

Date: February 19, 2008

DRAFT MEMORANDUM

To: Don Eley, PG, LFR-Santa Maria

From: Steve Beadle, PG, PE, LFR-Santa Maria

Subject: **Plan for Post-Removal Confirmation Sampling, January 2008 Davis Tank Battery Release, Zaca Oil Field, Santa Barbara County, California**

BACKGROUND

On January 5, 2008, there was a release of crude oil at the Davis Tank Battery, operated by Greka Energy Corporation (Greka) at the Zaca Oilfield, located north of Buellton in Santa Barbara County, California. An aboveground tank in the Davis Tank Battery facility overflowed, sending crude oil and produced water into a secondary containment area, which did not fully retain the release. The released fluids flowed downgradient, in the general southward direction.

The released fluids reached the adjacent property to the south, which is occupied by a County road maintenance facility. The fluids crossed a relatively flat parking lot/lay-down yard area; they passed beneath part of a County building with raised-floor construction adjacent to the yard area. The fluids then entered a small unnamed seasonal creek, which drains to the south.

Cleanup crews initially responded by building underflow dams in the creek, and removing the dammed crude oil. However, heavy rains caused increased movement of the released fluids; rainwater runoff swelled the creek and led to the failure of the underflow dams.

Most of the released crude oil was confined to the Davis lease. However, some crude oil was also observed farther downstream, in a stock pond on the adjacent Chamberlin property. Crude oil may have continued further downstream to a second stock pond on the Chamberlin property.

The Site (Figure 1) consists of these affected areas, including the Tank Battery Area, the parking lot/lay-down yard, the bed of the unnamed creek, and the two Chamberlin stock ponds. The total length of the affected area is approximately 1.65 miles, or 8,750 feet.

The width of the affected area varies. In the Tank Battery Area, the parking lot/lay-down yard, and the two Chamberlin stock ponds, the affected area may be a few hundred feet wide. In most of the affected area, however, the released fluids were confined to the bed of the unnamed creek, which is generally only about 5 feet wide.

Most of the affected soil and sediment was subsequently removed from the affected area by hand. Shovels or other hand tools were used to place the affected material into plastic (visqueen) bags, comparable in size to sandbags. The filled bags were transported to large roll-off bins, which will be hauled to an offsite landfill for disposal. LFR previously submitted a separate "Plan for Quantification of Removed Hydrocarbons," dated February 3, 2008, for the sampling and analysis of the bagged material in the bins; the results will be used to quantify the mass and/or volume of hydrocarbons that were released at the Site.

An inspection team, known as the “Sign-Off Field Team” (SOFT), was formed to evaluate the emergency response efforts; the SOFT was comprised of representatives from the United States Environmental Protection Agency (US EPA), the California Department of Fish and Game (CDFG), and Greka. It is LFR’s understanding that the SOFT subsequently “signed off” on all of the areas addressed in the cleanup.

The US EPA has required that Greka, as the Responsible Party, conduct post-removal confirmation sampling for analytes of potential concern at the Site. Specific conditions required by US EPA for the confirmation sampling included the following:

- Soil and creek water sampling in all affected areas outside the Secondary Containment of the Davis Tank Battery
- Sample analysis for Total Petroleum Hydrocarbons (TPH), heavy metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) by a California-approved testing laboratory
- Evaluation of ambient background levels for compounds of concern. Local background samples were previously collected by US EPA in January 2008.

The confirmation sampling was to be conducted after the SOFT signed-off on the completion of the emergency response efforts. Since the SOFT sign-off was recently completed, this Sampling Plan has been prepared to address the US EPA requirement for post-removal confirmation sampling at the Site.

AMBIENT BACKGROUND SAMPLING

On January 10, 2008, US EPA collected five ambient background sediment samples from the creek bed, designated GF-02, GF-03, GF-0-5, GF-07, and GF-09. No ambient background water samples were collected; there may not have been any surface water in the upgradient parts of the creek at the time that sampling was conducted.

The five soil samples were analyzed for TPH against diesel and motor oil standards (TPH-diesel and TPH-motor oil) by Extraction, VOCs using EPA Method 8260, and polynuclear aromatic hydrocarbons (PAHs, a subset of SVOCs) using EPA Method 8270. The results may be summarized as follows:

- **TPH-diesel** was not detected in the five ambient background samples. The detection limits ranged from 12 to 15 milligrams per kilograms (mg/kg).
- **TPH-motor oil** was detected in each of the five ambient background samples. The reported concentrations ranged from 30 to 73 mg/kg.
- **VOCs** were not detected in the ambient background samples. The detection limits ranged from 0.006 to 0.014 mg/kg.

- **PAHs** were not detected in the ambient background background samples. The detection limits ranged from 0.40 to 1.0 mg/kg.

These findings suggest that the ambient background sediments in the creek bed are affected by relatively low levels (< 100 mg/kg) of TPH in the motor oil range, most likely due to historic crude oil releases that have left hardened fragments of asphaltic material in this area. US EPA and CDFG have concurred that this material will not be addressed in the cleanup of the January 2008 Davis Tank Battery Release. The TPH cleanup action level for the Site is therefore 1,000 mg/kg “plus background” (US EPA 2008, p. 6).

The ambient background sediments in the creek bed do not appear to be affected by TPH-diesel, VOCs, or PAHs. Any detection of these compounds in the creek bed would therefore be attributable to the January 2008 Davis Tank Battery Release.


The ambient background sampling did not include metals, and so LFR proposes additional ambient background sampling to address this gap. Five additional samples would be collected, at the same approximate locations used by US EPA, and analyzed for metals by EPA Method 7471 (for mercury) and by EPA Methods 6010 or 6020 (for antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc).


Greka’s subcontractor Cole’s, of Bakersfield California, previously conducted metals analysis on four waste bin samples (designated Greka #202, Greka #203, Greka #205, and RTS 2502). These four samples contained relatively high TPH concentrations (between 10,000 and 100,000 mg/kg), but these high TPH concentrations were associated with relatively low metals concentrations. The detected metal concentrations in the four waste bin samples were consistently comparable to, or below mean statewide background levels for California (Bradford et al. 1996). This finding suggests that metals are unlikely to be a significant environmental concern, even in the samples most affected by crude oil.

The attached tables summarize analytical results available to-date from US EPA and Cole’s sampling activities.

SAMPLING AND ANALYSES OF CREEK BED


The released fluids were confined to the narrow channel of the unnamed creek throughout most of the length of the affected area. The geometry of this area is very long and very narrow, so that it closely approximates a linear feature. Software tools such as Visual Sample Plan cannot address a shape of this kind.


As an alternative, LFR proposes to collect sediment samples at along the inner bank of every significant creek meander (or bend). he inner bank of a meander is a relatively low-energy area where alluvial sediments are deposited (the outer bank, in contrast, is a relatively high-energy area subject to alluvial erosion). Based on a preliminary evaluation of the creek bed, approximately 110 to 120 sediment samples would be collected. Proposed sample collection procedures are outlined in Attachment A.




