

# Project Highlights

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## Project 1: California Rock and Asphalt

### Client Site & Address

California Rock and Asphalt  
Production Plant 1  
1 Quarry Road  
Brisbane, California 94005  
USA



### Business Type(s)

Aggregate Quarry and Asphalt Production

### Site Contamination & Remediation Parameters

<b>Contaminant(s) &amp; Levels</b>	Diesel - 11,100 mg/kg
<b>Analytical Test Method</b>	TPH Diesel 8015 (US EPA)
<b>Contamination Source</b>	Leaking Fuel-Storage Tanks
<b>Treatment Matrix</b>	Soil
<b>Volume/Mass Contaminated</b>	10,000 yd <sup>3</sup> (7.650 m <sup>3</sup> ) / 14,000 Tons (12,700 MT)
<b>Treatment Goal</b>	50 mg/kg
<b>Seasonal Conditions</b>	Project was to be completed during summer months.
<b>Agency In Charge</b>	City of South San Francisco
<b>Remediation Options(s)</b>	Dig and haul to remote disposal facility, on-site incineration, bioremediation
<b>Additional Client Requests</b>	Client wanted useful soil following remediation and wanted to treat on-site, providing labor and machinery. Client wanted to avoid or greatly reduce interference in business operations.

### Site-Specific Considerations

- **Geographical:** Site located in northern part of San Mateo County, California on the lower slopes of San Bruno Mountain. It is on the northeastern edge of South San Francisco, next to the San Francisco Bay.
- **Basic Geology/Soil Conditions:** Sandy soil with debris, cobble and large rocks. Multiple groundwater sources in immediate area.
- **Climate:** Mild during summer when temperatures are 16°C - 12°C, and medium humidity, and cool during winter when temperatures are 5°C - 10°C with medium humidity. The annual average precipitation at Brisbane is 50 cm. The wettest month of the year is January with an average rainfall of 11.3 cm and the driest is July with an average rainfall of 0.10 cm.
- **Additional Considerations:** Client had sufficient space to treat soil ex-situ on their property.



## Bioremediation Process

### Equipment Used

- Two 20,000 gallon (75,600 L) tanks for inoculation and nutrient mixing
- Electric pumps for distribution of microbial consortia and nutrients
- Air compressor for aeration of culture and nutrients
- Hoses for distribution of microbial consortia and nutrients
- Generators for remote power supply
- Earth moving equipment and labor for manipulation of soil (provided by client)



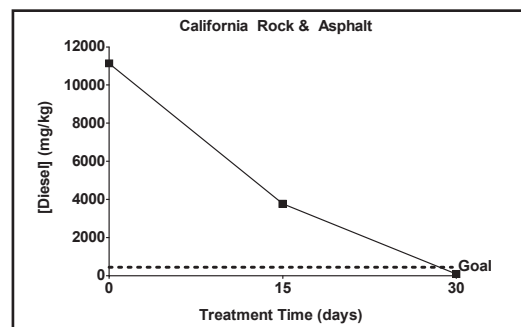
### Soil Preparation

- Soil was first screened to remove large rocks, cobble and debris
- Soil was situated in 1.2 m - 1.8 m deep lifts/biopiles for ex-situ inoculation, nutrient application and moisture maintenance
- Biopiles were situated for easy access from culturing/nutrient tanks and supply hose



### Inoculation, Treatment and Results

- **Culturing:** Large scale, high density cultures were prepared on-site for 48 hours.
- **Inoculation/Application:** Inoculations were made on day 0 and day 15. Moisture content of piles was monitored and maintained on a daily basis.
- **Duration:** The duration of treatment was based on periodic analytical testing. Based on periodic tests, treatment was stopped at 35 days pending final, official test results.



### Project Completion

- Soil was tested on days 0, 15 and 30 by an independent certified laboratory.
- Analytical tests from day 30 returned non-detect for all samples taken.
- Client was able to begin site closure procedures with no further remedial action, and was able to use treated material as backfill.
- Bioremediation provided an effective, rapid, low-cost and non-invasive solution for client.

