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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE TEXAS

05 May 95

MEMORANDUM FOR 12 CES/CEV
ATTN: Ms Monica Fields
1651 5th Street West
Randolph AFB, TX 78150-4513

FROM: HQ AFCEE/ERT
8001 Arnold Drive
Brooks AFB TX 78235-5357

SUBJECT: Completion of One Year Bioventing Test, Jet Fuel Storage Tank #20, Randolph AFB, TX

The Air Force Center for Environmental Excellence (AFCEE) one-year bioventing test and evaluation project at the Storage Tank #20 site has been completed. Figure 1 provides general site information and Table 1 provides a summary of initial, interim, and one-year fuel biodegradation rates measured at several monitoring points. The one year biodegradation rates are significant due to the amount of fuel residual at this active site. Table 2 provides a summary of initial and final soil and soil gas sampling results for total recoverable petroleum hydrocarbons (TRPH) and benzene, toluene, ethylbenzene, and zylenes (BTEX). Based on results from your site and 109 other sites, currently under operation, bioventing is cost-effectively remediating fuel contamination in a reasonable time frame. We recommend its application throughout the Air Force to include other sites on your installation using the criteria in the AFCEE Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, May 1992, including Addendum One, February, 1994. These documents are found in in the AFCEE/ERT "Tool Box" sent previously.

The objective of the one year sampling effort was not to collect the large number of samples required for statistical significance but to show relative changes in TRPH and BTEX concentrations. Soil sampling results are not available because the construction of a plastic liner at this site prevented the contractor from collecting the soil samples after the bioventing system had been operating one year. Soil gas sampling results showed a three order of magnitude reduction in TVH at MPA-6 and MPC-6.

Soil gas samples are similar to composite samples in that they are collected over a wider area. Thus, they provide a good indication of changes in soil gas profiles and volatile contaminant concentrations (See Addendum One to Test Plan and Technical Protocol for a Field Treatability Test for Bioventing - Using Soil Gas Surveys to Determine Bioventing Feasibility and Natural Attenuation Potential, February 1994) Soil samples, on the other hand, are discrete point samples subject to large variabilities over small distances/soil types. Given this variability coupled with known sampling and analytical variabilities, a large number of samples would have to be collected to conclusively determine "real" changes in soil contamination. Because of the limited number of samples collected, these results should not be viewed as conclusive indicators of bioventing progress or evidence of the success or failure of this technology. In-situ respiration tests are considered to be better indicators of hydrocarbon remediation than limited soil sampling.

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Print or Type Name: Laura Peña

Signature: Laura Peña

Telephone: 210-536-1431

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Final sampling results are not available because our contractor was not allowed to penetrate the liner for sample collection. AFCEE recommends that the bioventing pilot systems continue to operate at the Jet Fuel Storage Tank #20 site while planning for closure soil sampling. Our initial contacts with the Texas Natural Resource Conservation Commission (TNRCC) indicate that they are amenable to using a soil gas survey in lieu of collecting soil samples or collect soil samples immediately outside the plastic liner. Please contact Sam Taffinder, AFCEE/ERT, DSN: 240-4366, COM: 210-536-4366, to discuss closure soil sampling.

Data from your base and many others indicate that BTEX compounds are preferentially biodegraded over TPH. Since BTEX compounds represent the most toxic and mobile fuel constituents, a BTEX standard is a risk-based standard. We strongly encourage its use over an arbitrary TPH standard. Within the AFCEE Risk-based Petroleum Hydrocarbon "Tool Box", the report entitled, "Using Risk-based Standards will Shorten Cleanup Time at Petroleum Contaminated Sites". Attachment 3 summarizes the BTEX/TPH issue and a report sent under separate cover will assist you in negotiating for a BTEX cleanup standard. Our information indicates that Texas regulates to BTEX clean-up levels but this decision is made in conjunction with the results from a risk evaluation on a site-by-site basis. In conclusion, a risk-based approach will expedite site closure while reducing overall costs.

In general, quantitative destruction of BTEX will occur over a one to two year bioventing period. Soil gas surveys and respiration tests can be used as BTEX destruction indicators. If a non-risk-based/TPH cleanup is chosen, the pilot and full-scale systems should be operated until respiration rates approach background rates. We recommend that confirmatory soil sampling be conducted 4-6 months after background respiration rates are approached.

Because these are streamlined test and evaluation projects, our contract does not provide for additional reports to the base on pilot study results. The interim results report dated Feb 93 contains as-builts and initial data. This letter summarizes all data collected and provides the next step recommendations. AFCEE has initiated a contract to extend monitoring at your site beyond the initial one year test. Monitoring will include soil gas and respiration tests to document hydrocarbon degradation, but it also includes the collection of sufficient final soil samples to statistically demonstrate site cleanup.