All creekbed samples would be analyzed for TPH-diesel and TPH-motor oil by a state-certified laboratory (Level II QA/QC), in general accordance with previous US EPA sampling. Samples with TPH concentrations in excess of 1,000 mg/kg would also be analyzed for VOCs by EPA Method 8260, and for SVOCs by EPA Method 8270, since the available evidence indicates that the concentrations of VOCs and SVOCs are positively correlated with those of TPH at the Site. Targeted laboratory detection limits are summarized in Attachment B. 


No unusual concentrations of heavy metals have been reported in previous samples from the Site, even in samples with elevated TPH concentrations. Thus, the concentrations of metals may not be positively correlated with those of TPH. To gain further information about the distribution of metals at the Site, LFR proposes to evaluate every tenth sample for metals, using the same methods described above for the background sampling. This represents a total of approximately 11 to 12 metals analyses for creek bed samples. This approach should help to determine if any metals issue exists at the Site, and if so, whether it is associated with the January 2008 Davis Tank Battery Release.

SAMPLING AND ANALYSES OF PARKING LOT/LAY-DOWN AREA


LFR proposes to use Visual Sampling Plan (VSP) software to address the parking lot/lay-down yard immediately downgradient of the Tank Battery Area. This area appears to have a conventional non-linear shape, and should be well-suited to the use of VSP. 

However, the sampling area must be clearly and explicitly defined to use VSP. LFR anticipates that detailed maps delineating the affected parking lot/lay-down yard area will be available shortly. 

The number and location of samples in these areas will be determined using VSP. The sampling and analytical program will follow that proposed for the creek bed sampling.   ss the results of the creek bed sampling suggest that modifications are warranted. 

Surface water sampling will also be conducted in the stockponds. The exact number and location of surface water samples will be determined based on the amount of surface water in the ponds. 

SAMPLING AND ANALYSES OF STOCKPONDS

Based on discussions with CDFG, LFR proposes to conduct two transects across each of the two Chamberlin stockponds, and to collect sediment samples at 30-foot intervals along each transects. Proposed sampling procedures are outlined in Attachment A. 

Surface water sampling will also be conducted in the stockponds. At least two surface water samples will be obtained from each of the Chamberlin stockponds.

SCHEDULE AND REPORTING

The proposed supplemental ambient background sampling (for metals) and the proposed creek bed sampling can be initiated approximately 3 days after approval is granted by the US EPA. These sampling efforts should require no more than 3-4 days of fieldwork.


The sampling for non-creek bed areas will be scheduled after the areas have been mapped and evaluated using VSP. Since the stock ponds contain surface water, a sediment dredging technique may need to be used. LFR anticipates further discussion of this issue with CDFG.

A report will be prepared to document the distribution of TPH and other analytes in the confirmation samples. The report will include maps of sample locations, a table of analytical results, laboratory reports, and chain-custody of documentation. The report will be signed and stamped by a California-licensed Professional Geologist or Professional Civil Engineer. The report will be provided to the U.S. Environmental Protection Agency and California Department of Fish & Game within 4 weeks of the receipt of all laboratory results by LFR.




Legend


Comment

 Culvert Opening


NOTE

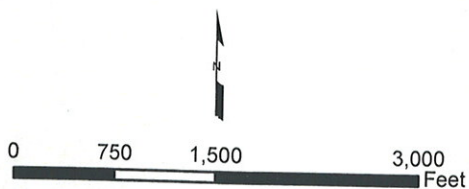
 Creek

Comment

 sheetflow direction

NOTE

 Catch Basin



Site Location Map

Greka / Davis Zaca



Figure 1

Preliminary Data for Greka/Davis Tank Battery Crude Oil Release

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-01	GF-02	GF-03	GF-04	GF-04D	GF-05	GF-06	GF-07	
Sample Type	Footprint	Ambient	Ambient	Footprint	Footprint	Ambient	Footprint	Ambient	
Total Petroleum Hydrocarbons by Extraction (mg/kg)									PRG*, mg/kg
Diesel	6.4 J	<15	<13	<140	81 J	<12	1000	<14	N/A
Motor Oil	68	73	70	1600	610	30	1100	41	N/A

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-08	GF-09	GF-10	GF-11	GF-12	GF-13	GF-14	GF-15	
Sample Type	Footprint	Ambient	Footprint	Footprint	Footprint	Footprint	Footprint	Footprint	
Total Petroleum Hydrocarbons by Extraction (mg/kg)									PRG*, mg/kg
Diesel	1300	<12	<11	390	<100	600	230	240	N/A
Motor Oil	1300	31	64	770	330	750	700	470	N/A

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	Greka # 203	Greka # 205	Greka # 202	RTS 2502	
Sample Type	Waste Bin	Waste Bin	Waste Bin	Waste Bin	
Total Petroleum Hydrocarbons by Extraction (mg/kg)					PRG*, mg/kg
Diesel	6100	6400	7900	48000	N/A
Motor Oil	6200	7000	7600	47000	N/A
Gasoline	4800	2400	1800	2300	N/A

J: Results between detection limit and reporting limit

*: USEPA Region 9 Preliminary Remediation Goals for Industrial Soil, October 2004

N/A: Not Applicable

Exceeds criteria of 1,000 mg/kg established by USEPA for this site/release

Preliminary Data for Greka/Davis Tank Battery Crude Oil Release

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-01	GF-02	GF-03	GF-04	GF-04D	GF-05	GF-06	GF-07	
Sample Type	Footprint	Ambient	Ambient	Footprint	Footprint	Ambient	Footprint	Ambient	
VOCs by EPA 8260B, mg/kg									PRG*, mg/kg
Benzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	1.4
Naphthalene	<0.006	<0.006	<0.006	0.0059 J	<0.008	<0.006	<0.007	<0.007	190
Toluene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	520
1,2,4-Trimethylbenzene	<0.006	<0.006	<0.006	0.0053 J	<0.008	<0.006	<0.007	<0.007	220
1,3,5-Trimethylbenzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	70
Ethylbenzene	<0.006	<0.006	<0.006	0.0053 J	<0.008	<0.006	<0.007	<0.007	400
Isopropyl Benzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	2000
Xylenes	<0.012	<0.012	<0.012	0.022	<0.016	<0.012	<0.014	<0.014	420
N-Butylbenzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	240
N-Propylbenzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	240
Acetone	<0.012	<0.012	<0.012	0.0085 J	<0.015	<0.012	<0.014	<0.014	54000
Sec-Butylbenzene	<0.006	<0.006	<0.006	<0.007	<0.008	<0.006	<0.007	<0.007	220