## Project 2: American River Asphalt Reject Dust

### Client Site & Address

American River Aggregates  
 Grant Line Plant  
 Grant Line Road  
 Folsom, California 95630  
 USA



### Business Type(s)

Aggregate Quarry and Asphalt Production

### Site Contamination & Remediation Parameters

<b>Contaminant(s) &amp; Levels</b>	Diesel - 150 mg/kg, Oil - 125 mg/kg
<b>Analytical Test Method</b>	TPH Diesel 8015, EPA Oil & Grease 418.1
<b>Contamination Source</b>	Asphalt processing & batch plant
<b>Treatment Matrix</b>	Soil mixed with reject dust from asphalt plant
<b>Volume/Mass Contaminated</b>	9,000 yd <sup>3</sup> (6,900 m <sup>3</sup> ) / 12,600 Tons (11,430 MT)
<b>Treatment Goal</b>	50 mg/kg
<b>Seasonal Conditions</b>	Project to be completed in summer months.
<b>Agency In Charge</b>	Sacramento County EPA
<b>Remediation Options(s)</b>	Dig and haul to disposal facility, on-site incineration, bioremediation
<b>Additional Client Requests</b>	Client wanted useful soil following remediation. Client wanted to avoid halt in business operations.

### Site-Specific Considerations

- **Geographical:** Site located in the northeast corner of Sacramento County, California near the foothills of the Sierra Nevada Mountains. It is on the northeastern edge of Sacramento, and borders Folsom Lake.
- **Basic Geology/Soil Conditions:** Soil had moderate clay content with varying degree of cobble small rocks. Multiple groundwater sources in area.
- **Climate:** Hot and dry during summer when temperatures are 32°C - 38°C with low humidity, and cold during winter when temperatures are in the 4.5°C - 10°C with low to moderate humidity. The annual average precipitation at Folsom is 68 cm. The wettest month of the year is January with an average rainfall of 11.3 cm. The driest month of the year is July with an average rainfall of 0.23 cm.
- **Additional Considerations:** Client had sufficient space to treat soil ex-situ on their property.



## Remediation Process

### Equipment Used

- 1# 500 gallon (1,890 L) primary culture tank
- 2# 10,000 gallon (37,850 L) tanks for inoculation- culture and water storage
- Air compressor for aeration and agitation of culture
- Electric pumps for distribution of microbial consortia and nutrients
- Hoses for distribution of microbial consortia and nutrients
- Generator for remote power supply
- Earth moving equipment for manipulation of soil (supplied by client)
- Water truck for daily watering (supplied by client)



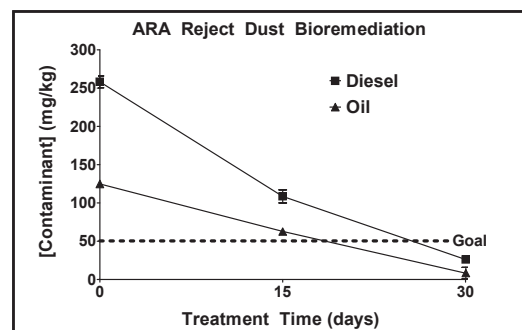
### Soil Preparation

- Soil was situated in 0.9 m - 1.2 m deep lifts for ex-situ inoculation, nutrient application and moisture maintenance
- Soil was situated for easy access from culturing and nutrient tanks, as well as providing easy access for water truck



### Inoculation, Treatment and Results

- **Culturing:** Large scale, high density cultures were prepared on-site for 48 hours.
- **Inoculation/Application:** Inoculations were made on day 0 and day 15. Moisture content of piles was monitored and maintained on a daily basis.
- **Duration:** The duration of treatment was based on periodic analytical testing. Based on periodic tests, treatment was stopped at 35 days pending final, official test results.



### Project Completion

- Soil was tested on day 0, 15 and 30 by an independent certified laboratory.
- Official analytical tests from day 30 returned non-detect for all samples taken.
- Client was able to immediately begin site closure procedures with no further remedial action necessary.
- Bioremediation provided an effective, rapid, low-cost alternative for the client.