The blower and accessories are now base property and should continue to be used on this or other bioventing sites. Although current equipment is explosion proof, under no circumstances should it be used for soil vapor extraction unless appropriate explosion-proof wiring is provided. If the base does not want the keep the blower or if you have further questions, please contact us.

On behalf of the AFCEE/ERT staff , I would like to thank you for your support of these bioventing tests and evaluation projects. The information gained from each site will be invaluable in evaluating this technology and will promote its successful application on other DOD, government, and private sites. I have attached a customer satisfaction survey. Please take a few minutes to fill it out and tell us how we did. We look forward to hearing from you.

ROSS N. MILLER, Lt Col, USAF, BSC
Chief, Technology Transfer Division

Attachments:
1. AFCEE Bioventing Initiative Site Map
2. Storage #20 Bioventing data, Tables 1 & 2
3. "Using Risk-based Standards will Shorten Cleanup Time at Petroleum Contaminated Sites"
4. Survey
5. Addendum One

cc: HQ USAF/CEVR
HQ AETC/CEVR

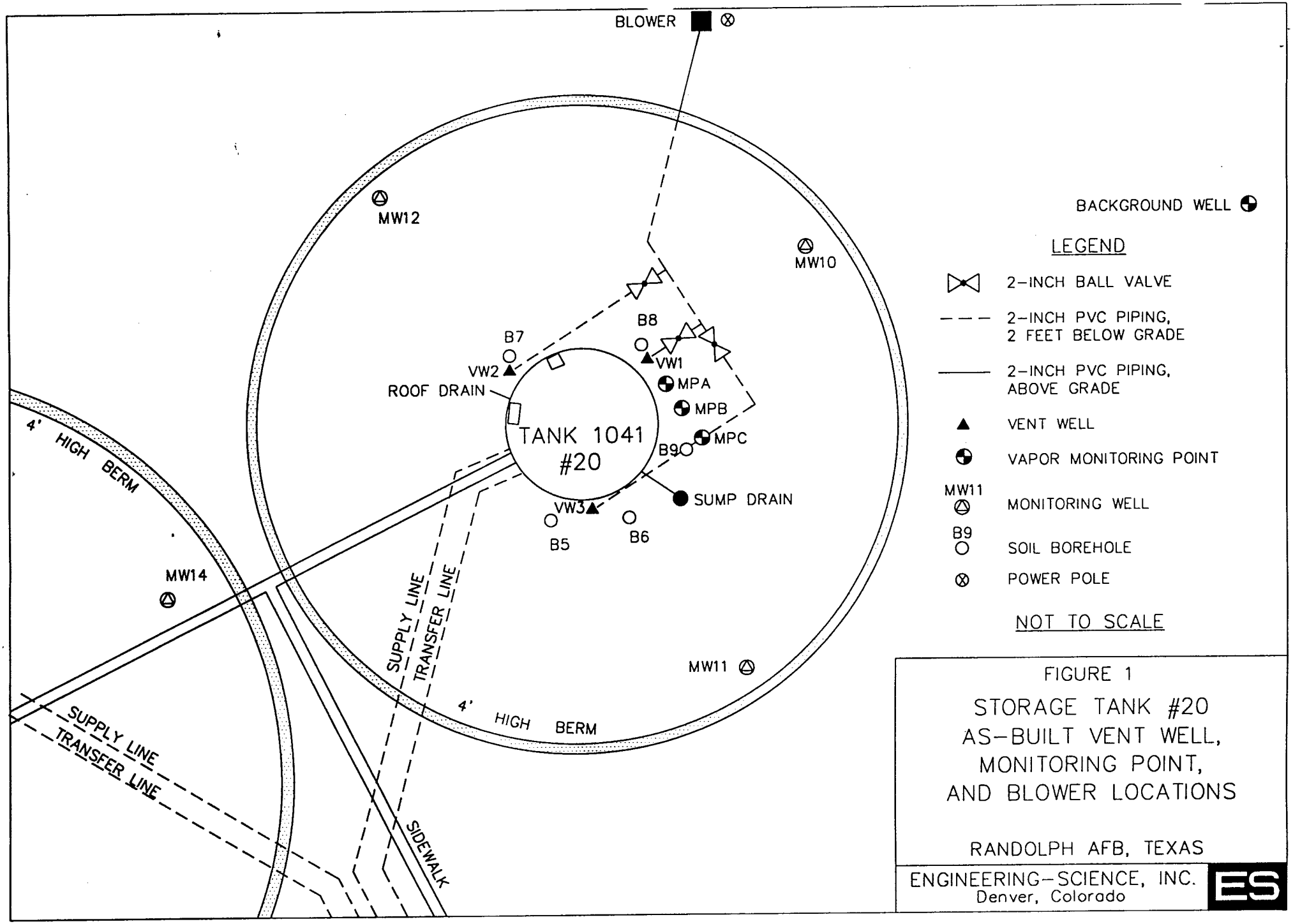

FIGURE 1

STORAGE TANK #20
AS-BUILT VENT WELL,
MONITORING POINT,
AND BLOWER LOCATIONS

RANDOLPH AFB, TEXAS

ENGINEERING-SCIENCE, INC.
Denver, Colorado

ES

93DN0297, 05/20/93 at 14:46

TABLE 1
ABOVEGROUND JET FUEL STORAGE TANK 20
RESPIRATION AND DEGRADATION RATES
RANDOLPH AFB, TEXAS

Location–Depth	Initial (Mar. 1993)			6–Month (Nov. 1993)			1–Year (May 1994)		
	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[a/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)	K_o (% O_2/min)	Degradation Rate (mg/kg/year)[b/]	Soil Temperature (°C)
VW1	0.0043	150	NS [c/]	NS	NC [d/]	NS	NS	NC	NS
MPA–3	0.0058	610	15.4	0.0023	240	NS	NS	NC	19.2
MPA–6	0.0076	290	NS	0.0021	80	NS	0.0024	90	NS
