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PARSONS

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June 26, 1998

Major Ed Marchand
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, Texas 78235-5363

Subject: Results of Bioventing System Monitoring at Building 8200, Fort Carson, Colorado (Contract No. F41624-92-8036, Order 17)

Dear Major Marchand:

This letter presents the results of the bioventing system monitoring performed by Parsons Engineering Science, Inc. (Parsons ES) from February to April 1998 at Building 8200, located at Fort Carson, Colorado. Oxygen influence monitoring and blower shut down occurred on 23 February 1998. *In situ* respiration testing was performed by Parsons ES between 23 February and 15 April 1998 to assess the extent of remediation completed during approximately 7 months of pilot-scale air injection bioventing followed by 9 months of expanded-scale bioventing. Static soil gas sampling for field and laboratory analysis was performed on 8 April 1998, 44 days following blower shut down. The purposes of this letter are to summarize site and bioventing activities to date, present the results of the 1998 system monitoring event and compare them with the results of the initial bioventing pilot test (July and August 1996) and expanded-scale system installation (April and May 1997), and to recommend future remediation activities for the site based on these findings.

SITE REMEDIATION HISTORY

Site Description

Building 8200, also known as the Vehicle Maintenance Facility, is currently used for vehicle maintenance, repair and storage. Building 8200 is located in the northeastern portion of Fort Carson approximately 200 feet south of Building 8203 and a former underground fuel storage area (Figure 1). Gasoline and diesel fuel were formerly stored in four steel 20,000-gallon underground storage tanks (USTs) and distributed to five pump/dispenser islands by pipelines. Three of the former tanks contained diesel fuel, and one had contained gasoline. The four USTs were in service from 1988 to 1992, and were removed in November 1996.

The site is level, and the portions of the site south of the perimeter fence are paved with concrete. Areas north of the perimeter fence are vegetated with grasses. Building 8200 and 8203 have concrete slab-on-grade foundations. The nearest surface water body is a drainage swale located near vent well (VW) VW1. Soils between 5 and 20 feet below ground surface (bgs) are generally dense silt and clay with intermittent layers of more permeable soils that contain some sand. Groundwater at Fort Carson is generally encountered at over 1,000 feet bgs; however, localized, perched, saturated zones occur intermittently between 5 and 20 feet bgs in the area between Buildings 8200 and 8203.

Site investigations performed by ICF Kaiser Engineers (United States Army Toxic and Hazardous Materials Agency [USATHMA], 1994) and RUST Environment & Infrastructure (RUST) (1994) indicated the presence of petroleum hydrocarbon contamination in site soils and perched groundwater. The likely sources of the contamination were leaks from the tank outlet (elbow) connections and/or associated piping (including pipe joints and pumpstand connections). Based on this information, bioventing pilot testing and subsequent expanded-scale system installation were completed by Parsons ES.

Bioventing Pilot Testing

In July and August 1996, a pilot-scale bioventing system was installed at Building 8200 by Parsons ES as part of the Air Force Center for Environmental Excellence (AFCEE) Extended Bioventing Project. The installed bioventing system consisted of one VW (VW2), seven MPs (MPA through MPG), and a 2-horsepower (HP) regenerative blower unit. Existing groundwater monitoring well FCMW89 was converted for use as air injection VW1. The initial bioventing test included soil and soil gas sampling and *in situ* respiration and air permeability testing. The results from the initial bioventing pilot test indicated that oxygen levels within the contaminated soil zones were depleted, and that air injection bioventing was an effective method for providing oxygen to the vadose zone soils. Results of pilot testing indicated that the radius of influence (ROI) from air injection at VW2 exceeded 31 feet in permeable soil lenses that corresponded to the discrete contaminant intervals. During July 1996, soil vapor monitoring points (MPs) MPA, MPB, and MPC were constructed within 2-inch-diameter Geoprobe® borings, and because of the small annulus of the screened interval and the low-permeability soil conditions, have not been functional; therefore, the ROI of VW1 (monitoring well FCMW89) is undetermined.

Respiration testing results indicated that fuel biodegradation rates were very slow, ranging from 20 to 80 milligrams of hydrocarbons degraded per kilogram of soil per year (mg/kg/year). A detailed description of the bioventing pilot test and initial site activities and results are provided in the Interim Bioventing Pilot Test Results report prepared by Parsons ES (1996) for this site.