## Project 3: Baldwin Construction Doyle Plant

### Client & Site Address

Baldwin Contracting Company, Inc  
Doyle Plant  
Highway 395 & County Road A26  
Lassen County, California 96109  
USA



### Business Type(s)

Ready Mix and Asphalt Production Plant

### Site Contamination & Remediation Parameters

<b>Contaminant(s) &amp; Levels</b>	Diesel - 3000 mg/kg
<b>Analytical Test Method</b>	EPA TPH-Diesel 8015 Modified
<b>Contamination Source</b>	Leaking fuel storage tanks
<b>Treatment Matrix</b>	Soil
<b>Volume/Mass Contaminated</b>	8,400 tons (5,520 MT) / 6,000 yd <sup>3</sup> (4,600 m <sup>3</sup> )
<b>Treatment Goal</b>	50 mg/kg
<b>Seasonal Conditions</b>	Project to be completed in summer months
<b>Agency In Charge</b>	Lassen County Environmental Health
<b>Remediation Options(s)</b>	Dig and haul to disposal facility, on-site incineration, bioremediation
<b>Additional Client Requests</b>	Client needed remedial action for sale of property, as required by State and County law.

### Site-Specific Considerations

- **Geographical:** Site located in southeastern part of Lassen County, California, 72 Km northwest of Reno, Nevada. Area typically considered high desert.
- **Basic Geology/Soil Conditions:** Soil had low clay content with varying degree of cobble small rocks, as well as some debris. No groundwater sources in immediate area.
- **Climate:** Hot and dry during summer when temperatures are 30°C - 40°C with low humidity, and cold with freeze during winter when temperatures are -4°C to 5°C. The annual average precipitation at Doyle is 27 cm. The wettest month of the year is January with an average rainfall of 4.6 cm. The driest month is August with 0.6 cm.
- **Additional Considerations:** Client had sufficient area for excavation and on-site treatment. Dry, hot summer climate required constant moisture supervision and maintenance.



## Remediation Process

### Equipment Used

- 2# 1,000 gallon (3,780 L) primary culture tanks
- 2# 1,000 (3,780 L) gallon tanks for inoculation culture and water storage
- Air compressor for aeration of culture and nutrients
- Electric pumps for distribution of microbial consortia and nutrients
- Hoses for distribution of microbial consortia and nutrients
- Generators for remote power supply
- Water Truck (provided by client)
- Earth moving equipment for manipulation of soil (provided by client)



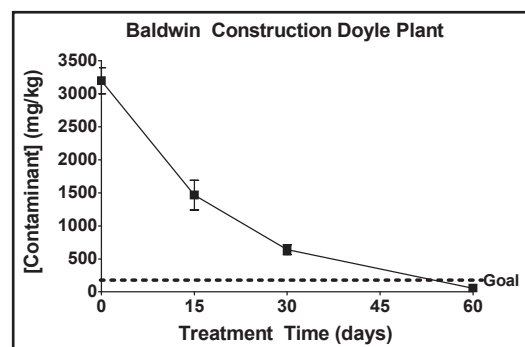
### Site Preparation

- Contamination was detected to depth of 6 meters. Soil was excavated for ex-situ treatment on site.
- Excavated soil was arranged into four treatment pads from 0.9 m - 1.8 m deep for ex-situ inoculation, nutrient application and moisture maintenance.
- Soil was situated for easy access from inoculation and nutrient tanks, as well as providing access for water truck



### Inoculation, Treatment and Results

- **Culturing:** Large scale, high density cultures were prepared on-site for 48 hours.
- **Inoculation/Application:** Inoculations were made on days 0, 15 and 45. Watering for moisture maintenance was performed twice a day for 60 days.
- **Duration:** The duration of treatment was based on analytical testing, and treatment was stopped after 30 days pending official test results. Several hot spots (approximately 2% of the contaminated soil) were detected, and soil was treated for an additional 30 days. Treatment was stopped at 60 days pending official test results.



### Project Completion

- Soil was tested on day 0, 15, 30 and 60 by an independent certified laboratory.
- Official analytical tests at day 60 returned non-detect for all samples taken.
- Client was able to begin site closure procedures and return material to excavation pits with no further remedial action necessary.

