 9 and 10, T30S, R24E, Mount Diablo Meridian
County of Kern, State of California

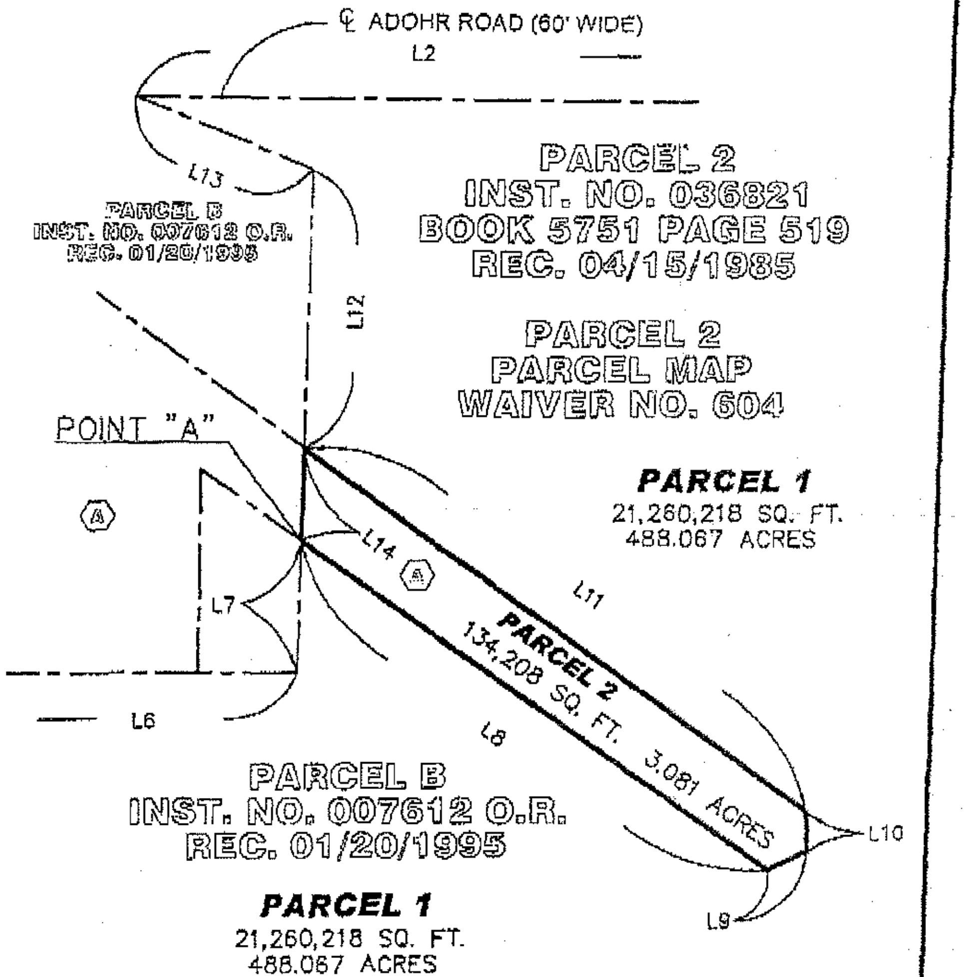
**HECA PROJECT**

EXHIBIT "B",
ATTACHMENT "A"
FOR CANCELLATION OF A LAND USE CONTRACT

| | |
|---|---|
| Scale: | 1' = 1600' |
| Date: | 02/17/10 |
| Drafted: | BJM |
| Reviewed: | DEW |
| Task No. | DWA-8255 |
| Sheet: | 1 of 2 |

D. Woolley & Associates
2832 Walnut Avenue, Suite A
Tustin, California 92780
(714) 734-8462 www.dwoolley.com




LINE TABLE

| LINE | BEARING | DISTANCE |
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| L1 | (S89°21'55"E) | 451.37' |
| L2 | (S89°21'55"E) | 1263.39' |
| L3 | (N89°24'15"W) | (1321.11') |
| L4 | (S89°14'01"E) | (1205.04') |
| L5 | (N00°23'43"W) | (56.24') |
| L6 | (S89°51'55"E) | 539.75' |
| L7 | N00°00'00"E | 233.53' |
| L8 | S54°20'18"E | 998.71' |
| L9 | N64°12'24"E | (75.09') |
| L10 | N02°38'35"W | (70.34') |
| L11 | N53°45'12"W | 1065.95' |
| L12 | N00°00'00"E | 482.28' |
| L13 | N67°30'00"W | 333.64' |
| L14 | S00°00'00"W | 162.77' |

RECORD REFERENCE

( ) INDICATES RECORD DATA PER CERTIFICATE OF COMPLIANCE, REC. 01/20/199 AS INST. NO. 007612 O.R.

LEGEND

(A) PARCEL A OF INST. NO. 007612 O.R., REC. 01/20/1995

SECTIONAL NUMBER OF T30S, R24E, M.D.M.

LAND USE BOUNDARY LINE

PROPERTY LINE

SECTION LINE

AFFECTING EASEMENT LINES, SEE EASEMENT NOTES.

PROFESSIONAL LAND SURVEYOR
DAVID E. WOOLLEY
EXP. 12/31/2010
No. 7304
STATE OF CALIFORNIA

Sections 9 and 10, T30S, R24E, Mount Diablo Meridian
County of Kern, State of California

**HECA PROJECT**

EXHIBIT "B", ATTACHMENT "B"
FOR CANCELLATION OF A LAND USE CONTRACT

D. Woolley & Associates
2832 Walnut Avenue, Suite A
Tustin, California 92780
(714) 734-8462 www.dwoolley.com

| | |
|---|---|
| Scale: | 1' = 300' |
| Date: | 02/17/2010 |
| Drafted: | BJM |
| Reviewed: | DEW |
| Task No. | DWA-8255 |
| Sheet: | 2 of 2 |

## Exhibit "C"

### I. Reasons for Which the Proposed Cancellation is Being Requested

This Williamson Act cancellation over the 491.15 acre portion of APN Nos. 159-040-16-00 and 159-040-18-00 described and depicted in Exhibit "B" (the "*Project Site*") is being requested by the Project Site's Owners in order to facilitate construction of an Integrated Gasification Combined Cycle power generating facility by Hydrogen Energy California LLC of the project ("*Project*") on the Project Site. The Project will be the first of a kind. It will produce low-carbon baseload electricity by capturing carbon dioxide ("$CO_2$") and transporting it for enhanced oil recovery ("*EOR*") and sequestration (permanent storage)[1]. Hydrogen Energy California LLC ("*HECA*"), a direct affiliate and successor-in-interest to Hydrogen Energy International LLC ("*HEI*"), which has an option to purchase the Project Site together with an additional 628 surrounding acres, has an application now pending before the California Energy Commission ("*CEC*") to construct the Project. HEI is jointly owned by BP Alternative Energy North America Inc. and Rio Tinto Hydrogen Energy LLC.