Tank Removal Activities and Horizontal VW Installation

The USTs and pump islands were removed in November 1996 by Parker Excavating, Inc. (Parker Excavating, Inc., 1997). The removed tanks were in good condition, but petroleum contamination was observed throughout the tank excavation and around the removed pump islands (Madsen, 1996). Approximately 1,800 cubic yards of fuel-contaminated soil was removed from the site; however, soils at the bottom and sides of the tank excavation and several of the pump island excavations were still visibly contaminated and exhibited a fuel odor. The pipelines were properly abandoned in place. A horizontal VW (VW3) was placed in the tank excavation and covered with clean fill material.

Expanded-Scale Bioventing System Installation

In addition to the pilot-scale bioventing system installation activities (contractually referred to as Option 3), the site also was funded for an expanded-scale system installation (Option 4), and 1 year of system operation followed by soil gas sampling and respiration testing (Option 1) under the AFCEE Extended Bioventing Project. The expanded-scale system, which was installed in April and May 1997, included three new VWs (VW5, VW6, and VW7), 6 new MPs (MPH through MPM), and a 5-HP rotary-vane blower unit (Figure 1). Existing groundwater monitoring well FCMW88 was converted for use as an air injection VW (VW4). The regenerative blower installed during the initial bioventing pilot test was re-plumbed to inject air into the horizontal VW (VW3), and the rotary-vane blower was plumbed for air injection into all of the vertical VWs (VW1, VW2, and VW4 through VW7). The expanded-scale bioventing system installation also included soil and soil gas sampling and *in situ* respiration testing. The results from the expanded-scale bioventing system installation indicated that oxygen levels within the contaminated soil zones were depleted, and that the ROI from air injection at VW5, VW6, and VW7 exceeded 30 feet at depths corresponding to the discrete contaminant intervals. Although biodegradation rates at MPI, MPJ, and, MPK were higher than pilot test results from VW2, MPD, and MPG, they were still very low, ranging from 80 to 220 mg/kg/year. A detailed description of the expanded-scale bioventing system installation activities and results are provided in a remediation plan (RAP) (Parsons ES, 1997a) and a letter report (Parsons ES, 1997b) prepared for this site.

Second Level Site Assessment (SLSA)

During the April 1998 sampling/testing event, under a delivery order with the US Army Environmental Center (USAEC) on the Air Mobility command (AMC) contract, Parsons ES conducted additional investigations at the site to delineate the extent of soil and groundwater contamination. A total of eight additional well points and five Geoprobe® borings were installed at the site. Results of this investigation will be reported to the Army in a separate report.

1998 BIOVENTING SYSTEM MONITORING EVENT

The 1998 (Option 1) bioventing system monitoring event consisted of oxygen influence monitoring, respiration testing, and static soil gas sampling. Oxygen influence monitoring was completed on 23 February 1998. *In situ* "area" respiration testing was performed between 23 February and 15 April 1998. Static soil gas sampling was performed 8 April 1998. The system was shut down 44 days prior to static soil gas sampling to allow soils and soil gas to come to equilibrium in order to compare initial (1996 and 1997) and 1998 conditions. The blower system was re-started and optimized following testing to continue bioventing treatment of site soils. Results of oxygen influence monitoring, respiration testing, and soil gas sampling at Building 8200 are presented and compared with results from the previous bioventing pilot test and expanded-scale system installation efforts.

Oxygen Influence Monitoring

Oxygen influence monitoring was performed on 23 February 1998, prior to blower system shut down. Soil gas samples were collected from 14 vapor MPs and 3 groundwater monitoring wells and field analyzed for oxygen, carbon dioxide, and total volatile hydrocarbons (TVH). Table 1 presents the changes in soil gas parameters that occurred following approximately 9 months of expanded-scale bioventing system operation. Oxygen concentrations ranged from 8.7 to 20.7 percent, indicating that the entire targeted area is receiving a sufficient supply of oxygen. Oxygen influence was noted at MW-2 and MW-3, located approximately 90 and 140 feet from the nearest air injection VW. Oxygen may be reaching these locations through lenses of permeable soil, or by movement of injected air through utility corridors. The ROI from air injection at each vertical VW is expected to exceed 30 feet. After oxygen influence measurements were collected the blowers were shut down, and the area respiration test was initiated.