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-08	GF-09	GF-10	GF-11	GF-12	GF-13	GF-14	GF-15	
Sample Type	Footprint	Ambient	Footprint	Footprint	Footprint	Footprint	Footprint	Footprint	
VOCs by EPA 8260B, mg/kg									PRG*, mg/kg
Benzene	0.17	<0.006	0.029	0.0077	<0.005	<0.006	<0.028	0.0094	1.4
Naphthalene	0.39	<0.006	0.025	0.029	<0.005	<0.006	<0.028	0.10	190
Toluene	0.25	<0.006	0.064	0.022	<0.005	<0.006	<0.028	0.048	520
1,2,4-Trimethylbenzene	0.12	<0.006	0.0079	0.0061 J	<0.005	<0.006	<0.028	0.027	220
1,3,5-Trimethylbenzene	0.11	<0.006	0.0087	0.0079	<0.005	<0.006	<0.028	0.032	70
Ethylbenzene	0.030 J	<0.006	0.015	0.0097	<0.005	<0.006	<0.028	0.028	400
Isopropyl Benzene	0.030 J	<0.006	0.0043 J	0.0038 J	<0.005	<0.006	<0.028	0.013	2000
Xylenes	0.99	<0.012	0.11	0.079	<0.010	<0.011	0.046 J	0.38	420
N-Butylbenzene	0.081	<0.006	0.0055 J	0.0077	<0.005	<0.006	<0.028	0.025	240
N-Propylbenzene	0.024 J	<0.006	0.0042 J	0.0049 J	<0.005	<0.006	<0.028	0.018	240
Acetone	<0.014	<0.012	0.012 J	<0.012	<0.010	<0.011	<0.056	<0.011	54000
Sec-Butylbenzene	0.054	<0.006	0.0037 J	0.0043 J	<0.005	<0.006	<0.028	0.015	220

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	Greka # 203	Greka # 205	Greka # 202	RTS 2502	
Sample Type	Waste Bin	Waste Bin	Waste Bin	Waste Bin	
VOCs by EPA 8260B, mg/kg					PRG*, mg/kg
Benzene	7.5	1.5	3.3	3.8	1.4
Naphthalene	12	6.9	3.3	6.6	190
Toluene	23	7.3	12	11	520
1,2,4-Trimethylbenzene	21	9.2	7.8	8.6	220
1,3,5-Trimethylbenzene	5	2.4	1.8	2.4	70
Ethylbenzene	25	7.9	10	11	400
Isopropyl Benzene	4.6	1.9	1.6	2.2	2000
4-Isopropyltoluene	2	1.2	0.9	1.2	NA
m,p-Xylene	33	12	14	14	NA
o-Xylene	19	7.8	8	8.5	NA
Xylenes	52	20	22	23	420
N-Butylbenzene	8.3	3.1	2.4	3.2	240
N-Propylbenzene	13	5	5	5.3	240
Acetone	<1.3	<1.3	<1.3	<1.3	54000
Sec-Butylbenzene	2.7	1.1	0.83	1.2	220
Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GFW-01	GFW-02	GFW-03	GFW-03D	
Sample Type	Grab Water	Grab Water	Grab Water	Grab Water	
VOCs by EPA 8260B, ug/L					MCL**, ug/L
Benzene	46	<5.0	25	25	1
Naphthalene	5.1	<5.0	5.8	6.3	NA
Toluene	71	<5.0	44	45	150
1,2,4-Trimethylbenzene	8.8	<5.0	9.7	10	NA
1,3,5-Trimethylbenzene	2.2 J	<5.0	2.2 J	2.3 J	NA
Ethylbenzene	26	<5.0	23	23	300
Isopropyl Benzene	2.3 J	<5.0	2.2 J	2.4 J	NA
Xylenes	59	<10	61	61	1750
N-Butylbenzene	4.1 J	<5.0	3.4 J	<5.0	NA
N-Propylbenzene	5.1	<5.0	5.8	3.6 J	NA
Acetone	6.5 J	<10	5.7 J	6.2 J	NA
Sec-Butylbenzene	<5.0	<5.0	<5.0	<5.0	NA

**: California Maximum Contaminant Level; primary, August 2007

J: Results between detection limit and reporting limit

*: USEPA Region 9 Preliminary Remediation Goals for Industrial Soil, October 2004

N/A: Not Applicable

Exceeds criteria

Preliminary Data for Greka/Davis Tank Battery Crude Oil Release

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-01	GF-02	GF-03	GF-04	GF-04D	GF-05	GF-06	GF-07	
Sample Type	Footprint	Ambient	Ambient	Footprint	Footprint	Ambient	Footprint	Ambient	
PAHs by EPA 8270C, mg/kg									PRG*, mg/kg
Acenaphthene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	29000
Acenaphthylene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	NA
Anthracene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	100000
Benzo(a)anthracene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	2.1
Benzo(a)pyrene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	0.21
Benzo(b)fluoranthene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	2.1
Benzo(k)fluoranthene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	21
Benzo(g,h,i)perylene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	NA
Chrysene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	210/13**
Dibenz(a,h)anthracene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	0.21
Fluoranthene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	22000
Fluorene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	26000
Indeno(1,2,3-cd)pyrene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	2.1
Naphthalene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	190
Phenanthrene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	NA
Pyrene	<0.76	<1.0	<0.42	<0.91	<1.0	<0.40	<0.86	<0.92	29000

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	GF-08	GF-09	GF-10	GF-11	GF-12	GF-13	GF-14	GF-15	
Sample Type	Footprint	Ambient	Footprint	Footprint	Footprint	Footprint	Footprint	Footprint	
PAHs by EPA 8270C, mg/kg									PRG*, mg/kg
Acenaphthene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	29000
Acenaphthylene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	NA
Anthracene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	100000
Benzo(a)anthracene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	2.1
Benzo(a)pyrene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	0.21
Benzo(b)fluoranthene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	2.1
Benzo(k)fluoranthene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	21
Benzo(g,h,i)perylene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	NA
Chrysene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	210/13**
Dibenz(a,h)anthracene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	0.21
Fluoranthene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	22000
Fluorene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	26000
Indeno(1,2,3-cd)pyrene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	2.1
Naphthalene	<1.4	<0.41	<0.88	0.61 J	<0.69	<0.36	<2.9	<0.71	190
Phenanthrene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	NA
Pyrene	<1.4	<0.41	<0.88	<0.81	<0.69	<0.36	<2.9	<0.71	29000

** : CAL-Modified PRG

NA: Not Available

*: USEPA Region 9 Preliminary Remediation Goals for Industrial Soil, October 2004