The Project will gasify petroleum coke ("*petcoke*") (or blends of petcoke and coal, as needed) to produce hydrogen to fuel a combustion turbine operating in combined cycle mode. The gasification block feeds a 390-gross-megawatt ("*MW*") combined cycle plant. The net electrical generation output from the Project will provide California with approximately 250 MW of low-carbon, baseload power to the grid. The gasification block will also capture approximately 90 percent of the carbon from the raw syngas at steady-state operation, which will be transported to the Elk Hills Field for $CO_2$ EOR and sequestration.

Highlights of the Project are as follows:

- The Project is being designed to operate with petcoke from California refineries and/or coal. Petcoke is a by-product of the refining process of heavy oils, and is predominantly exported overseas for use as fuel.
- The feedstock will be gasified to produce a synthesis gas (syngas) that will be processed and purified to produce a hydrogen-rich gas, which will be used to fuel the combustion turbine for electric power generation. A portion of the product

[1] The carbon dioxide will be compressed and transported via pipeline to a custody transfer point for injection and use at the nearby Elk Hills Field . The $CO_2$ EOR process involves the injection and reinjection of carbon dioxide to reduce the viscosity and enhance other properties of the trapped oil, thus allowing it to flow through the reservoir and improve extraction. During the process, the injected carbon dioxide becomes sequestered in a secure geologic formation. This process is referred to herein as $CO_2$ EOR and sequestration.

(hydrogen-rich fuel) will also be used to supplementally fire the heat recovery steam generator that produces steam from the combustion turbine exhaust heat.

- Approximately 90 percent of the carbon in the raw syngas will be captured in a high-purity carbon dioxide stream during steady-state operation, compressed, and transported by pipeline to a custody transfer point and then injected into deep underground hydrocarbon reservoirs for $CO_2$ EOR and sequestration.

- The power produced by the Project will have a low-carbon-emission profile, significantly lower than would otherwise be produced by traditional fossil-fueled sources, including natural gas.

- Project greenhouse gas emissions (*e.g.*, carbon dioxide) and sulfur emissions will be reduced through $CO_2$ EOR and sequestration and state of the art emission control technology.

- The gasification block feeds a 390-gross-megawatt (MW) combined cycle plant. The net electrical generation output from the Project will provide approximately 250 MW of low-carbon, baseload power to the grid, feeding major load sources.

- The water source for the Project will be brackish groundwater supplied by the Buena Vista Water Storage District ("*BVWSD*"), and will be treated onsite to meet Project standards. Potable water may be supplied by West Kern Water District for drinking and sanitary purposes.

- There will be no direct surface water discharge of industrial wastewater or storm water. Process wastewater will be treated onsite and recycled within the gasification and power plant systems. Other wastewaters from cooling tower blowdown and raw water treatment will be collected and directed to one of two on-site plant wastewater zero liquid discharge units.

- The Project is designed with state-of-the-art emission-control technology. The Project will feature near zero sulfur emissions during steady-state operation. The Project is also designed to avoid flaring during steady-state operation, and to minimize flaring and sulfur emissions during startup and shut-down operations.

## II. Cancellation Complies with Government Code Section 51282(a)(2)

### A. Other public concerns substantially outweigh the objectives of the Williamson Act

As discussed in detail below, the public concerns of energy supply, energy security, global climate change, water supply, hydrogen infrastructure, and the economy substantially outweigh the objectives of the Williamson Act. As such, the finding set forth in Government Code Section 51282(c)(1) is satisfied.

The Project will demonstrate a first of a kind combination of proven technologies at commercial scale that can provide baseload low-carbon power that will make an essential contribution to addressing each of these concerns as discussed below. Furthermore, the Project's production of low-carbon energy and its associated benefits may serve as a model to be implemented elsewhere in the world. Among the many public interests the Project will advance at the local, statewide, regional, national, and global levels, are the following:

- **Supplying Electricity.** The Project will provide approximately 250 MW of new, baseload low-carbon generating capacity, enough to power over 150,000 homes. The CEC estimates that the State will need to add over 9,000 MW of capacity between 2008 and 2018 to meet demand (CEC 2007).

- **Capturing Green House Gas Emissions.** The Project will prevent the release of more than 2 million tons (roughly equivalent to the carbon dioxide output of 500,000 automobiles) per year of greenhouse gases to the atmosphere by sequestering them underground. Existing conventional power plants release carbon dioxide into the atmosphere, rather than capturing and sequestering it. The Project will employ state-of-the-art emission control technology to achieve near-zero sulfur emissions and avoid flaring during steady-state operations. This will help California meet its important greenhouse gas reduction targets as set forth and exemplified by AB 32[2], AB 1925[3], and SB 1368[4]. The Project is also designed to support Executive Order S-3-05 which sets a State target of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050.

- **Water Supply and Agricultural Production.** The Project will conserve fresh water sources by using brackish groundwater for Project water needs. The brackish groundwater will be supplied from BVWSD, which is a local water district with impaired groundwater sources not suitable for agricultural or drinking use. Project consumption of these impaired sources should beneficially affect local agriculture by

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[2] Assembly Bill 32 (AB 32) was passed to reduce greenhouse gas emissions to 1990 levels by 2020. AB 32 requires the California Air Resources Board ("*CARB*") to assign emissions targets to each sector in the California economy, and to develop regulatory and market methods to ensure compliance, which takes effect in 2012. The California Public Utilities Commission ("*CPUC*") and CEC are to develop specific proposals to CARB for implementing AB 32 in the electricity sector, possibly including a cap-and-trade program.

[3] AB 1925, a law passed in 2006, required the CEC to provide a report to the California legislature by November 2007 "with recommendations for how the State can develop parameters to accelerate the adoption of cost-effective geologic carbon sequestration strategies." This type of legislation clearly demonstrates California's commitment to supporting and encouraging in-state carbon capture and sequestration technology.

[4] Senate Bill 1368 (SB 1368), passed in 2006, establishes an Emission Performance Standard for greenhouse gas emissions from power plants used to serve baseload power in California, which was set by the CPUC at 1,100 pounds of carbon dioxide per megawatt hour of electricity. The intended effect of SB 1368 is to encourage low-carbon power production. The Project's greenhouse gas emissions will be well below this threshold requirement.

removing salts from the groundwater sourcing the BVWSD, thereby improving the groundwater quality. As a result, the Project will facilitate efforts by the BVWSD to improve local groundwater quality and agriculture in localized areas.

- **Protecting Energy Security and Domestic Energy Supplies.** The Project will conserve domestic energy supplies by using petcoke, a local energy source that currently exported overseas for fuel. Conservation of this domestic energy supply will enhance energy security. The Project will also reduce stress on U.S. natural gas supplies by using petcoke to generate electricity. Petcoke is a by-product from the oil refining process and is abundantly available. In addition, the Project will produce additional energy from existing California oil fields by injecting $CO_2$ for enhanced oil recovery, which could increase field reserves by up to 25 percent.

- **Promoting Hydrogen Infrastructure.** The Project will increase the supply of hydrogen available to support the State's goal of energy independence as expressed in California Executive Order S-7-04, which mandates the development of a hydrogen infrastructure and hydrogen transportation in California. The Project is poised to supplement the quantities of hydrogen necessary for these future energy and transportation technologies, and support California's role as a world leader in clean energy.