Respiration Test Results

The 1998 *in situ* respiration testing was performed at Building 8200 from 23 February to 15 April 1998. An area respiration test was conducted at MPJ-11, MPJ-20, MPK-5, MPL-16 and MW1, and a point respiration test was conducted at MPI-16.5. A point respiration test was performed at MPI-16.5 because oxygen influence concentrations were low during the area respiration test. The tests were performed according to protocol procedures (Hinchee *et al.*, 1992). The area test was initiated by shutting down the blower and measuring changes in oxygen, carbon dioxide, and TVH concentrations in soil gas over a 44-day period. The point respiration test was performed by injecting air (oxygen) into MPI-16.5 for an 18-hour period using a 1-cubic-foot-per-minute (cfm) pump. After the pump was turned off changes in soil gas chemistry at MPI-16.5 were measured for 6 days. Observed rates of oxygen utilization were used to estimate aerobic fuel biodegradation rates following 9 months of expanded-scale bioventing. Respiration and fuel biodegradation rates from the pilot test, expanded-scale system installation, and 9-month monitoring event are shown on Table 2.

As can be seen from Table 2, significant reductions occurred in respiration and fuel biodegradation rates at MPI-16.5, MPJ-11, MPJ-20, and MPK-5 following 9 months of expanded-scale system operation. Final respiration rates and fuel biodegradation rates measured only 14 to 35 percent of the initial values at these locations. Oxygen utilization and fuel biodegradation rates typically decrease with continued bioventing as the lighter, more readily biodegraded hydrocarbons are preferentially destroyed over more biologically recalcitrant, higher molecular weight hydrocarbons. Fuel biodegradation rates ranged from 20 mg/kg/year at MPJ-11, MPK-5, MPL-16, and MW1, to 80 mg/kg/year at MPI-16.5 (Table 2). These very low biodegradation rates correspond to the low static TVH concentrations at these locations.

Observed oxygen utilization rates have remained very low at Building 8200, indicating that fuel biodegradation rates are low and that the bioventing technology may not be very feasible at this site. At the Building 8200 site, there may not be enough substrate (i.e., fuel) to sustain high rates of aerobic fuel biodegradation. Also, the population of indigenous microbes may be scarce within these weathered bedrock soils, and/or the moisture content of the soil may be limiting biodegradation rates. Low biodegradation rates at the Building 8200 site should not be viewed as conclusive evidence that bioventing will not work at other petroleum-contaminated sites at Fort Carson; however, should the Army consider using this technology at another Fort Carson site, it is recommended that *in situ* respiration testing first be conducted at an existing site well (if present) to determine the potential for aerobic biodegradation.

Soil Gas Chemistry Results

Field screening and collection of soil gas samples for laboratory analysis were performed on 8 April 1998 following approximately 7 months of pilot-scale system operation, 9 months of expanded-scale system operation, and 44 days of system shutdown. Soil gas samples were collected from each MP interval, and field-screened to assess soil gas concentrations of oxygen, carbon dioxide, and TVH. In addition, soil gas samples for laboratory analysis were collected from several of the same MP screened intervals sampled during July 1996 (pilot-scale installation) and April and May 1997 (expanded-scale installation). For all soil gas sampling events, laboratory samples were sent to Air Toxics, Ltd. in Folsom, California, and analyzed for TVH and BTEX using USEPA Method TO-3. Field and laboratory soil gas sampling results from July 1996, April and May 1997, and April 1998 are presented in Table 3.

Static oxygen concentrations in soil gas have generally increased and TVH concentrations have generally decreased with continued air injection bioventing at the site (Table 3). The overall increases in soil gas oxygen concentrations indicate that aerobic hydrocarbon biodegradation rates have decreased substantially, suggesting that little substrate (fuel hydrocarbon contamination) remains in the soil at these locations. The only locations where oxygen levels had not increased over the 9-month expanded-scale treatment period were MPL (MPL-10.5 and 16), where 1-year oxygen concentrations in soil gas were significantly lower than initial values.

Residual fuel hydrocarbon concentrations in site soils have been significantly reduced through both biodegradation and volatilization as indicated by the large decreases in TVH and BTEX concentrations measured in soil gas samples collected during the 1998 sampling event. Soil gas TVH field screening results and laboratory TVH and BTEX concentrations from site MPs (Table 3) indicate a 1 to 4 order of magnitude reduction during 9 to 16 months of system operation (depending on MP location). At MPD-18, TVH concentrations were reduced from 37,000 parts per million, volume per volume (ppmv) to 5.3 ppmv. BTEX concentrations in soil gas collected from MPD-18, MPI-16.5, and MPK-5 have been reduced 2 to 3 orders of magnitude during the 9 to 16 month period of system operation. Lesser, but significant benzene reductions also were measured in the sample from MW1.