Exceeds criteria

Preliminary Data for Greka/Davis Tank Battery Crude Oil Release

Date Sampled	1/10/2008	1/10/2008	1/10/2008	1/10/2008	
Sample ID	Greka # 203	Greka # 205	Greka # 202	RTS 2502	
Sample Type	Waste Bin	Waste Bin	Waste Bin	Waste Bin	
Mecury by EPA 7471, mg/kg					PRG*, mg/kg
Mercury	<0.5	<0.5	<0.5	<0.5	310
Metals by EPA 6010B with acid digestion, mg/kg					PRG*, mg/kg
Antimony	<10	<10	<10	<10	410
Arsenic	<1.0	1.8	<1.0	<1.0	0.25**
Barium	32	35	23	33	67000
Beryllium	<0.5	<0.5	<0.5	<0.5	1900
Cadmium	<0.5	<0.5	<0.5	<0.5	450
Chromium	14	7	3.4	6.6	450
Cobalt	<5.0	<5.0	<5.0	<5.0	1900
Copper	4.9	6	3.9	6.3	41000
Lead	2.5	4.4	2.5	2.8	800/150+
Molybdenum	<5.0	<5.0	<5.0	<5.0	5100**
Nickel	20	23	8.5	23	20000
Selenium	<2.5	<2.5	<2.5	<2.5	5100
Silver	<1.0	<1.0	<1.0	<1.0	5100
Thallium	<25	<25	<25	<25	67
Vanadium	42	46	16	46	1000
Zinc	20	40	21	150	100000

** : CAL-Modified PRG

* : USEPA Region 9 Preliminary Remediation Goals for Industrial Soil, October 2004

Exceeds criteria

ATTACHMENT A

LFR Field Protocols



SOIL SAMPLING



Soil borings for soil sampling will be drilled with hand-auger tools, hand tools (i.e. trowel, shovel, pick, etc.), direct-push, or hollow-stem auger drilling methods. A description of drilling methods is presented at the end of Appendix A. Where possible, efforts will be made to conduct sampling by all methods on established roads or pads. However, if assessment activities are conducted off established roads or in existing disturbed areas, care will be taken to minimize potential impact to the environment.

To reduce the potential for cross contamination between borings, all downhole drilling and sampling equipment will be steam cleaned prior to use at each drilling location or scrubbed with laboratory-grade non-phosphate detergent and double-rinsed with distilled water between soil boring locations. Hand-tool and soil sampling equipment will be steam cleaned or scrubbed with laboratory-grade non-phosphate detergent and double-rinsed with distilled water between soil boring locations. Equipment will be decontaminated in a pre-designated area on plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas.

Care will be taken to minimize sloughing into the soil borings during hand augering and/or digging a shallow soil pit. However, it is unlikely that sloughing can be fully mitigated.

Soil will be sampled and observed continuously when using the hand-auger, hand-tool (trowel, shovel, etc.) and direct-push drilling methods. Soil will be sampled and observed at the intervals described in the workplan when using the hollow-stem augering drilling method. During the drilling and sampling process, LFR will screen the soil with a photoionization detector (PID) and inspect the soil for evidence of hydrocarbons.

Soil samples obtained by the hand-auger and hand-tool methods will be collected directly from the hand-auger tool and transferred into a laboratory-supplied glass jar. The jar threads will be cleaned by hand (nitrile-gloved), and the jar will be capped, sealed and labeled. Alternately, a stainless steel tube will be driven ahead of the boring in a core barrel. The sample stainless steel tube will be removed from the core-barrel, covered on both ends with Teflon sheeting, and sealed using plastic caps.

Grab soil samples will be collected by using single-use disposable trowels (or using multi-use trowels that are decontaminated between sampling locations) to access and collect soil from the surface to approximately 15 cm below ground surface (bgs), which will then be transferred into a new laboratory-provided glass jar. This approach will be used for the purpose of minimizing the need for decontamination of hand tools. The disposable trowels will be treated as investigative derived waste, which will be stored and disposed of following regulatory procedures.


Soil samples obtained by the direct-push method (Geoprobe® or equivalent) will be collected using a 1 ¾-inch diameter, 3- or 4-foot section of clear acetate tubing. Field

staff will inspect the whole section of acetate and determine which portion is to be analyzed. The selected portion will then be cut into a 6-inch segment, covered on both ends with Teflon sheeting, and sealed using plastic caps.

Soil samples obtained by the hollow stem auger drilling method will be collected in a split- spoon sampler containing 2.5-inch diameter, 6-inch long stainless steel tubes fitted inside the split-spoon sampler. The sample stainless steel tube to be retained will be removed from the split-spoon sampler, covered on both ends with Teflon sheeting, and sealed using plastic caps.

The samples are then labeled and stored in a chilled cooler (at 4 degrees Celsius) pending delivery to the analytical laboratory. Strict chain-of-custody protocol is followed throughout all phases of the sample handling process.

Sampling Interval

Soil borings will be advanced and sampled at selected intervals specified by the work plan.  Additional samples may be collected at the discretion of the on-site LFR geologist or engineer. Samples will be delivered to the analytical laboratory indicated in the work plan, and the samples will be analyzed for the compounds listed in the work plan.

Soil Boring Abandonment

After samples are collected from the boring, the boring will be filled with bentonite chips and then hydrated.

Sample Identification

All samples will be identified and labeled at the time of collection. Sample identification will follow a specific format to ensure that all sample numbers are unique. The sample identification format is described below:

Hand Auger Boring Samples

Hand auger soil samples will be given the prefix of HA, followed by the well pad/ area/stockpile name, followed by the next number in sequence, followed by the depth from the surface to the interval sampled, in feet.

Example: HADAVIS-01-1'

Direct Push Boring Samples

Direct push soil samples will be given the prefix of DP, followed by the well pad/ area/stockpile name, followed by the next number in sequence, followed by the depth from the surface to the interval sampled, in feet.

Example: DPDAVIS-02-5'

Grab Samples

Grab sample soil samples will be given the prefix of GS, followed by the well pad/tank battery area/stockpile name, followed by the next number in sequence, followed by the depth from the surface to the interval sampled, in feet.

Example: GSDAVIS-02-0'

Hollow Stem Auger Samples

Hollow stem auger soil samples will be given the prefix of HS, followed by the well pad/ area/stockpile name, followed by the next number in sequence, followed by the depth from the surface to the interval sampled, in feet.

Example: HSDAVIS-02-5'

Sample labels will also include date and time of sample collection, the sampler's name, and Site location. The chemical analyses to be performed by the laboratory will be described via the chain-of-custody.

Lithologic Logs

Soil samples will be lithologically described and classified using the Unified Soil Classification System. A lithologic log will be prepared for each boring. Drilling and logging will be performed under the direction of a California Professional Geologist (PG) or California Registered Professional Engineer.

Soil Cuttings


Soils and other investigative derived wastes generated during drilling activities will be placed in DOT-approved 55-gallon drum. The drum will be appropriately labeled, and disposition of its contents will be the responsibility of Greka.

Decontamination Water

Decontamination water, generated from cleaning and rinsing equipment, will be collected in a 55-gallon drum. The drum will be appropriately labeled, and disposition of its contents will be the responsibility of Greka.

Adjacent Samples

Adjacent samples will be collected at a frequency of more than 10 percent of the samples collected for analysis, to evaluate the heterogeneity of the soil and give some

insight regarding laboratory reproducibility. Duplicate soil samples will not be created. The adjacent samples will be submitted to the primary laboratory, Oilfield Environmental & Compliance (OEC) of Santa Maria, California, or equivalently state-licensed laboratory. 

