

June 28, 2013

Alaska Department of Environmental Conservation  
555 Cordova Street  
Anchorage, Alaska 99501

Attn: Mr. Bill O'Connell

**RE: FREE PRODUCT RECOVERY ASSESSMENT, FORMER MARKAIR  
FACILITY, KING SALMON, ALASKA; ADEC HAZARD ID: 1879**

This letter report presents the results of Shannon & Wilson, Inc.'s (Shannon & Wilson) free product recovery assessment conducted at the Former MarkAir Facility in King Salmon, Alaska in June 2013. The project purpose was to recover free product from select monitoring wells at the site, evaluate the product recharge rate, and provide recommendations for recovering the free product.

The project was performed under Shannon & Wilson, Inc.'s Alaska Department of Environmental Conservation (ADEC) Hazardous Substance Spill Prevention and Cleanup Term Contract 18-4002-12. ADEC authorization to proceed was received on February 10, 2012 with Notice to Proceed No. 18-4002-12-041C.

### **BACKGROUND**

The former MarkAir facility is located on Lot 2, Block 1 of the King Salmon Airport. The facility is located on the western side of the apron, near the northwestern end of the airport's northwest/southeast runway as shown in the vicinity map included as Figure 1. A bulk fuel storage facility was previously located on an unpaved portion of the project site, as well as several other above and below ground fuel storage tanks. Contamination at the site is the result of leaks and spills from the various fuel storage tanks. A site plan showing relevant site features and monitoring well locations is provided as Figure 2.

During site characterization activities conducted by Shannon & Wilson between 2003 and 2007, impacted soil and groundwater were encountered across the former MarkAir facility and extended off the facility towards the west and south. Free-phase petroleum product, measuring up to 8.71 feet thick (Well B4MW), has been observed in on-site Wells B4MW, B5MW, and B9MW, and in off-site Wells B10MW and B11MW during previous site assessments.

In January 2008, Shannon & Wilson installed passive bailers in Monitoring Wells B4MW and B5MW and a passive skimmer in Monitoring Well B9MW. As a result of the product monitoring and recovery efforts conducted during the 2008, 2009, 2011, and 2012 field seasons, approximately 151 gallons of petroleum product was recovered, with most of the product generated from Well B9MW. The recovered product was disposed off-site at an approved facility.

### **FIELD ACTIVITIES**

The project consisted of measuring free product and the depth to water in five monitoring wells, recovering product, and conducting a bail-down test at Well B9MW. The 2013 field activities were conducted in general accordance with Shannon & Wilson's May 10, 2013 work plan. Copies of the field logs are included in Attachment 1.

#### ***Product Recovery***

On June 6, 2013, an oil/water interface probe was used to measure the depth to product and water in five monitoring wells (B4MW, B5MW, B9MW, B10MW, and B11MW). With the exception of Well B11MW, product was observed in each of the monitoring wells. Approximately 0.71, 0.15, 5.60, and 0.05 feet of product were measured in Wells B4MW, B5MW, B9MW, and B10MW, respectively. The product was removed from the wells by emptying the passive bailers or skimmers and removing the remaining product in the wells with disposable bailers. An attempt was made to minimize the amount of water recovered with the product during bailing, but water was unavoidably recovered with the product as the product thickness decreased during bailing. Approximately 0.5, 0.5, 7.5, and 0.1 gallons of product/water were removed from wells B4MW, B5MW, B9MW, and B10MW, respectively. The product and water measurement data and volume of product/water mixture removed from the Former MarkAir Facility monitoring wells in 2013 are summarized in Table 1.

#### ***Bail-Down Test***

On June 6 and 7, 2013 a bail-down test was conducted at Well B9MW. Due to a malfunctioning Spill Buster pump, a disposable bailer was used to conduct the bail-down test. It took approximately one hour to remove the measurable product from Well B9MW. Once the product was removed, depth to product and water were measured periodically over 24 hours. The rate of product recovery and time interval is shown in Table 1.

### ***Investigation Derived Waste***

Approximately 8.6 gallons of product/water mixture was recovered on June 6, 2013 and was stored on-site in a 55-gallon drum. The drum is in the process of being shipped to Anchorage for disposal. Emerald Alaska, Inc. will recycle/dispose of the product/water. The certificate of disposal will be provided under separate cover.

### **CONCLUSIONS/RECOMMENDATIONS**

As shown on Graph 1 the rate of product entering the well dropped off significantly after ten minutes of monitoring. Due to the purging method and drawdown induced in the well, the initial recharge rate of 0.355 gallons per hour (gph) is likely higher than would be observed for a passive product recovery system. If a combined groundwater suppression/product recovery system is installed this would likely be the initial recovery rate. It is unknown how long this rate might be sustained.