- **Stimulating the Local and California Economy.** The Project will boost the local and California economy with an estimated 1,500 jobs associated with construction and approximately 100 permanent positions associated with Project operations. In addition, estimated indirect and induced effects of construction that will occur within Kern County could result in more than 4,000 jobs. This will represent a long-term economic benefit to Kern County.

The Project has been awarded federal funds by the Department of Energy and the study of the Project has the financial support of Southern California Edison Company. The California Public Utilities Commission ("*CPUC*") has determined that the Project is "consistent with a variety of state policies". CPUC Resolution E-4227A at 3. Also, in a recent decision, the CPUC stated that: "Edison demonstrated the relevance and necessity of the [Project] study research in detail, describing the potential emissions reductions, environmental and economic benefits to California, and the Project study's potential to enhance the application of other current research. " D.09-09-049.

Given these significant public concerns that will be addressed by the Project, substantial evidence supports the finding set forth in Government Code Section 51282(c)(1) that "other public concerns substantially outweigh the objects of the Williamson Act."

**B. There is no proximate non-Contracted land which is both available and suitable for the use to which it is proposed the Contracted land be put**

The Project Site is located in a sparsely populated agricultural area near the Elk Hills Oil Field. The Project Site is contiguous land bounded by Adohr Road to the north, Tupman Road to the east, an irrigation canal to the south, and the Dairy Road right-of-way to the west. There are only a few homes within a mile of the Project Site and the unincorporated community of Tupman is 1.5 miles from the site. Primary access will be from Interstate 5, to Stockdale Highway west, to Dairy Road then south to Adohr Road. The topography of the Project Site is flat. The geology at the Project Site has been determined suitable for power plant construction.

The Project Site was selected based upon, among other things, the available land, proximity to a carbon dioxide storage reservoir, and the existing natural gas transportation, electric transmission, and brackish groundwater supply infrastructure that could support the proposed 250 MW of baseload low-carbon power generation. The Project Site was also chosen for its reasonable proximity to Interstate 5, State Routes (SR) 58 and 119, and Stockdale Highway. The geology in the vicinity of the Project Site makes it one of the premier locations in the United States for $CO_2$ EOR and sequestration.

There is no non-contracted land proximate to the Project Site which is both available and suitable for the Project. As such, the finding set forth in Government Code Section 51282(c)(2) is satisfied. With regard to availability, according to County Planning Department records (including the 2009 Kern County Williamson Act Map), virtually all land in the proximity of the Project Site is either under Williamson Act or in the Tule Elk Reserve State Park.

With regard to suitability, as concluded in HEI's Revised Application for Certification ("*Revised AFC*"), there are no alternative sites that meet the highly specific site selection requirements of the Project discussed above. Prior to selecting the Project Site, HEI submitted its initial AFC (08-AFC-8) to the CEC on July 30, 2008, which proposed the Project on a different site. HEI subsequently decided to move the Project when it discovered the existence of previously undisclosed sensitive biological resources at the prior site. As a result, HEI was required to conduct an alternative site analysis to identify an alternative site for the Project, which has now become the Project Site. In the process, several possible alternative sites in the vicinity of the unincorporated communities of Buttonwillow and Tupman were considered. However, the alternative sites were rejected for various reasons, including (1) topography, (2) distance from the proposed carbon dioxide custody transfer point, (3) lengths of linear facilities, (4) sensitive environmental receptors and/or (5) land availability. In addition, each of these sites (with one exception), like the Project Site, were contracted under the Williamson Act.

In summary, no alternative sites were identified on either contracted or non-contracted land that were both available and suitable for the Project. As such, the finding set forth Government Code Section 51282(c)(2) that "[t]here is no proximate non-Contracted land which is both available and suitable for the use to which it is proposed the Contracted land be put" is supported by substantial evidence.

# Appendix I

# Proposed Projects within 6 Miles

**Appendix I**
**Proposed Projects within 6 Miles**

| Case ID | Project Location | APN | Applicant | Case Type | Request | Acres | Use Type | Notes |
|---|---|---|---|---|---|---|---|---|
| 10212 | North and West of the Project Site; Intersection of Dairy Road and Adohr Road | 159-030-06<br>159-070-03<br>159-130-11<br>159-020-16 | Dykstra Dairies/David Albers | CUP | Conditional Use Permit to Establish a 1,061-Acre Dairy (121-Acre Dairy, 739 Acres of Liquid Waste Disposal/Spreading, and 201 Acres for Solid Waste Disposal/ Spreading) (Palm Ranch) | 1,061 | Agriculture | |
| 10660 | Southeast Corner of 7th Standard Road and Brandt Road | 463-030-12 | Affentranger, Franz (Pine Dairy) | CUP | Conditional Use Permit to Establish a 589.35-Acre Dairy and 1,973.28-Acre Crop Area (Pine Dairy) | 2,564 | Agriculture | |
| 11392 | Northwest Corner of Stockdale Highway and Enos Lane | 104-291-10 | Stockdale Investor, LLC\David Wood | GPA | General Plan Amendment From Resource – Intensive Agriculture (R-LA) and Service Industrial (SI) to Low/Medium-Density Residential (LMR) Max 10 Units/Net Acre | 264 | Residential | Assume Maximum of 2640 Residential Dwelling Units |
| 12698 | Tracy Avenue, Buttonwillow | 103-080-44 | Rio Bravo Vista/Mcintosh and Associates | PD | Precise Development for 'La Quinta' Hotel | 6.5 | Commercial | |
| 12766 | 345 Driver Road | 104-291-52 | Petro Ready Mix/Pete Pedroza | PD | Precise Development for Concrete Batch Plant | 78.2 | Industrial | |
| 11389; 11390 | Highway 43 at Country Triangle Road | 104-292-29 | Stockbuilding Supply/Klassen Corp | PD; ZV | Precise Development for Lumber Truss Manufacturing/Warehouse Includes Variance for Reduction of Parking, May Require General Plan Amendment of Circulation Element; Zoning Variance for Reduced Parking | 26.6 | Industrial | |
| 11484; 11708 | Southwest Corner of Highway 58 and Highway 43 | 104-220-19 | Cn Holdings By San Joaquin Engineering | ZCC; Exclusion | Zoning Change/Amendment to Estate Minimum Lot Size 1-Acre [E(1)] District, General `Commercial (C-2) District, and Precise Development (PD) Combining District; Exclusion From Agricultural Preserve #9 | 149.6 | Mixed | Assume Maximum of 149 Residential Dwelling Units |
| 9952; 9953 | 7626 Superior Road | 104-012-15 | Cooper, Michael and Cheryl/D and D | ZCC; Exclusion | Zoning Change/Amendment From Exclusive Agriculture (A) to Natural Resource 5 Gross Acre Minimum Lot Size [NR(5)] District; Exclusion From Agricultural Preserve | 10 | Industrial | |
| 10507 | East Side of Enos Lane, 1 Mile North of Panama Lane | | Kern Water Bank Authority/D Millazo | CUP | Conditional Use Permit to Establish a Public Agency Building | | Commercial | |
| 11620 | North Side of Brite Road, 1 Mile East of Wasco Way | 103-210-12 | Brewer, Susan By Del Marter & Deifel | MOD | Modify (Lot Size Reduction) Lot Line Adjustment (#105-06) | 1.4 | Residential | |
| 11869 | 312 Cotton Avenue, Buttonwillow | 101-041-12 | Scott, Leland | Vacation | Summary Vacation | | | |
| 11955 | Olen Avenue, West of Enos Lane, Bakersfield | 184-010-83 | Jenkins, Larry/Joe Engel | PD | Precise Development for Warehouse and Mobile Home | 20 | Mixed | |
| 12374 | Southwest of I-5 and Enos Lane, Bakersfield` | 160-130-23 | Enos Lane Farm Properties LLC by Summit Engineering | ZV | Zoning Variance for Lot Size | 40.7 | | |
| 12408 | West of Elk Hills Road, 1 Mile North of Highway 119 | 298-050-16 | Kern County Planning Department | CUP | Conditional Use Permit, Establish SMARA Enforcement Proceedings | 10 | | |
| 12434 | South Side Interstate 5, South of Enos Lane, Bakersfield | | Enos Lane Farm/Summit Engineering | Vacation | Vacate Offer of Dedication/Public Road | | | |
| 13004 | Southwest Corner Stockdale Highway and Enos Lane, Bakersfield | 160-010-02<br>160-010-07<br>160-010-19<br>160-010-21<br>160-010-22<br>160-010-59<br>160-010-60 | AECOM | SPA | Circulation Amendment | 640 | | |
| 13218 | 31139 7th Standard Road, Buttonwillow | 104-012-38 | Swan, Murrel/Bruce Anderson | CUP | Conditional Use Permit to Establish Agriculture Related Uses | 24 | Agriculture | |
| 13220 | 1 Mile West of Elk Hill Road South of Aqueduct | 158-010-15 | Kern County Planning Department | CUP | Conditional Use Permit, Establish SMARA Enforcement Proceedings | 81 | | |