MPA–12	NS	NC	18.2	NS	NS	NS	NS	NC	20.0
MPB–3	0.0055	580	NS	0.0021	220	NS	NS	NC	NS
MPB–6	0.0084	320	NS	0.0026	100	NS	0.0032	120	NS
MPB–12	0.0083	320	NS	NS	NS	NS	NS	NC	NS
MPC–3	0.0042	440	NS	0.0035	370	NS	0.0086	900	NS
MPC–6	0.0094	360	NS	0.0028	110	NS	0.0045	170	NS
VW2	0.0078	300	NS	NS	NS	NS	NS	NC	NS

[a/] Milligrams of hydrocarbons per kilogram of soil per year.
[b/] Based on moisture content of the soil at initial sampling. Final sampling was not performed as a liner was placed over the site.
[c/] NS = Not sampled.
[d/] NC = Not calculated

TABLE 2
ABOVEGROUND JET FUEL STORAGE TANK 20
INITIAL AND 1-YEAR SOIL AND SOIL GAS ANALYTICAL RESULTS
RANDOLPH AFB, TEXAS

Analyte (Units)[a]	Sample Location-Depth (feet below ground surface)					
	VW1		MPA-6		MPC-6	
Soil Gas Hydrocarbons	Initial[b]	1-Year[c]	Initial	1-Year	Initial	1-Year
TVH (ppmv)	16,000	NS[d]	21,000	53	22,000	47
Benzene (ppmv)	11	NS	21	<0.002	16	<0.002
Toluene (ppmv)	<1.1	NS	<1.0	<0.002	<1.1	<0.002
Ethylbenzene (ppmv)	7.9	NS	5.5	<0.002	4.9	0.094
Xylenes (ppmv)	18	NS	16	<0.063	21	0.38

	VW1-5		MPA-1		MPA-9.5		MPB-5	
Soil Hydrocarbons	Initial[e]	1-Year[f]	Initial	1-Year	Initial	1-Year	Initial	1-Year
TRPH (mg/kg)	32	NS	851.8	NS	3.2	NS	17	NS
Benzene (mg/kg)	<0.31	NS	<1.3	NS	0.0014	NS	<0.14	NS
Toluene (mg/kg)	1.5	NS	16	NS	0.0031	NS	1.2	NS
Ethylbenzene (mg/kg)	<0.26	NS	13	NS	<0.0012	NS	<0.12	NS
Xylenes (mg/kg)	1.357	NS	130	NS	<0.0022	NS	2.0	NS
Moisture (% by wt.)	4.2	NS	6.7	NS	16.9	NS	14.0	NS

[a] TRPH=total recoverable petroleum hydrocarbons; mg/kg=milligrams per kilogram; TVH=total volatile hydrocarbons; ppmv=parts per million, volume per volume.

[b] Initial soil gas samples collected on 3/21/93.

[c] 1-Year soil gas samples collected on 5/16/94 and 6/29/94.

[d] NS=Not sampled.

[e] Initial soil samples collected on 3/19/93 and 3/20/93.

[f] 1-Year soil samples were not collected due to a liner being placed over the site.