CONCLUSIONS AND RECOMMENDATIONS

Although aerobic biodegradation rates are still very low, soil gas sampling results indicate that residual BTEX and TPH concentrations have been greatly reduced as the result of bioventing system operation. Static oxygen concentrations drop below 5 percent throughout much of the site when air injection is stopped, indicating that some oxygen demand still exists. However, soil gas TVH and BTEX concentrations are very low, indicating that little biodegradable substrate remains to be treated.

Parsons ES recommends that the US Army continue to operate the existing bioventing system until site closure is granted by the Colorado Department of Labor and Employment, Oil Inspection Section. Sustained bioventing system operation will continue to oxygenate soils and enhance aerobic biodegradation of any petroleum hydrocarbon contaminants which may remain in site soils. In addition, continued bioventing system operation may promote oxygen delivery to the perched water zones through diffusion.

If soil, soil gas, and groundwater analytical data obtained during the SLSA activities indicate that the full areal extent of contamination has been defined at Building 8200, then initiation of site closure activities may be appropriate. Since a remedial action plan has already been prepared and implemented for the vadose zone contamination at the site, CDLE may only require that a long-term groundwater monitoring plan is prepared, if groundwater BTEX concentrations exceed CDLE action levels.

This report is the final deliverable for Building 8200 under the AFCEE Extended Bioventing Project; however, Parsons ES looks forward to assisting the Army in implementing a long-term monitoring plan or obtaining regulatory closure at this site through the AMC contract. If you have any questions or require additional information, please contact either Dave Teets at (406) 254-6533, or John Ratz at (303) 831-8100.

Sincerely,
PARSONS ENGINEERING SCIENCE, INC.
for Dave Teets
David B. Teets
Site Manager

John W. Ratz, P.E.
Project Manager

Attachments:
References
Tables, 1, 2, and 3; Figure 1

cc: Mr. Gene Fabian, US Army Environmental Center
Mr. John Cloonan, Fort Carson
File 727876.73310.E Letter Results Report

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TABLE 1
OXYGEN INFLUENCE MONITORING
BUILDING 8200
FORT CARSON, COLORADO

Sampling Location-Depth (feet bgs)[c]	Distance from Nearest VW (Feet)	O_2 (%)			CO_2 (%)			Field TVH[a] (ppmv)[b]		
		Initial[d]	17-Day	9-Month	Initial	17-Day	9-Month	Initial	17-Day	9-Month
MPD-10	14.6 (VW2)	11.5	NC[e]	NC	2.6	NC	NC	200	NC	NC
MPD-18	14.6 (VW2)	0.9	19.2	15.8	4.2	3.3	0.8	600	80	220
MPE-7	18.1 (VW2)	10.8	10.1	17.8	4.1	5.9	2.9	300	85	280
MPF-12	18.0 (VW4)	1.6	17.7	8.7	5.7	3.4	4.7	10,000	10,000	440
MPG-13	30.5 (VW2)	5.0	NC	19.4	5.8	NC	1.5	78	NC	280
MPH-12	29.5 (VW2)	20.8	NC	20.7	0.05	NC	0.1	0	NC	180
MPI-11.5	29.4 (VW4)	9.7	10[f]	NC	1.7	2.6[f]	NC	280	140[f]	NC
MPI-16.5	29.4 (VW4)	0.0	20.2[f]	13.9	5.0	1.3[f]	1.5	800	93[f]	260
MPJ-11	15.3 (VW5)	6.0	20.0	18.3	0.6	1.2	0.8	600	160	260
MPJ-20	15.3 (VW5)	1.4	20.0	20.4	0.9	0.6	0.1	650	150	230
MPK-5	29.8 (VW7)	3.0	20.0	20.6	2.6	2.3	0.2	2,400	390	230
MPL-10.5	14.3 (VW7)	19.0	20.2	20.2	4.5	0.5	0.6	380	100	240
MPL-16	14.3 (VW7)	11.8	20.6	20.6	5.2	0.15	0.1	2,200	38	210
MPM-10	44.1 (VW6)	6.1	19.7	NC	1.6	2.6	NC	2,000	120	NC
MW1-1-16	28.8 (VW5)	1.3	14.9[f]	19.5	3.4	0.1[f]	1.0	2,200	500[f]	300
MW2-8-18	89.5 (VW7)	0.0	20.7[f]	20.7	6.0	0.05[f]	0.05	12,800	0[f]	210
MW3-5-15	138 (VW7)	0.0	NC	13.7	7.6	NC	2.2	1,100	NC	300