## Appendix I
## Proposed Projects within 6 Miles

| Case ID | Project Location | APN | Applicant | Case Type | Request | Acres | Use Type | Notes |
|---|---|---|---|---|---|---|---|---|
| 13252 | Elk Hills | 298-170-27 | ENXCO Development Corporation | CUP | Conditional Use Permit to Establish 7 MW Solar Project | 47.3 | Energy | |
| 13263 | Enos Lane and Baker Road, Bakersfield | 104-011-12 | Recurrent Energy by Seth Isreal | CUP | Conditional Use Permit to Establish 5 MW Solar Project | 40 | Energy | |
| 13264 | Acacia Street and Cherry Avenue, Taft | 298-190-15 | Recurrent Energy by Seth Isreal | CUP | Conditional Use Permit to Establish 20 MW Solar Project | 160 | Energy | |
| 13311 | 22356 Rosedale Highway | 104-230-26 | Wattenbarger, Scott | PD | Precise Development for RV Storage | 4.7 | Light Industrial | |
| 13312 | Shank Road | 103-280-50<br>103-280-54<br>103-280-55<br>103-280-57<br>103-280-72 | Urban Land Advisors/Matt Wade | Vacation | Vacation of Shank Road | | | |
| 13479 | Old Tracy Avenue and Interstate 5, Buttonwillow | 103-080-45<br>103-080-46 | Thomas Nguyen | GPA | General Plan Amendment from Other Facilities (3.3) and Light Industrial (7.1) to Service Industrial (7.2) to Develop a 1.3 Million Square Foot Distribution Facility | | Industrial | |
| 13489 | Dustin Acres Road and Van Pelt Court, Taft | 298-120-49<br>298-120-51 | Van Pelt, Don | ZCC | Zoning Change/Amendment to Estate (E) Non-jurisdictional Land (1) Residential Suburban Combining District (RS) Mobile Home Combining District( MH) | 7.5 | Residential | |
| 13536 | Enos Lane and Snow Road, Buttonwillow | 104-012-26 | Brandon G. Eaton | CUP | Conditional Use Permit to Establish a Rock Gravel Sand Distribution and Asphalt Batch Plant | | Industrial | |
| 13605 | 14 Mile Area, West of Enos Lane | | Plains Westside Pipeline/KC General Services | SP | Negative Declaration only for Pipeline Franchise | | Industrial | 14 Mile Pipeline Section |
| 13663 | Southwest Corner of Isaac Road and Ferrel Street, Taft | 298-300-15 | Torres Sandra by Aaron Byrd | ZCC | Zoning Change/Amendment to Limited Agriculture District (A-1) or Residential Estate District (E(5)) Residential Suburban Combining District (RS) | 40.1 | Residential | |
| 13727 | Northeast Corner of Brite Road and Parsons Street | 103-200-10 | Pierucci A&L Family Trust by Ruettgers & Schuler | ZV | Zoning Variance to Home-site Parcel | 119.7 | Residential | |
| 13729 | 28323 Highway 119, Dustin Acres | 298-110-21<br>298-110-22 | Harrington, Billy | CUP | Conditional Use Permit to Establish an Agricultural Supply Service | | Commercial | |
| 13772 | 7th Standard Road and Superior Road | 104-012-03<br>104-012-06 | First Solar Development Inc. | CUP | Conditional Use Permit to Establish a 20 MW Alternating Current Photovoltaic Solar Project | | Energy | |
| 13835 | 20641 Tracy Avenue, Buttonwillow | 103-280-49 | Castro, Salvador | ZV | Zoning Variance to Expand Existing Pole Sign Area | | Commercial | |
| - | Occidental of Elk Hills Gas Plant | | Occidental of Elk Hills | | Authority to Construct (Air Permits) to Construct and Operate a Cryogenic Natural Gas Processing Plant | | Oil and Gas | |

Source: Mynk, 2012
Notes:

| | |
|---|---|
| CALUC | Cancellation of Williamson Act Contract |
| CUP | Conditional Use Permit |
| Exclusion | Exclusion from Agricultural Preserve |
| GPA | General Plan Amendment |
| MOD | Modification |
| PD | Precise Development |
| SPA | Specific Plan Amendment |
| Vacation | Vacate a Street, Highway, or Public Service Easement |
| ZCC | Zoning Change/Amendment |
| ZV | Zoning Variance |

### References

Mynk, Christopher (Kern County Planning Department), 2012. Email communication to Christopher Wolf, URS. March 12, 2012.