Sample Transfers

Strict chain-of-custody protocols will be followed throughout all sample transfers. A chain-of-custody form will be completed in triplicate. Two copies of the form will accompany the samples to the laboratory, and LFR will retain one copy. A photocopy of the completed chain-of-custody form will be forwarded to LFR.

SEDIMENT SAMPLING IN SURFACE WATER

If the water column at a sampling location is less than 2.5 feet deep, the sample of the bottom sediment may be collected by field personnel wearing waders, using a cleaned or one-use disposable trowel. Recovered sediment will be transferred into a laboratory-supplied glass jar. The jar threads will be cleaned by hand (nitrile-gloved), and the jar will be capped, sealed and labeled.

If the water column is more than 2.5 feet deep, the sample core will be collected from a boat using an Eckman dredge (or similar). The dredge unit will be cleaned prior to use at each location by scrubbing with laboratory-grade non-phosphate detergent and double-rinsed with distilled water between soil boring locations.

Care will be taken to avoid visible surface slicks and the vessel's exhaust when raising and lowering the dredge unit. The dredge unit will be smoothly lifted through the water column with the objective of minimizing sediment loss during the ascent. Recovered sediment will be transferred into a laboratory-supplied glass jar. The jar threads will be cleaned by hand (nitrile-gloved), and the jar will be capped, sealed and labeled.

Sediment Samples

Sediment samples collected from within a surface water body will be given the prefix of SD, followed by the well pad/ area/stockpile name, followed by the next number in sequence, followed by the depth from the surface to the interval sampled, in feet.

Example: SDDAVIS-02-0'

After the samples are labeled, they are stored in a chilled cooler (at 4 degrees Celsius) pending delivery to the analytical laboratory. Strict chain-of-custody protocol is followed throughout all phases of the sample handling process.

GROUNDWATER SAMPLING

Groundwater samples will be collected using the Hydropunch™ sampling technique, from new temporary or permanent groundwater monitoring wells. Water samples collected by the Hydropunch™, or similar, sampling technique are considered “grab groundwater” samples.

To reduce the potential for cross contamination when sampling temporary or permanent monitoring wells, all probes and sampling equipment will be steam cleaned or scrubbed with laboratory-grade non-phosphate detergent and double-rinsed with distilled water between well locations. Equipment will be decontaminated in a pre-designated area on plastic sheeting, and clean bulky equipment will be stored on plastic sheeting in uncontaminated areas.

Hydropunch Sampling

Discreet depth groundwater samples will be collected from hollow stem auger or direct push boreholes using the HydroPunch II™ sampling device, or an equivalent brand device. The borehole will be advanced to approximately 2 feet above the target depth from which a discreet water sample is desired. The drilling subcontractor will prepare the Hydropunch™ sampling device according to the manufacturer’s specifications and lower the device to the bottom of the borehole. The drill rod will be sealed with built in gaskets, Teflon tape, or an equivalent sealing method. The drilling contractor will drive the sampling device to the target depth into undisturbed sediment beneath the bottom of the borehole. The drill rod will then be withdrawn to expose the screen of the sampling device. After waiting sufficient time to allow water to enter the screen, a groundwater sample will be collected by lowering a bailer through the rods and body of the sampler.

Monitoring Well Sampling; Purging

Purging is the process whereby stagnant water is removed from a monitoring well immediately prior to collection of groundwater samples. Purging causes the stagnant water to be replaced by groundwater from the surrounding formation, which is representative of actual conditions.

Prior to initiating the purge by placing any sampling equipment into a well, the amount of standing water in the water column (water inside the well riser and screened interval) should be determined. To do this, the diameter of the diameter of the well annulus, the water level, and the total depth of the well will be measured and recorded on the appropriate water quality field data sheet. Measurements will be made using a Solinst electric water-level meter, as described in the previous section. Once this information is obtained, the volume of water to be purged can be determined using a casing volume per foot factor. A 2-inch diameter well contains 0.163 gallons per foot of casing.

The water level is subtracted from the total depth of the well, providing the height of the water column. The height of the water column is multiplied by the factor in the above table that corresponds to the appropriate well diameter, providing the amount of water, in gallons, contained in the well (or one casing volume):

[Total Depth of well (feet)-Depth to Static Water (feet)] x volume = Gallons of Water in well.

With respect to volume, an adequate groundwater purge is achieved when approximately four times the volume of standing water in the well has been removed.

Wells will be purged by hand-bailing using a disposable bailer fitted with a clean (new) length of polyethylene twine, with a peristaltic pump, or with a Grundfoss Rediflow 2-inch electric submersible pump. In the case of the latter, the pump will be lowered into the well and placed approximately 2 to 3 feet below the top of the air/water interface to ensure that all of the water in the casing is purged and minimize the possibility of mixing and/or sampling stagnant water when the disposable bailer is lowered into the and subsequently retrieved. In wells that recharge slowly, the pump will be placed lower in the screened interval.

Prior to the collection of groundwater samples, the submersible pump will be slowly pulled through the air/water interface, while running, to eliminate any stagnant groundwater not removed during the purging process.

Field Water Quality Measurements

In order to determine when a well has been adequately purged, field personnel will monitor the pH, specific conductance (EC), and temperature. Field water quality parameters will be measured for stabilization after each water-column volume is purged. The following target criteria for two consecutive measurements (one water-column volume apart) will be used to demonstrate stabilization:

- pH +/- 10%
 - EC +/- 10%
 - Temperature +/- 1 degree Centigrade
 - Dissolved oxygen (DO) may be monitored during specialized sampling events.
- The target criterion for two consecutive measurements is +/- 10%.

An Oakton pH/EC/Temp meter, or equivalent, will be used to record water quality data during purging of monitoring wells where only those parameters listed above are required. The field parameters will be measured in a representative water sample from each appropriate casing volume. The sample will be poured from the disposable bailer or drawn directly from the pump effluent water line into a 250-ml beaker. Water quality measurements will be recorded on a water quality data sheet.

Groundwater monitoring wells where DO is recorded will be purged into a Geotech Multiprobe Sampling System, or equivalent, flow through cell. This closed system will allow minimal changes in temperature, pressure and dissolved gasses from the in-situ aquifer environment. Parameters will be recorded “in-line” using a Multiline P4 pH/ORP, DO, EC, and temperature meter, or equivalent. The flow through cell has the following characteristics:

- Air tight fittings for installation of all probes
- Intake connected directly to the pump discharge line
- A discharge line at least 3 feet long that is connected to the flow cell with an airtight connection.
- A maximum volume of no greater than five times the per-minute volumetric rate of inflow to the cell to maintain measurement sensitivity to temporal changes in water quality.
- A minimum volume of 500 ml to provide enough thermal mass to minimize external temperature effects
- The flow through cell will be shielded from strong winds and on hot days will be shielded from direct sunlight

The operation of the probes nested into the flow through cell will be as follows:

- The flow of the extracted groundwater through the flow through cell will be maintained as continuous and steady as practical throughout the measurement period.
- Discharge velocities through the flow cell will be kept low enough to prevent streaming potential problems with probes.
- All probes will be fully immersed without touching the sides of the airtight, non-metallic flow cell.
- All probes will be allowed to equilibrate with fresh well water for two minutes before measurements are recorded.