## Project 4: Tiger Lines Trucking Facility

### Client & Site Address

Tiger Lines Trucking Facility  
 1430 South Cherokee Lane  
 Lodi, California 95240  
 USA



### Business Type(s)

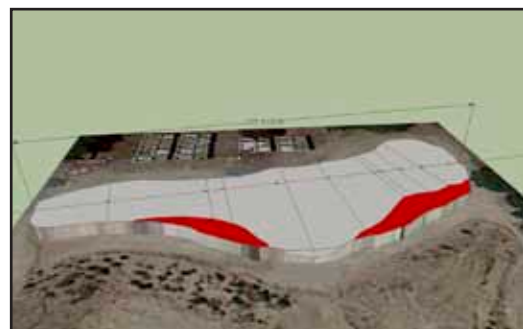
Former Refueling Depot

### Site Contamination & Remediation Parameters

<b>Contaminant(s) &amp; Levels</b>	Diesel - 1962 mg/kg
<b>Analytical Test Method</b>	EPA TPH-Diesel 8015B TEPH w/sgc
<b>Contamination Source</b>	Leaking fuel storage tanks
<b>Treatment Matrix</b>	Soil
<b>Volume/Mass Contaminated</b>	7,000 tons (6,350 MT) / ~5,000 yd <sup>3</sup> (~3,800 m <sup>3</sup> )
<b>Treatment Goal</b>	100 mg/kg
<b>Seasonal Conditions</b>	Project to be completed in summer months
<b>Agency In Charge</b>	Central Valley RWQCB
<b>Remediation Options(s)</b>	Dig and haul to disposal facility, on-site incineration, bioremediation
<b>Additional Client Requests</b>	Property required remedial action, as required by State and County law.

### Site-Specific Considerations

- **Geographical:** Site located in the city of Lodi, San Joaquin County, California. (+38°6'54.54", -121°15'33.50")
- **Basic Geology/Soil Conditions:** Soil was sandy with low clay content and small amounts of gravel. Various ground-water sources in immediate area.
- **Climate:** Hot and dry during summer when daily temperatures average 14°C to 33°C with low humidity, and cold during winter when daily temperatures average 3°C to 13°C. The annual average precipitation at Lodi is 46 cm. The wettest month of the year is January with an average precipiatain of 90 cm. The driest month is July with an average of 1.5 cm.
- **Additional Considerations:** Client had sufficient area for excavation and on-site treatment. Dry, hot summer climate required constant moisture supervision and maintenance.



## Remediation Process

### Equipment Used

- 1# 200 gallon (756 L) primary culture tank
- 1# 12,000 (45,360 L) gallon tank for inoculation culture and water storage/irrigation
- Air compressor for aeration of culture and nutrients
- Electric pumps for distribution of microbial consortia and nutrients
- Hoses for distribution of microbial consortia and nutrients
- Generators for remote power supply
- Bobcat with 8-inch auger for inoculation wells
- Earth moving equipment for manipulation of soil (provided by client)



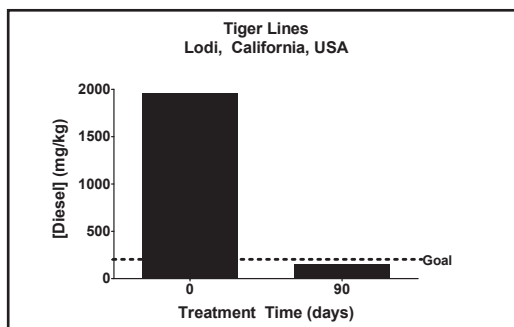
### Site Preparation

- Contamination was detected to depth of 5 meters. Soil was excavated for ex-situ treatment on site.
- Excavated soil was arranged into one treatment pads ~2.85 m deep for ex-situ inoculation, nutrient application and moisture maintenance.
- ~115 8-inch diameter inoculation wells were drilled into the pile to allow for adequate absorption and dispersion of microbes, nutrients and moisture.
- Pile was covered with visqueen following primary inoculation.



### Inoculation, Treatment and Results

- **Culturing:** Large scale, high density cultures were prepared on-site for one week (8 days).
- **Inoculation/Application:** One, high-density inoculation was made on day 01. Four additional nutrient applications were made on days 07, 14, 21 and 30. Moisture maintenance was performed as determined by daily moisture content evaluations.
- **Duration:** The duration of treatment was based on analytical testing results. Tests conducted on effective day\* 90 demonstrated that the project goal had been met.



\*Effective day is defined as the number of days treatment was conducted following the recommended guidelines. In this case, it represents the number of days of treatment where the average daily mean temperature was  $\geq 68^{\circ}$  F.

### Project Completion

- Soil was tested on days 0 and 90 by independent certified laboratories.
- Official analytical tests at day 90 indicated that the project goal had been reached.
- Client was able to begin site closure procedures and return material to excavation pits with no further remedial action necessary.