# Appendix J

# Noise

# Appendix J-1

## Noise Measurement Site Data Logs and Equipment Calibration Records

## FIELD MEASUREMENT DATA SHEET

**URS** Project Name: HECA 2 Red Job # 28067571.40211

SITE IDENTIFICATION: LT-1 OBSERVER(s): RR & RM
START DATE & TIME: 3/2/09 16:56:00 3/3 11:58 am END DATE & TIME: 11:15 am 3/3/09
ADDRESS: Ackerman (Just East)
GPS coordinates: 35° 20' 18.8 N 119° 23' 32.4 W
Meter Time = GPS Time + 11

ID

TEMP: 70 °F HUMIDITY: 56 % R.H. WIND: CALM (LIGHT) MODERATE VARIABLE
WINDSPEED: 1 MPH DIR: N NE E SE S SW (W) NW STEADY GUSTY MPH Sine Anemometer 95022
SKY: CLEAR SUNNY DARK (PARTLY CLOUDY) OVRCST FOG DRIZZLE RAIN Other:

Weather

INSTRUMENT: LD 820 TYPE: (1) 2 SERIAL #: 1528 Red
CALIBRATOR: CAL 200 SERIAL #: 2794
CALIBRATION CHECK: PRE-TEST 93.7 dBA SPL POST-TEST 93.6 dBA SPL WINDSCREEN ✓
SETTINGS: (A-WEIGHTED) (SLOW) FAST FRONTAL (RANDOM) ANSI OTHER:

| | Rec # | Start Time | End Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3/2 | 1 | 16:56 pm | 11:15 am | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |
| 3/3 | 2 | 11:58 am | | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |
| | | | | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |
| | | | | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): (TRAFFIC) AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER Birds
ROADWAY TYPE: Hard Sfc Asphalt ADOHR Rd.
COUNT DURATION: -MINUTE

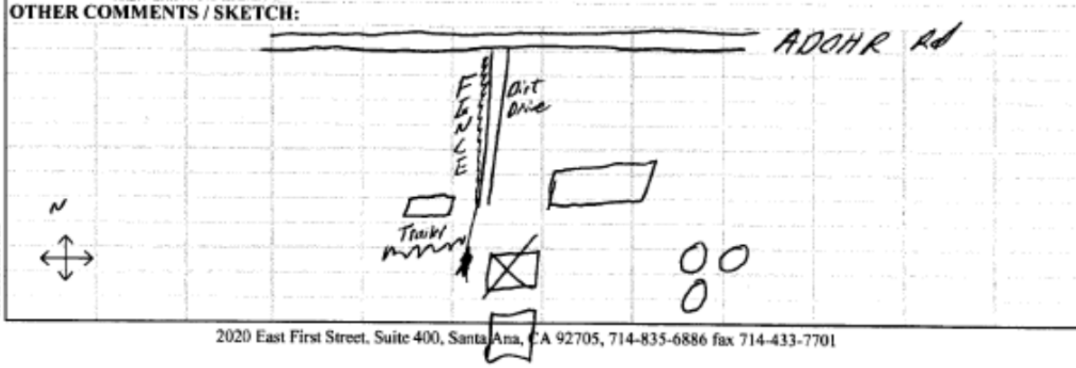
| | NB / EB | SB / WB | SPEED (mph) NB EB | SB WB | #2 COUNT: NB / EB | SB / WB | SPEED (mph) NB EB | SB WB |
|---|---|---|---|---|---|---|---|---|
| AUTOS: | | | | | | | | |
| MED. TRUCKS: | | | | | | | | |
| HVY TRUCKS: | | | | | | | | |
| BUSES: | | | | | | | | |
| MOTORCYCLES: | | | | | | | | |

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING / distant TRAFFIC / distant LANDSCAPING / distant TRAINS
OTHER:

Source Info and Traffic Counts

TERRAIN: HARD SOFT (MIXED) FLAT OTHER:
PHOTOS: ✓
**OTHER COMMENTS / SKETCH:**




Description / Sketch

measurement.xls

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## FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

ST-1/

**SITE IDENTIFICATION:** ~~ST~~ NT-1 **OBSERVER(s):** RA + RM
**START DATE & TIME:** 3/3 + 3/4 **END DATE & TIME:** 3/3 + 3/4
**ADDRESS:**

**GPS coordinates:** N 35° 20' 23.7" W 119° 23' 28.4"

ID

TEMP:____ °F HUMIDITY:____ % R.H. WIND: **CALM LIGHT MODERATE VARIABLE**
WINDSPEED:____ MPH DIR: **N NE E SE S SW W NW STEADY GUSTY**____ **MPH**
SKY: **CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN** Other:____

Weather

**INSTRUMENT:** B + K 2250 **TYPE:** (1) 2 **SERIAL #:** 2672021
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794
CALIBRATION CHECK: **PRE-TEST** 93.9 **dBA SPL POST-TEST** 93.9 **dBA SPL WINDSCREEN** ✓
SETTINGS: **(A-WEIGHTED) SLOW (FAST) FRONTAL (RANDOM) ANSI OTHER:**____

| | Rec # | Start Time | End Time | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| Heca 2029 | 1 | 21:10 | 21:20 | 3/3 45.8 | 61.4 | 37.2 | 40.5 | 44.2 | 49.0 | |
| Heca 2030 | 2 | 21:21 | 21:31 | 3/3 46.5 | 57.4 | 38.4 | 42.0 | 44.9 | 49.2 | |
| | | | | | | | | | | |
| | | | | | | | | | | |

COMMENTS: (1) windy (9 mph) w/ gusts up to 15 mph, sheep

Acoustic Measurements

PRIMARY NOISE(S): **TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER**
**ROADWAY TYPE:**
COUNT DURATION:____ **-MINUTE**

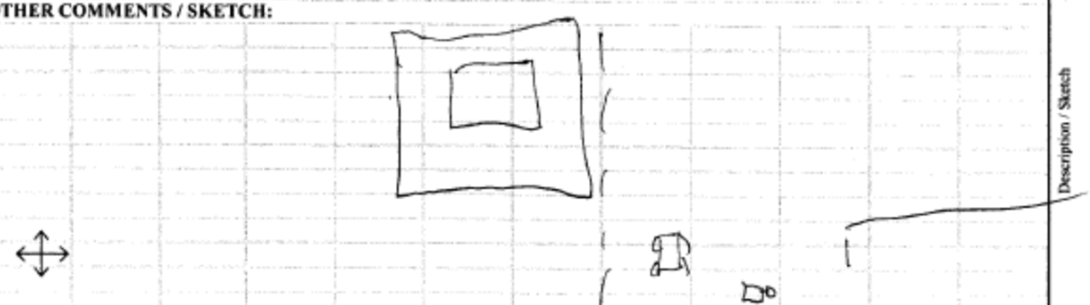
| | NB / EB | SB / WB | SPEED (mph) NB EB | SB WB | #2 COUNT: NB / EB | SB / WB | SPEED (mph) NB EB | SB WB |
|---|---|---|---|---|---|---|---|---|
| **AUTOS:** | | | | | | | | |
| **MED. TRUCKS:** | | | | | | | | |
| **HVY TRUCKS:** | | | | | | | | |
| **BUSES:** | | | | | | | | |
| **MOTORCYCLES:** | | | | | | | | |

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant **AIRCRAFT** overhead / **RUSTLING LEAVES** / distant **BARKING DOGS** / **BIRDS**
distant **CHILDREN PLAYING** / distant **TRAFFIC** / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT MIXED FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**