Purged groundwater will be collected and stored temporarily in 55-gallon poly-drums. The purge water will be transported to Greka’s appropriate waste water treatment facility by Greka for treatment and disposal.

Groundwater Sample Collection

Prior to the collection of groundwater samples, each well will be allowed to recover to 80 percent of the measured static groundwater, but not exceeding two hours after the conclusion of the purging activities.

Groundwater samples will be collected from all the wells using disposable PVC bailers lowered by clean (new) length of polyethylene twine. Groundwater samples will be

decanted from the bailer into the appropriate laboratory supplied sample container(s) using a bottom emptying device.

Groundwater samples for VOC and TPH analysis will be collected in two 40-ml VOA vials with Teflon septa and one 1-liter amber bottle, respectively. The sample containers will be sealed, labeled, and placed in a cooler chilled to 4 degrees Centigrade for delivery to OEC of Santa Maria, California, or an equivalently state-certified laboratory.

If additional analyses are necessary, the samples will be collected in the appropriate laboratory-supplied containers.

Duplicate Samples

Duplicate groundwater samples will be collected from approximately 10 percent of the wells sampled to assess the reproducibility of analytical procedures. The duplicate samples will be submitted to the primary laboratory, OEC of Santa Maria, California, or an equivalently state-certified laboratory.

Sample Identification

All samples will be identified and labeled with unique sample numbers using the following sample designations:

Hydropunch™ Samples

Groundwater samples will be labeled with the prefix GW, HP to designate Hydropunch name, boring location name, depth interval, followed by the six-digit date.

Example: GWDAVIS-02-5'100108

Well Groundwater Samples

Groundwater samples will be labeled with the prefix GW, followed by the well type temporary well (TW) or permanent well (MW), well name, and the six-digit date.

Example: GWDAVIS-1-100108

Duplicate Samples

Duplicate samples will be the same as above, followed by -0.

Example: GWDAVIS-1-100108-0

Equipment Blanks

Equipment blanks will be labeled using the prefix EB, followed by the name of the last well sampled, followed by the six-digit date.

Example: EBDAVIS -1-100108

Sample Transfers

Strict chain-of-custody protocols will be followed throughout all sample transfers. A chain-of-custody form will be completed in triplicate. Two copies of the form will accompany the samples to the project laboratory, and LFR will retain one copy.

SURFACE WATER SAMPLING

Surface water samples will be collected from surface water bodies, including streams, ponds and lakes as described in the workplan.

Accessing Water Bodies

Sampling personnel typically will not physically enter the water body; samples will typically be collected using an extension pole with a dipper attached to the end. While collecting the sample, samplers will be careful not to stir up bottom sediments and to collect water samples free of turbid waters caused by disturbance of sediments in the water body.

In instances where sampling personnel must physically enter the water body, they will access the surface water bodies on foot wearing hip or other watertight protective apparel. While accessing the sample collection area, samplers will be careful not to stir up bottom sediments and to collect water samples free of turbid waters caused by disturbance of sediments in the water body. At water body locations where the water column is too deep to access the target location on foot, sampling personnel will use a canoe or flat bottom to collect water samples.

Sample Collection

At sampling locations accessed with the extension pole, surface water samples will be collected using an attached clean poly sampling cup. The sampling cup is extended out into the surface water body and dipped into the pond. The cup fills with the water approximately 2 cm deep into the surface water body.

At sampling locations physically accessed directly by the sampler, surface water samples will be collected directly into appropriate laboratory-supplied containers (plastic and/or glass, as described in the workplan). The collection containers will be submersed into the surface water body to collect the samples. In instances where depth specific samples are required, a depth specific sampler will be used (EPA approved Water Mark Horizontal polycarbonate discrete interval liquid sampler, or similar). To fill 40-ml VOA vials, water will then be decanted from a collection container (laboratory-supplied glass or plastic jar) into the laboratory-supplied 40-ml VOA vials with Teflon septa.

Following sample collection, the sample containers will be sealed, labeled, and placed in a cooler chilled to 4 degrees Centigrade for delivery to the analytical laboratory. The samples will be submitted to project laboratory under strict chain-of-custody protocol for analysis as described in the work plan.

Decontamination of Equipment

All re-usable sampling equipment will be scrubbed with a laboratory-grade detergent, double-rinsed with distilled water, and/or steam cleaned between each sampling location and depth interval.

Duplicate Samples

Duplicate surface water samples will be collected from approximately 10 percent of the surface water stations sampled to assess the reproducibility of analytical procedures. The duplicate samples will be also be submitted to the primary laboratory, OEC of Santa Maria, California, or an equivalently state-certified laboratory.

Equipment Blanks

Collection of field equipment blanks will be conducted to simulate actual field sampling methods in a manner that would detect the presence of background or cross-contamination of samples from the ambient environment, preservatives, or samplings equipment. Equipment blanks will be collected by pouring distilled water over the sampling equipment (with a preference for re-usable equipment) into the appropriate sample containers (i.e. two 40-milliter VOA s and one 1-liter bottle).

Sample Transfers

Strict chain-of-custody protocols will be followed throughout all sample transfers. A chain-of-custody form will be completed in triplicate. Two copies of the form will accompany the samples to the laboratory, and LFR will retain one copy.

Sample Identification

All samples will be identified and labeled with unique sample numbers using the following sample designations:

Surface Water Samples

Surface water samples will be labeled with the prefix SW, followed by the associated assessment feature name, and the six-digit date.

Example: SWDAVIS-1-100108

Duplicate Samples

Duplicate samples will be the same as above, followed by -0.

Example: SWDAVIS-1-100108-0

DRILLING METHODS

Soil borings advanced for soil and/or groundwater sampling will be advanced using hand-auger tools, hand tools, direct-push, or hollow-stem auger drilling methods. These methods are described in detail below.

Hand-Auger

The hand auger assembly includes a 3 ¼-inch diameter auger bucket head with a 4-inch lead blade and 36-inch long extension rod(s) attached to a tee-handle. As the auger handle is rotated manually into the soil, the auger bucket advances into the ground. Once the bucket is full of cuttings, the assembly is retrieved from the borehole and the cuttings are removed from the bucket. The process is repeated until the desired depth of sampling is reached.

When the borehole is advanced to the desired depth, the soil sample is collected directly from the hand-auger tool and transferred into a glass jar. The jar threads will be cleaned by hand (nitrile-gloved), and the jar will be capped and sealed. Alternately, the soil sample is collected in-situ with a slide hammer assembly comprised of a core barrel attached to 36-inch long extension rod(s) and slide handle. A clean, 2-inch by 6-inch stainless steel sleeve is inserted into the core barrel, and the slide hammer is advanced into the ground by manually raising and lowering the slide handle. After the core barrel is advanced approximately 6 inches beneath the bottom of the borehole, the slide-hammer assembly is removed and the stainless steel sleeve containing the soil sample is retrieved from the core barrel.