[a] TVH = total volatile hydrocarbons.
[b] ppmv = parts per million, volume per volume.
[c] bgs = below ground surface.
[d] Most of the initial soil gas samples were collected after the 1997 respiration test, therefore, soil gas concentrations may differ from Table 2.
[e] NC = No sample collected; either soil permeability was too low or the MP was flooded.
[f] Sample collected on June 4, 1997 following 21 days of air injection at all VWs, except VW3.

TABLE 2
RESPIRATION AND BIODEGRADATION RATES
BUILDING 8200
FORT CARSON, COLORADO

Sampling Location-Depth (feet bgs)[b]	Pilot-Scale Test Results (July 1996)		Expanded-Scale Test Results[a] (May 1997)		9-Month Test Results[a] (February-April 1998)	
	O_2 Utilization (% O_2/hour)	Biodegradation Rate (mg/kg/year)[c]	O_2 Utilization (% O_2/hour)	Biodegradation Rate (mg/kg/year)	O_2 Utilization (% O_2/hour)	Biodegradation Rate (mg/kg/year)
VW2-4.5-19.5	0.056	80	---[d]	---	---	---
MPD-10	0.027	40	---	---	---	---
MPD-18	0.046	70	---	---	---	---
MPG-13	0.013	20	---	---	---	---
MPI-11.5	---	---	0.081	120	---	---
MPI-16.5	---	---	0.144	220	0.051	80
MPJ-11	---	---	0.096	150	0.012	20
MPJ-20	---	---	0.139	210	0.029	40
MPK-5	---	---	0.083	130	0.011	20
MPL-16	---	---	---	---	0.010	20
MPM-10	---	---	0.051	80	---	---
MW1-6-16	---	---	---	---	0.010	20

[a] Assumes moisture content of the soil is equal to the average moisture content of 15.1 percent measured in July 1996.
[b] bgs = below ground surface.
[c] Milligrams of hydrocarbons per kilogram of soil per year.
[d] --- = Respiration test not conducted at this location.

TABLE 3
PILOT-SCALE, EXPANDED-SCALE, AND 9-MONTH SOIL GAS FIELD AND LABORATORY ANALYTICAL RESULTS
BUILDING 8200
FORT CARSON, COLORADO