Description / Sketch

measform3.xls

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## FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

**SITE IDENTIFICATION:** NT-1/ST-1 **OBSERVER(s):** Ron + Ryan
**START DATE & TIME:** 3:4? on 3/2 9:40 on 3/3 **END DATE & TIME:**
**ADDRESS:**

**GPS coordinates:** ST-1 N 35°20'17.9" W 119° 23' 33.9"
NT-1 N 35°20'23.7" W 119° 23' 28.4"

ID

TEMP:_____ °F HUMIDITY:_____ % R.H. WIND: **CALM LIGHT MODERATE VARIABLE**
WINDSPEED:______ MPH DIR: **N NE E SE S SW W NW** **STEADY GUSTY**____ **MPH**
SKY: **CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN** Other: ______

Weather

**INSTRUMENT:** B+K 2250 **TYPE:** (1) 2 **SERIAL #:** 2672024
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794
CALIBRATION CHECK: **PRE-TEST** 93.9 **dBA SPL** **POST-TEST** 93.9 **dBA SPL** **WINDSCREEN** ✓
SETTINGS: (A-WEIGHTED) SLOW (FAST) FRONTAL (RANDOM) ANSI OTHER:

| | Rec # | Start Time | End Time | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ |
|---|---|---|---|---|---|---|---|---|---|
| Heca2003 | 1 | 23:04 | 23:11 | 29.8 | ~~[illegible]~~ 48.8 | 25.4 | 27.1 | 28.5 | 31.3 |
| Heca2004 | 2 | 23:12 | 23:22 | 34.5 | 52.2 | 26.4 | 29.2 | 32.1 | 36.3 |
| Heca2009 | 3 | 12:04 | 12:14 | 43.8 | 57.3 | 34.3 | 38.2 | 41.3 | 46.2 |
| Heca2010 | 4 | 12:15 | 12:25 | 42.4 | 52.7 | 31.0 | 36.6 | 41.3 | 45.4 |

COMMENTS: (1) sheep (2) distant traffic from stockdale highway (3) birds; industrial (tractor - distant) car (near) twice; dog barking, airplane overhead

Acoustic Measurements

PRIMARY NOISE(S): **TRAFFIC AIRCRAFT RAIL INDUSTRIAL (AMBIENT) (OTHER)** birds
**ROADWAY TYPE:**

COUNT DURATION:______**-MINUTE**

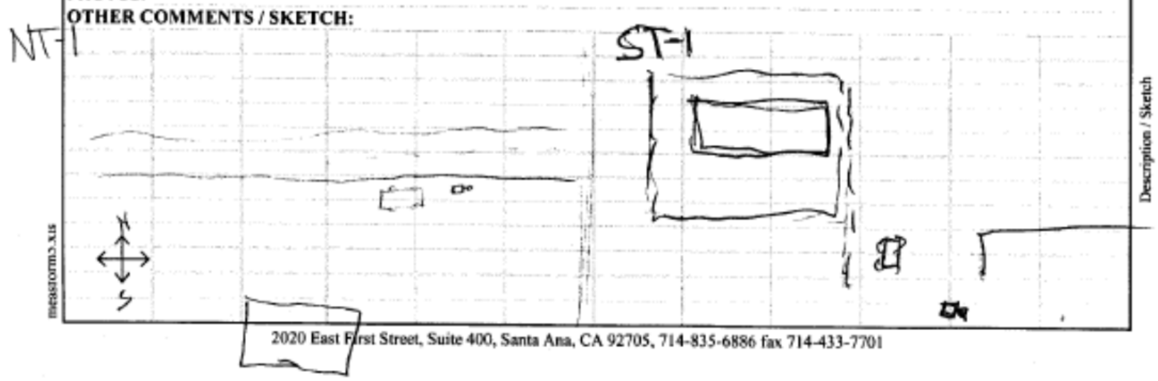
| | NB / EB | SB / WB | SPEED (mph) NB EB | SB WB | #2 COUNT: NB / EB | SB / WB | SPEED (mph) NB EB | SB WB |
|---|---|---|---|---|---|---|---|---|
| **AUTOS:** | | | | | | | | |
| **MED. TRUCKS:** | | | | | | | | |
| **HVY TRUCKS:** | | | | | | | | |
| **BUSES:** | | | | | | | | |
| **MOTORCYCLES:** | | | | | | | | |

**SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER**

OTHER NOISE SOURCES: (distant **AIRCRAFT** overhead) / **RUSTLING LEAVES** / distant **BARKING DOGS** / (**BIRDS**)
distant **CHILDREN PLAYING** / distant **TRAFFIC** / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT MIXED FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**




Description / Sketch

measform3.xls

# FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

**SITE IDENTIFICATION:** LT-2 **OBSERVER(s):** RR & RM
**START DATE & TIME:** 3/2/09 17:30 **END DATE & TIME:** 3/3/09 12:35 Meter= GPS+30
**ADDRESS:** Adams (Tule House)

**GPS coordinates:** 36°19'58.7"N 119°22'21.0"

ID

TEMP: 70 °F HUMIDITY: 66 % R.H. WIND: **CALM LIGHT MODERATE VARIABLE**
WINDSPEED: 1 MPH DIR: N NE E SE S SW (W) NW **STEADY GUSTY** ___ MPH
SKY: **CLEAR SUNNY DARK (PARTLY CLOUDY) OVRCST FOG DRIZZLE RAIN** Other: ___

Weather

**INSTRUMENT:** LD 820 **TYPE:** (1) 2 **SERIAL #:** 1597 Mic 2491 101267 Green
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794
CALIBRATION CHECK: **PRE-TEST** 93.8 **dBA SPL POST-TEST** 93.8 **dBA SPL WINDSCREEN** ✓
SETTINGS: **(A-WEIGHTED) (SLOW) FAST FRONTAL (RANDOM) ANSI OTHER:** ___

| Rec # | Start Time / End Time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 3/2 17:30 / 3/3 12:35 | $L_{eq}$ ___ | $L_{max}$ ___ | $L_{min}$ ___ | $L_{90}$ ___ | $L_{50}$ ___ | $L_{10}$ ___ | ___ |
| 2 | 3/3 13:09 / ___ | $L_{eq}$ ___ | $L_{max}$ ___ | $L_{min}$ ___ | $L_{90}$ ___ | $L_{50}$ ___ | $L_{10}$ ___ | ___ |
| ___ | ___ / ___ | $L_{eq}$ ___ | $L_{max}$ ___ | $L_{min}$ ___ | $L_{90}$ ___ | $L_{50}$ ___ | $L_{10}$ ___ | ___ |
| ___ | ___ / ___ | $L_{eq}$ ___ | $L_{max}$ ___ | $L_{min}$ ___ | $L_{90}$ ___ | $L_{50}$ ___ | $L_{10}$ ___ | ___ |

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): **(TRAFFIC) AIRCRAFT RAIL INDUSTRIAL (AMBIENT) OTHER**
**ROADWAY TYPE:** Hard Surface Asphalt [I-5 barely audible when quiet]
COUNT DURATION: ___ **-MINUTE**