Direct Push

Borings completed using the Direct Push method will be advanced using a Geoprobe® or equivalent rig operated by OEC of Santa Maria, California (or similar state-licensed drilling contractor). Using this method, a hydraulic hammer or vibrator drives the push-probe system as soil samples are collected over four-foot long intervals on a continuous basis. As the core barrel is advanced to the desired sample depth, soil is driven into an inner 1 ¾-inch diameter acetate sleeve inserted inside the rods. After being advanced to the appropriate sample depth, the rods will be retrieved from the borehole and the acetate liner containing the soil will be removed.

Hollow Stem Auger

Borings will be advanced for soil sampling and possibly the installation of temporary or permanent groundwater monitoring wells using a CME-95 or equivalent drill rig operated by a California state-licensed, local drilling company. Eighteen-inch long intervals are sampled every five feet during the drilling process. Using this method, a bit at the bottom of the auger cuts into subsurface material, and a spiral-formed auger

is used to convey material from the subsurface to the surface as the auger rotates. Inside the auger is a plug connected to inner drive rods.

Five-foot sections of 8-inch diameter auger will be attached to the drive mechanism that is connected to the drill rig. The auger will advance to greater depth as it is rotated. Once the desired depth of drilling is reached, the center plug and rods are removed leaving the augers in place, and the borehole remains open for sediment sampling through the hollow augers. Well installation can also be performed through the hollow augers.

Soil samples are collected in-situ using a split spoon sampler that is lowered through the hollow stem auger and driven into undisturbed sediments below the auger bit using a weight attached to a pulley system.

Monitoring Well Construction and Development

Monitoring wells may be installed using hollow stem auger, direct push or hand tool installation methods. These methods are described below for permanent and temporary well applications.

In order to accurately identify the location and top of casing elevation of newly installed permanent monitoring wells, the wells will be surveyed by a licensed land surveyor.

Permanent Monitoring Well; with Hollow Stem Auger. Once the borehole is advanced to the desired depth (approximately 10 feet below the water table) using the hollow-stem auger drilling method, the monitoring well will be constructed through the 8-inch diameter augers. The well casing will consist of 2-inch diameter, blank Schedule 40 PVC casing and 0.020-inch slotted PVC screen. The well sections will be cleaned thoroughly before installation. The wells will be constructed with 15 feet of screen and installed so that approximately 5 feet extends above the water table.

The annulus of the borehole will be filled with No. 3 Monterey sand extending from the bottom of the borehole to approximately 2 feet above the top of the screened interval. Sections of auger will be removed during this process as the sand is poured into the annular space. An approximately 2 feet of bentonite pellets or chip seal will be placed above the sand pack and hydrated. The remaining annular space will be backfilled with bentonite grout to provide a sanitary seal. The wells will be completed with either the top of casing slightly below the surface protected by a flush-mounted, traffic-rated well box, or the top of casing extending above ground surface protected by a locking stove pipe.

A minimum of 24 hours after installation, the wells will be developed using a surge block and a bailer and/or pump to remove sediment that may have entered the well during construction and to enhance the hydraulic communication between the well and surrounding formation. Development will proceed until a minimum of 5 well volumes

have been removed from the well and measurements of pH, temperature and conductivity have stabilized to within 10 percent. Purge rates, water-level measurements and volume removed from each well will be recorded with parameter measurements on Water Quality Sampling Forms.

Permanent Monitoring Well; with Direct Push. Once the borehole is advanced to the desired depth (approximately 10 feet below the water table) using the direct-push drilling method, the monitoring well will be constructed through hollow push casing. The well casing will consist of 1-inch diameter, blank Schedule 40 PVC casing and 0.020-inch slotted PVC screen. The well sections will be cleaned thoroughly before installation. The wells will be constructed with 15 feet of screen and installed so that approximately 5 feet extends above the water table.

The annulus of the borehole will be filled with No. 3 Monterey sand extending from the bottom of the borehole to approximately 2 feet above the top of the screened interval. Sections of push casing will be removed during this process as the sand is poured into the annular space. An approximately 2 feet of bentonite pellets or chip seal will be placed above the sand pack and hydrated. The remaining annular space will be backfilled with bentonite grout to provide a sanitary seal. The wells will be completed with either the top of casing slightly below the surface protected by a flush-mounted, traffic-rated well box, or the top of casing extending above ground surface protected by a locking stove pipe.

A minimum of 24 hours after installation, the well is developed using a peristaltic pump and tubing to remove sediment that may have entered the well during construction and to enhance the hydraulic communication between the well and surrounding formation. Development will proceed until approximately 5 well volumes have been removed from the well and measurements of pH, temperature and conductivity have stabilized to within 10 percent. Purge rates, water-level measurements and volume removed from each well will be recorded with parameter measurements on Water Quality Sampling Forms.

Permanent Shallow Monitoring Well, with Hand Tools. For shallow applications, less than 5 feet, in relatively soft soil conditions, a monitoring well can be constructed using narrow-diameter (1-inch) stainless steel drive points with 0.010-slot screen. Hand auger tools are used to auger a hole down to the water table. The drive point is then manually driven to the desired depth using a T-post slide hammer. No. 3 or no. 2-12 Monterey sand is added from above the well screen, extending to approximately 1 foot above the top of the screened interval. The balance of the annular area is backfilled with hydrated bentonite pellets or chip seal will be placed above the sand pack and hydrated.

A minimum of 24 hours after installation, the well is developed using a peristaltic pump and tubing to remove sediment that may have entered the well during construction and to enhance the hydraulic communication between the well and surrounding formation. Development will proceed until approximately 5 well volumes have been removed from the well and measurements of pH, temperature and

conductivity have stabilized to within 10 percent. Purge rates, water-level measurements and volume removed from each well will be recorded with parameter measurements on Water Quality Sampling Forms.

Temporary Monitoring Well. A temporary monitoring well can be constructed using the exact same protocol as the permanent monitoring wells installed using the hollow stem or direct push drilling methods, only construction is complete when the filter pack is added, no annular bentonite seal is added, and little if any development and purging is performed. A grab groundwater sample is then collected from inside the temporary well. After sampling, the casing is removed and the boring is properly destroyed and sealed with hydrated bentonite within 24 hours, in accordance with County of Santa Barbara regulations.

Temporary Shallow Monitoring Well. For shallow applications, less than 5 feet, in relatively soft soil conditions, temporary monitoring wells can be constructed using narrow-diameter (1-inch) stainless steel drive points with 0.010-slot screen. Hand auger tools are used to auger a hole down to the water table. The drive point is then manually driven to the desired depth using a T-post slide hammer. A grab groundwater sample is then collected from inside the temporary well using a peristaltic pump and tubing. After sampling, the casing is removed and the boring is properly abandoned and sealed within 24 hours, in accordance with County of Santa Barbara regulations.