			Field Screening Data			Laboratory Analytical Data[a]					
Sample Location	Sample Depth (ft bgs)[e]	Sampling Date[f]	Oxygen (percent)	Carbon Dioxide (percent)	TVH (ppmv)[g]	TVH[b] as gasoline[c] (ppmv)	TVH as jet fuel[d] (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethyl-benzene (ppmv)	Xylenes (ppmv)
MPD	10	7/25/96	0.8	6.8	300	---[h]	42	0.026	0.018	0.013	0.19
		5/14/97	11.5	2.6	200	---	---	---	---	---	---
		4/8/98	Purged	Water		---	---	---	---	---	---
MPD	18	7/25/96	0.9	5.3	>20,000[i]	---	37,000	48	24	3.7	5.6M[j]
		5/14/97	0.9	4.2	600	---	---	---	---	---	---
		4/8/98	16.5	0.4	320	---	5.3	<0.025	0.075	0.075	0.30
MPE	7	7/30/96	6.8	5.2	46	---	---	---	---	---	---
		5/14/97	10.8	4.1	300	---	---	---	---	---	---
		4/8/98	18.3	1.6	520	---	---	---	---	---	---
MPE	11	7/30/96	18.2	0.1	95	---	---	---	---	---	---
		5/14/97	10.8	4.1	300	---	---	---	---	---	---
		4/8/98	Purged	Water		---	---	---	---	---	---
MPF	12	7/30/96	0.0	6.6	20,000	---	48,000	56	26	7.8	5.0
		5/14/97	1.6	5.7	10,000	---	---	---	---	---	---
	(Blower on)	2/23/98	8.7	4.7	440	---	---	---	---	---	---
		4/8/98	Purged	Water		---	---	---	---	---	---
MPH	12	5/30/97	20.8	0.05	0	---	---	---	---	---	---
		4/8/98	20.8	0.05	40	---	---	---	---	---	---
MPI	11.5	4/30/97	2.0	2.9	720	---	---	---	---	---	---
		4/8/98	Purged	Water		---	---	---	---	---	---
MPI	16.5	4/30/97	0.0	6.0	11,200	570	---	0.25	4.5M	2.2M	5.9M
		4/8/98	0.6	0.5	160	8.7	---	>0.025	0.066	0.075	0.32
MPJ	11	4/30/97	2.9	0.5	940	---	---	---	---	---	---
		4/8/98	7.4	1.4	380	---	---	---	---	---	---
MPJ	20	4/30/97	0.0	1.0	1,200	570	---	0.14	0.58	1.4M	8.0M
		4/8/98	1.2	0.4	240	---	---	---	---	---	---
MPK	5	4/30/97	0.0	4.4	4,800	3,700	---	33	8.3	3.5	7.4
		4/8/98	9.1	0.2	140	12	---	<0.024	0.058	0.067	0.27
MPL	10.5	5/14/97	19.0	4.5	380	---	---	---	---	---	---
		4/8/98	6.2	2.8	520	---	---	---	---	---	---
MPL	16	5/14/97	11.8	5.2	2,200	---	---	---	---	---	---
		4/8/98	9.4	0.8	280	---	---	---	---	---	---
MPM	10	4/30/97	0.0	3.0	4,200	218	---	0.057	0.14U[k]	0.14U	0.028
		4/8/98		Damaged		---	---	---	---	---	---
MW1	5.8-15.8	7/25/96	4.1	3.8	2,200	---	---	---	---	---	---
		4/30/97	4.9	2.2	4,000	551	---	2.8	5.0U	5.0U	5.0U
		4/8/98	8.6	2.0	460	22	---	<0.025	0.098	0.11	0.44
MW2	7.6-17.6	7/25/96	0.7	6.5	10,200	---	---	---	---	---	---
		1/24/97	0.0	6.0	12,800	---	---	---	---	---	---
		4/8/98	18.1	1.3	250	---	---	---	---	---	---
MW3	4.1-14.1	7/27/96	0.0	9.1	200	---	80	0.059M	0.014M	0.014M	0.20
		1/24/97	0.0	7.6	1,100	---	---	---	---	---	---
	(Blower on)	2/23/98	13.7	2.2	300	---	---	---	---	---	---

Note: Only data for regularly sampled MPs are shown. Vapor monitoring points MPA, MPB, MPC, MPF-16, MPG, MPL-22.5, and MPM-5.5 have either been too tight to sample or were submerged under water. O_2 and CO_2 results from the 1998 sampling may be biased since oxygen utilization was still occurring, however, TVH levels appeared to be stable.

[a] Laboratory analysis of soil gas performed using USEPA Method TO-3.

[b] TVH = total volatile hydrocarbons.

[c] Laboratory TVH referenced to gasoline (MW=100).

[d] Laboratory TVH referenced to jet fuel (MW=156).

[e] ft bgs = feet below ground surface.

[f] Soil gas sampling for laboratory analysis was performed in July 1996 (pilot-scale test), April 1997 (expanded-scale), and April 1998 (final).