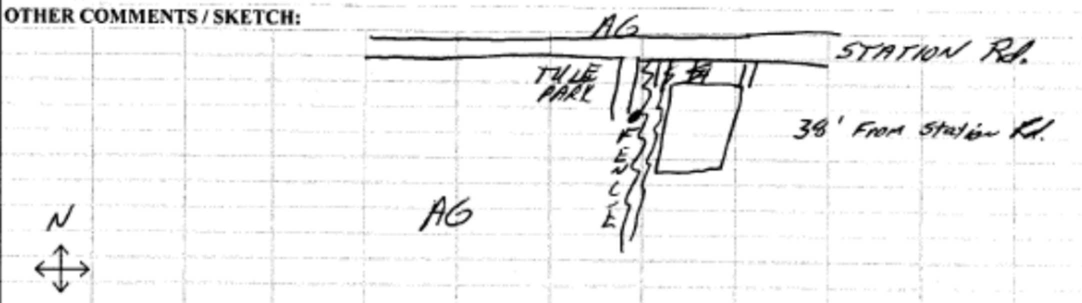
| | SPEED (mph) NB / EB / SB / WB | NB EB / SB WB | #2 COUNT: NB / EB / SB / WB | SPEED (mph) NB EB / SB WB |
|---|---|---|---|---|
| **AUTOS:** | ___ / ___ | ___ / ___ | ___ / ___ | ___ / ___ |
| **MED. TRUCKS:** | ___ / ___ | ___ / ___ | ___ / ___ | ___ / ___ |
| **HVY TRUCKS:** | ___ / ___ | ___ / ___ | ___ / ___ | ___ / ___ |
| **BUSES:** | ___ / ___ | ___ / ___ | ___ / ___ | ___ / ___ |
| **MOTORCYCLES:** | ___ / ___ | ___ / ___ | ___ / ___ | ___ / ___ |

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER NOISE SOURCES: distant **AIRCRAFT** overhead / **RUSTLING LEAVES** / (Occasional / distant **BARKING DOGS**) (**BIRDS**)
distant **CHILDREN PLAYING** / distant **TRAFFIC** / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT (MIXED) FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**




Description / Sketch

measform3.xls

2020 East First Street, Suite 400, Santa Ana, CA 92705, 714-835-6886 fax 714-433-7701

# FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

**SITE IDENTIFICATION:** ST-2 / NT-2 **OBSERVER(s):** Ron + Ryan
**START DATE & TIME:** 3/3 13:14, 13:31 **END DATE & TIME:** 3/3 13:24, 13:41
**ADDRESS:** Tule House

**GPS coordinates:** N 35° 19' 58.4" W 119° 22' 20.7"

ID

TEMP:_____ °F HUMIDITY:_____ % R.H. WIND: **CALM LIGHT MODERATE VARIABLE**
WINDSPEED:_________MPH DIR: **N NE E SE S SW W NW** **STEADY GUSTY**____**MPH**
SKY: **CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN** Other:________

Weather

**INSTRUMENT:** B+K 2250 **TYPE:** (1) 2 **SERIAL #:** 2672071
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794
CALIBRATION CHECK: **PRE-TEST** 93.9 **dBA SPL POST-TEST** 93.9 **dBA SPL WINDSCREEN** ✓
SETTINGS: (**A-WEIGHTED**) **SLOW** (**FAST**) **FRONTAL** (**RANDOM**) **ANSI OTHER:**________

| | Rec # | Start Time / End Time | ST-2 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Heca2011 | 1 | 13:14 / 13:24 | $L_{eq}$ 51.4 | $L_{max}$ 72.4 | $L_{min}$ 24.8 | $L_{90}$ 26.6 | $L_{50}$ 29.2 | $L_{10}$ 44.0 | |
| Heca2012 | 2 | 13:31 / 13:41 | $L_{eq}$ 48.0 | $L_{max}$ 75.2 | $L_{min}$ 24.2 | $L_{90}$ 25.9 | $L_{50}$ 28.7 | $L_{10}$ 36.6 | |
| | | / | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |
| | | / | $L_{eq}$ (NT-2) | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ | |

COMMENTS: (1) cars, birds, distant highway

Acoustic Measurements

PRIMARY NOISE(S): **TRAFFIC AIRCRAFT RAIL INDUSTRIAL** (**AMBIENT**) **OTHER**
**ROADWAY TYPE:**

| COUNT DURATION: ____-MINUTE | NB / EB / SB / WB | SPEED (mph) NB EB / SB WB | #2 COUNT: NB / EB / SB / WB | SPEED (mph) NB EB / SB WB |
|---|---|---|---|---|
| **AUTOS:** | / | / | / | / |
| **MED. TRUCKS:** | / | / | / | / |
| **HVY TRUCKS:** | / | / | / | / |
| **BUSES:** | / | / | / | / |
| **MOTORCYCLES:** | / | / | / | / |

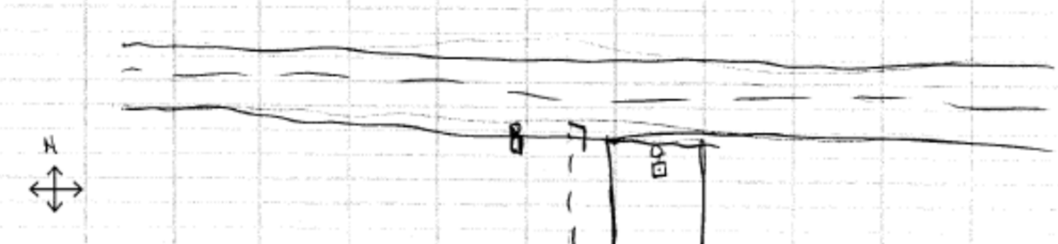
SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER NOISE SOURCES: (distant **AIRCRAFT** overhead) / **RUSTLING LEAVES** / distant **BARKING DOGS** / (**BIRDS**)
distant **CHILDREN PLAYING** / (distant **TRAFFIC**) / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT MIXED FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**

ST-2




Description / Sketch

measform3.xls

2020 East First Street, Suite 400, Santa Ana, CA 92705, 714-835-6886 fax 714-433-7701

# FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

**SITE IDENTIFICATION:** ~~ST-2~~ **OBSERVER(s):** Ron + Ryan
**START DATE & TIME:** 3/3 below **END DATE & TIME:** 3/3 below
**ADDRESS:** Tule House

**GPS coordinates:** N 35° 19' 59.2" W 119° 22' 17.0"

ID

TEMP:_____ °F HUMIDITY:_____ % R.H. WIND: **CALM LIGHT MODERATE VARIABLE**
WINDSPEED: 11 MPH DIR: **N NE E SE S SW W NW** **STEADY GUSTY** 15 **MPH**
SKY: **CLEAR SUNNY DARK PARTLY CLOUDY OVRCST FOG DRIZZLE RAIN** Other: ______