ATTACHMENT B

Targeted Laboratory Detection Limits

NOTE: FPD does not accept EPA Method 418.1 for TPH analysis.

Table F-2 – Practical Quantitation Limits for Gasoline Related Constituents

Constituent	PQL in Groundwater µg/L	PQL in Soil mg/kg
Total Petroleum Hydrocarbons		
as Gasoline C4-C12	50	10
as diesel C13-C22	50	10
as oil C23-C40	500	50
Aromatic Compounds		
benzene	0.5	0.005
toluene	0.5	0.005
ethylbenzene	0.5	0.005
xylene	0.5	0.005
Fuel Oxygenates		
di-isopropyl ether (DIPE)	3	0.030
ethyl tertiary butyl ether (ETBE)	3	0.030
ethanol	500	5
methanol	500	5
methyl tertiary butyl ether (MTBE)	1	0.010
tertiary butyl ether (TBA)	10	0.100
tertiary amyl methyl ether (TAME)	3	0.030
Lead Scavengers and Breakdown Products		
chlorobenzene	0.5	0.005
dichlorobenzene	0.5	0.005
1,2-dichloroethane (EDC)	0.5	0.005
ethylene dibromide (EDB)	0.5	0.005
Recalcitrant Constituents		
n-butylbenzene	1	0.005
sec-butylbenzene	1	0.005
tert-butylbenzene	1	0.005
naphthalene	1	0.005
isopropylbenzene	1	0.005
n-propylbenzene	1	0.005
1,2,4-trimethylbenzene	1	0.005
1,3,5-trimethylbenzene	1	0.005
Lead	7.5	1

TABLE F-3 - Investigation Levels for the FPD Sites

Constituent	Groundwater µg/L	Soil mg/kg
Total Petroleum Hydrocarbons		
Aggregate of all Carbon Chains	1000	†
Aromatic Compounds		
benzene	1	0.1*
toluene	150	15
ethylbenzene	700	70
xylene	1,750	175
Fuel Oxygenates		
methyl tertiary butyl ether (MTBE)	5	0.050
tertiary butyl ether (TBA)	12	0.120
Lead Scavengers		
1,2-dichloroethane (EDC)	0.5	5
ethylene dibromide (EDB)	0.05	0.5
Older Gasoline Constituents		
n-butylbenzene	260	26
sec-butylbenzene	260	26
tert-butylbenzene	260	26
naphthalene	170	1.7
isopropylbenzene	770	77
n-propylbenzene	260	26
1,2,4-trimethylbenzene	330	33
1,3,5-trimethylbenzene	330	21
Total Lead	15	50
Soluble Lead in soil (mg/L)	--	5

† If soil contamination is <50 feet from groundwater the investigation level for TPH is 100 mg/kg

† If soil contamination is >50 feet from groundwater the investigation level for TPH is 200 mg/kg

* If soil contamination is >100 feet from groundwater, the investigation level for Benzene is 0.2 mg/kg.

Analytical results for soil samples shall be reported in mg/kg or parts per million (ppm).

Analytical results for water samples shall be reported in µg/L or parts per billion (ppb).

Table F-4 -Analytical Detection Limits and Investigation Levels for Polynuclear Aromatic Hydrocarbons (a.k.a. PAHs or PNAs) in Various Media

Chemical	PQL		Investigation Levels				
	Soil mg/kg	Water µg/L	Soil ¹ mg/kg	Marine Sediment ² mg/kg	Freshwater Sediment ² mg/kg	Ground or Fresh Water ³ µg/L	Marine Waters ⁴ µg/L
Acenaphthene	0.005	100	29	0.00671	0.29	370	710
Acenaphthalene	0.005	1	29	0.00587	0.16	---	300
Anthracene	0.01	100	590	0.04685	0.01	1800	300
Benz(a)anthracene	0.01	0.01	0.08	0.07483	0.01572	0.092	300
Benzo(b)fluoranthene	0.1	0.01	0.2	1.8	0.26405	0.092	300
Benzo(k)fluoranthene	0.01	0.01	0.38	1.8	0.0272	0.056	300
Benzo(g,h,i)perylene	0.1	100	NA	0.67	0.3	NA	300
Benzo(a)pyrene	0.01	0.001	0.062	0.0881	0.0319	0.0092	300
Chrysene	0.01	0.1	3.8	0.10777	0.02683	0.56	300
Dibenz(a,h)anthracene	0.005	0.001	0.062	0.00622	0.01	0.0092	300
Fluoranthene	0.01	10	210	0.11282	0.03146	1500	16
Fluorene	0.01	100	28	0.019	0.01	240	300
Indeno(1,2,3-cd)pyrene	0.01	0.01	0.62	0.6	0.01732	0.092	300
Naphthalene	0.01	1	1.7	0.03457	0.01465	6.2	2350
Phenanthrene	0.01	1	5	0.08668	0.01863	6.3	4.6
Pyrene	0.01	100	10	0.15266	0.0447	180	300

Footnotes:

All units are ppm (mg/kg) for soil and sediments and ppb (µg/L) for water

1 = Soil Investigation Levels are the lowest available and appropriate values from U.S. EPA's Region IX Preliminary Remediation Goals Table (Cal-Modified PRGs used where available) and NOAA's Screening Quick Reference Tables.

2 = Marine and Freshwater Sediment Investigation Levels are the lowest available and appropriate values from NOAA's Screening Quick Reference Tables.

3 = Groundwater and Freshwater Investigation Levels are the lowest available and appropriate values selected from California and U.S. EPA Maximum Contaminant Levels, U.S. EPA's Region IX Preliminary Remediation Goals (Cal-Modified PRGs used where available) and NOAA's Ambient Water Quality Criteria.

4 = Marine Waters Investigation Levels are the lowest available and appropriate values from NOAA's Ambient Water Quality Criteria.

Table F-5 - Investigation Levels for Total Metals in Various Media

Chemical	Groundwater µg/L	Soil mg/kg
Antimony	6	31
Arsenic	10	0.062
Barium	1000	1000*
Beryllium	4	7.5*
Cadmium	5	10*
Chromium	50	50*
Cobalt	50	800*
Copper	1000	250*
Lead	15	50*
Mercury	2	2*
Molybdenum	10	390
Nickel	100	200*
Selenium	50	10*
Silver	100	50*
Thallium	2	5.2
Vanadium	50	78
Zinc	5000	2300

Footnotes:

Soil Investigation Levels are the lowest available and appropriate values from U.S. EPA's Region IX Preliminary Remediation Goals Table (Cal-Modified PRGs used where available), Title 22 Hazardous Waste Criteria, or 10 times the Title 22 Soluble Threshold Limit Concentration (STLC)*. Samples with concentrations above 10 times the STLC shall be analyzed for the soluble fraction using the Waste Extraction Test.

End of Appendix F