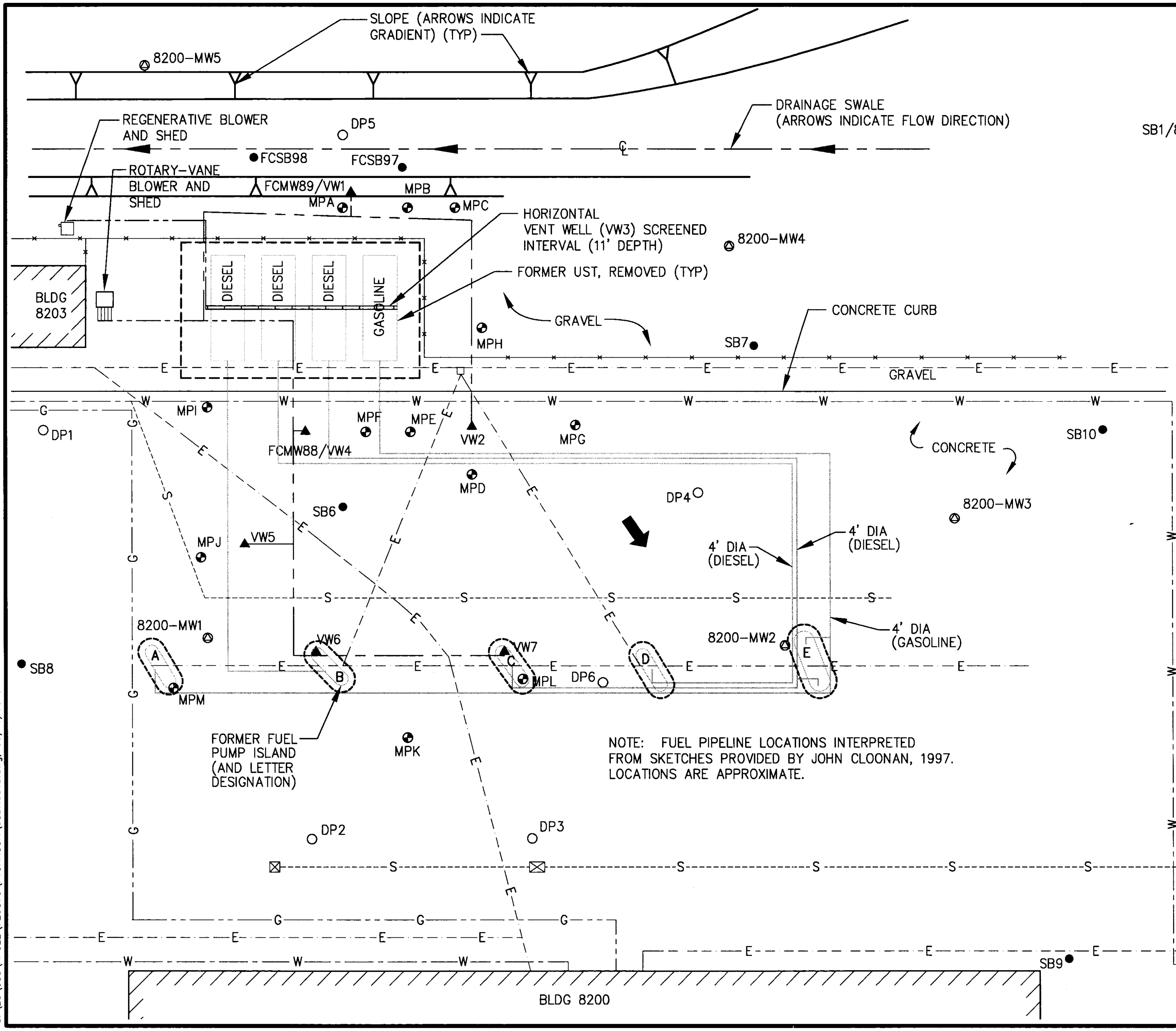
[g] ppmv = parts per million, volume per volume.

[h] --- = not analyzed.

[i] > = denotes field measurement greater than maximum meter reading.

[j] M = Laboratory reported value may be biased due to apparent matrix interferences..

[k] U = compound analyzed for , but not detected. Number shown represents the laboratory method detection limit.



LEGEND

VW2 ▲	VENT WELL
MPA	VAPOR MONITORING POINT
SB1/8200-MW1	GROUNDWATER MONITORING WELL
DP4 ○	PREVIOUS DIRECT PUSH SOIL/WATER SAMPLING LOCATION
SB10 ●	PREVIOUS SOIL BORING LOCATION
	HEADER PIPE TO VENT WELL
—E—	ELECTRIC
—G—	GAS
—W—	WATER
—S—	SEWER
—x—	CHAIN LINK FENCE
	FUEL PIPELINE (ABANDONED IN PLACE)
	EXPECTED FLOW DIRECTION OF PERCHED GROUNDWATER
	LIMITS OF EXCAVATION

Sources: ICF Kaiser, 1992; RUST, 1994; Cloonan, 1997

N

0 15 30

APPROXIMATE SCALE IN FEET

FIGURE 1

SITE LAYOUT

Extended Bioventing
Building 8200
Fort Carson, Colorado

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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