Weather

**INSTRUMENT:** B+K 2250 **TYPE:** (1) 2 **SERIAL #:** 2672071
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794

CALIBRATION CHECK: **PRE-TEST** 93.9 **dBA SPL** **POST-TEST** 93.9 **dBA SPL** **WINDSCREEN** ✓

SETTINGS: **A-WEIGHTED SLOW FAST FRONTAL RANDOM ANSI OTHER:** ______

| | Rec # | Start Time | End Time | $L_{eq}$ | $L_{max}$ | $L_{min}$ | $L_{90}$ | $L_{50}$ | $L_{10}$ |
|---|---|---|---|---|---|---|---|---|---|
| Heca 2007 | 1 | 0:00 | 0:10 | 42.4 | 61.5 | 32.2 | 34.0 | 35.3 | 37.1 |
| Heca 2008 | 2 | 0:11 | 0:21 | 52.5 | 79.4 | 31.9 | 33.9 | 35.7 | 39.4 |
| Heca 2025 | 3 | 20:12 | 20:22 | 53.4 | 75.1 | 38.5 | 43.0 | 48.3 | 55.8 |
| Heca 2026 | 4 | 20:23 | 20:33 | 52.5 | 73.5 | 33.7 | 38.9 | 44.4 | 52.8 |

NT-2 (beside records 1–2); NT-2 (beside records 3–4)

COMMENTS: (1) + (2) low freq industrial distant (3) winds up to 11 mph gusting to 15 (4) same winds

Acoustic Measurements

PRIMARY NOISE(S): **TRAFFIC AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER**
**ROADWAY TYPE:**

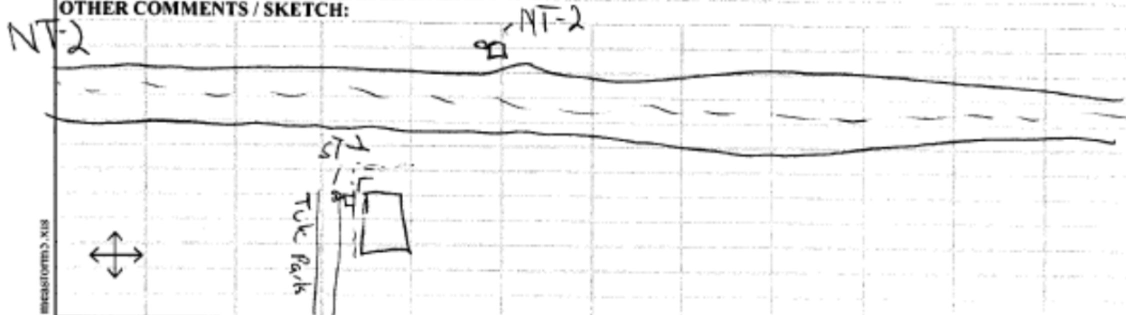
| COUNT DURATION: ___-MINUTE | NB / EB | SB / WB | SPEED (mph) NB EB | SB WB | #2 COUNT: NB / EB | SB / WB | SPEED (mph) NB EB | SB WB |
|---|---|---|---|---|---|---|---|---|
| **AUTOS:** | | | | | | | | |
| **MED. TRUCKS:** | | | | | | | | |
| **HVY TRUCKS:** | | | | | | | | |
| **BUSES:** | | | | | | | | |
| **MOTORCYCLES:** | | | | | | | | |

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER NOISE SOURCES: distant **AIRCRAFT** overhead / **RUSTLING LEAVES** / distant **BARKING DOGS** / **BIRDS**
distant **CHILDREN PLAYING** / distant **TRAFFIC** / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT MIXED FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**




Description / Sketch

measform3.xls

# FIELD MEASUREMENT DATA SHEET

**URS** **Project Name:** HECA 2 **Job #** 28067571.40211

**SITE IDENTIFICATION:** LT-3 **OBSERVER(s):** RR & RM
**START DATE & TIME:** 3/2/09 18:15 **END DATE & TIME:**
**ADDRESS:** Along Stockdale Rd Telephone Pole Time = GPS + 30
**GPS coordinates:** 35° 21' 17.2" N 119° 22' 24.5" W.

ID

TEMP: 65 °F HUMIDITY: 53 % R.H. WIND: **CALM** **(LIGHT)** **MODERATE VARIABLE**
WINDSPEED: 1 MPH DIR: **N NE E SE S SW (W) NW** **STEADY GUSTY**____MPH
SKY: **CLEAR SUNNY DARK (PARTLY CLOUDY) OVRCST FOG DRIZZLE RAIN** Other: ____

Weather

**INSTRUMENT:** LD 820 **TYPE:** (1) 2 **SERIAL #:** 1470
**CALIBRATOR:** CAL 200 **SERIAL #:** 2794
CALIBRATION CHECK: **PRE-TEST** 93.8 **dBA SPL** **POST-TEST** 93.8 **dBA SPL** **WINDSCREEN** ✓
SETTINGS: **(A-WEIGHTED SLOW)** **FAST FRONTAL (RANDOM) ANSI OTHER:** ____

| Rec # | Start Time | End Time | |
|---|---|---|---|
| 1 | 18:15 | ≈14:30 | : $L_{eq}$__, $L_{max}$__, $L_{min}$__, $L_{90}$__, $L_{50}$__, $L_{10}$__, __ |
| 2 | ≈14:30 | | : $L_{eq}$__, $L_{max}$__, $L_{min}$__, $L_{90}$__, $L_{50}$__, $L_{10}$__, __ |
| | | | : $L_{eq}$__, $L_{max}$__, $L_{min}$__, $L_{90}$__, $L_{50}$__, $L_{10}$__, __ |
| | | | : $L_{eq}$__, $L_{max}$__, $L_{min}$__, $L_{90}$__, $L_{50}$__, $L_{10}$__, __ |

COMMENTS:

Acoustic Measurements

PRIMARY NOISE(S): **(TRAFFIC) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER**
**ROADWAY TYPE:** Hard Surface Asphalt
COUNT DURATION:____**-MINUTE** **SPEED (mph)** 35 **#2 COUNT:** **SPEED (mph)**

| | NB / EB / SB / WB | NB EB / SB WB | NB / EB / SB / WB | NB EB / SB WB |
|---|---|---|---|---|
| **AUTOS:** | / | / | / | / |
| **MED. TRUCKS:** | / | / | / | / |
| **HVY TRUCKS:** | / | / | / | / |
| **BUSES:** | / | / | / | / |
| **MOTORCYCLES:** | / | / | / | / |

SPEED ESTIMATED BY: **RADAR / DRIVING / OBSERVER**

OTHER NOISE SOURCES: distant **AIRCRAFT** overhead / **RUSTLING LEAVES** / distant **BARKING DOGS** / **BIRDS**
distant **CHILDREN PLAYING** / distant **TRAFFIC** / distant **LANDSCAPING** / distant **TRAINS**
OTHER:

Source Info and Traffic Counts

TERRAIN: **HARD SOFT MIXED FLAT OTHER:**
PHOTOS:
**OTHER COMMENTS / SKETCH:**


Description / Sketch

meastorm3.xls