The longer term recharge rate dropped below 0.01 gallons per hour [(0.58 milliliters per minute (mL/m))] after two hours and continued to decrease as the monitoring continued. Some of the measured decrease in the recharge rate is likely due to reaching static site conditions. With a continuous passive recovery system, it is estimated that a recovery rate of approximately 0.04 gph may be achievable for a limited amount of time.

The volume of product in the subsurface is unknown; but assuming an average formation thickness of one foot (based on the recent product recovery test), a radius of 30 feet from Monitoring Well B9MW, and estimates of magnification and porosity there may be approximately 7,500 gallons of product in the vicinity of Monitoring Well B9MW. Based on our experience only 10 to 30 percent of this product is likely recoverable in liquid form.

While a combined groundwater suppression/product recovery system may increase product recovery rates it will also generate large quantities of water that will require treatment. We recommend installing 2 to 3 recovery wells in the vicinity of Monitoring Well B9MW. The recovery wells should be completed as six-inch diameter wells with stainless steel wire-wound screens. These screens allow product to enter the well more easily and generally minimize magnification effects opposed to slotted polyvinyl chloride wells. The use of a hydrophobic filter pack should also be evaluated.

Mr. Bill O'Connell  
ADEC  
June 28, 2013  
Page 4 of 5

SHANNON & WILSON, INC.

After the wells are installed removal and recovery testing should be conducted to evaluate potential product recovery rates. We recommend that any automated system used to collect product be mobile and preferably rented as effective product recovery is generally not accomplished over the long term. Combined remediation techniques such as bioslurping should also be evaluated, but are likely not feasible due to the high electrical demand of such systems.

### **CLOSURE/LIMITATIONS**

This report was prepared for the exclusive use of our client and their representatives in the study of this site. The findings we have presented within this report are based on the limited scope of work. The data presented in this report should be considered representative of the time of our site assessment. Changes in site conditions can occur over time, due to natural forces or human activity. In addition, changes in government codes, regulations, or laws may occur. Because of such changes beyond our control, our observations and interpretations may need to be revised. Shannon & Wilson has prepared the documents in Attachment 2, "Important Information About Your Geotechnical/Environmental Report", to assist you and others in understanding the use and limitations of our reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact the undersigned.

Mr. Bill O'Connell  
ADEC  
June 28, 2013  
Page 5 of 5

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We appreciate this opportunity to be of service. Please call the undersigned at (907) 561-2120 with any questions or comments concerning the contents of this letter report.

Sincerely,

SHANNON & WILSON, INC.

Prepared by:



Jake Tracy, E.I.T.  
Environmental Engineer II

Approved by:



Stafford Glashan, P.E.  
Vice President

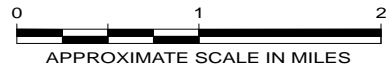
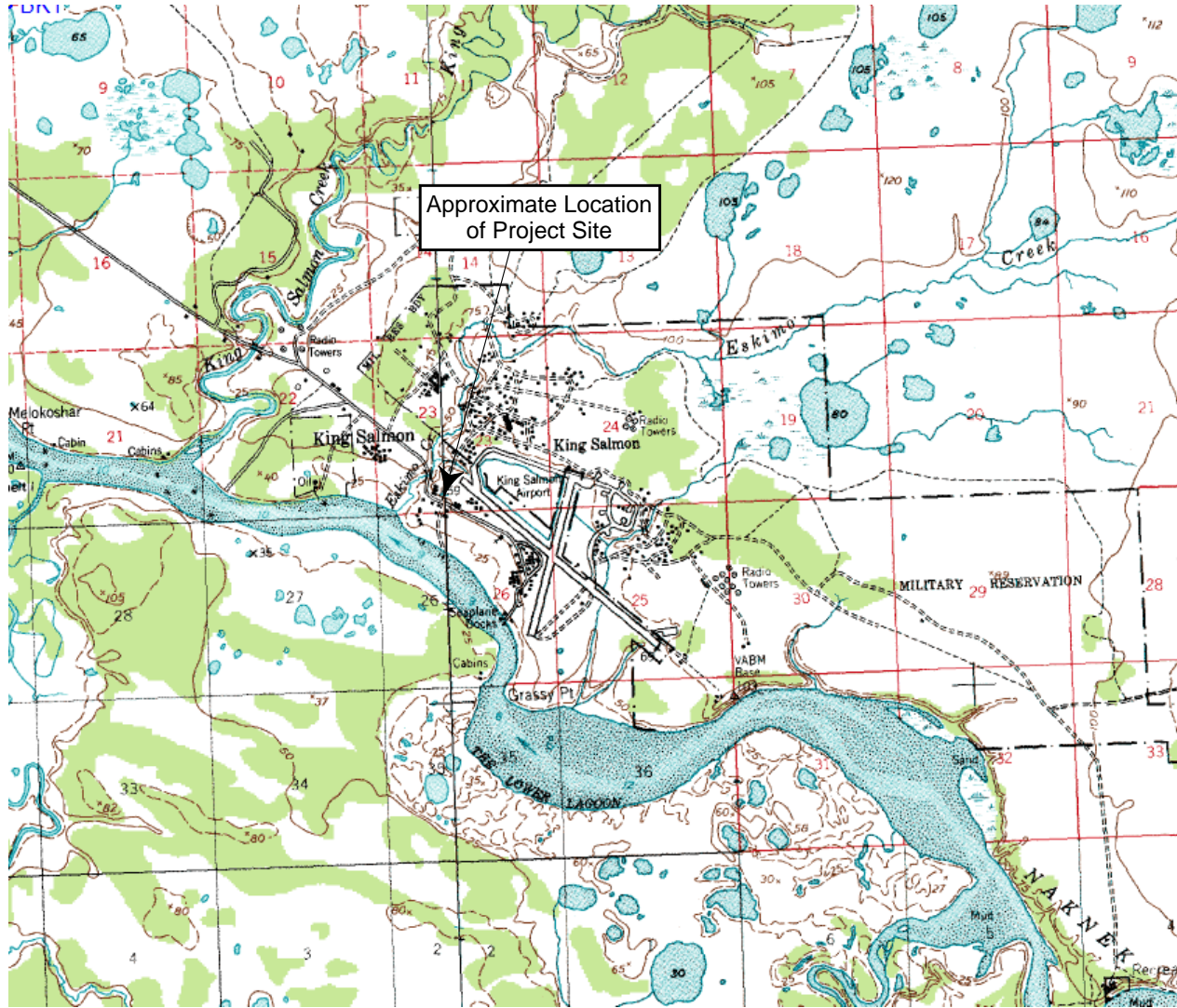
- Encl: Table 1 – Summary of 2013 Product Recovery Data  
Figure 1 – Vicinity Map  
Figure 2 – Site Plan  
Graph 1 – Product Recovery Rate  
Attachment 1 – Field Logs  
Attachment 2 – Important Information About Your Geotechnical/Environmental Report

**TABLE 1**  
**SUMMARY OF 2013 PRODUCT RECOVERY DATA**

Monitoring Well Number	Date	Time	Depth to Product below TOC (feet)	Depth to Water below TOC (feet)	Product Thickness (feet)	Product/Water Removed (gallons)	Product Recovery Rate (gallons per hour)*
B4MW	6/6/2013	11:04	17.19	17.90	0.71	0.5	-
	6/6/2013	13:40	18.18	18.35	0.17	-	-
Total amount of product/water removed from Well B4MW:						0.5	
B5MW	6/6/2013	11:08	15.74	15.89	0.15	0.5	-
	6/6/2013	14:05	16.16	16.31	0.15	-	-
Total amount of product/water removed from Well B5MW:						0.5	
B9MW	6/6/2013	11:12	26.08	31.68	5.60	7.5	-
	6/6/2013	12:45	38.09	38.59	0.50	-	-
	6/6/2013	12:55	27.36	28.23	0.87	-	0.355
	6/6/2013	13:15	27.04	28.07	1.03	-	0.0512
	6/6/2013	13:50	26.90	28.01	1.11	-	0.0118
	6/6/2013	15:00	26.82	28.06	1.24	-	0.0092
	6/6/2013	16:00	26.80	28.10	1.30	-	0.0030
	6/6/2013	17:30	26.79	28.19	1.40	-	0.0034
	6/6/2013	19:30	26.74	28.22	1.48	-	0.0019
	6/6/2013	21:00	26.74	28.30	1.56	-	0.0016
	6/6/2013	23:00	26.74	28.39	1.65	-	0.0014
	6/7/2013	10:30	26.73	28.63	1.90	-	0.0018
	6/7/2013	13:30	26.73	28.73	2.00	-	0.0006
Total amount of product/water removed from Well B9MW:						7.5	
B10MW	6/6/2013	11:00	16.90	16.95	0.05	0.1	-
	6/6/2013	13:24	-	17.00	0.00	-	-
Total amount of product/water removed from Well B10MW:						0.1	
B11MW	6/6/2013	10:52	-	14.54	0.00	-	-
Total amount of product/water removed from Well B11MW:						0	
Total amount of product/water removed from MarkAir Facility wells:						8.6	

## Notes:

- TOC = top of casing  
 - = not applicable or not measured  
 \* Only includes volume inside of casing; does not consider recovery in the sand pack.



Taken from Naknek C-2 and C-3  
 U.S. Geological Survey Quadrangles  
 50 Foot Contour Interval



Former MarkAir Facility  
 King Salmon, Alaska

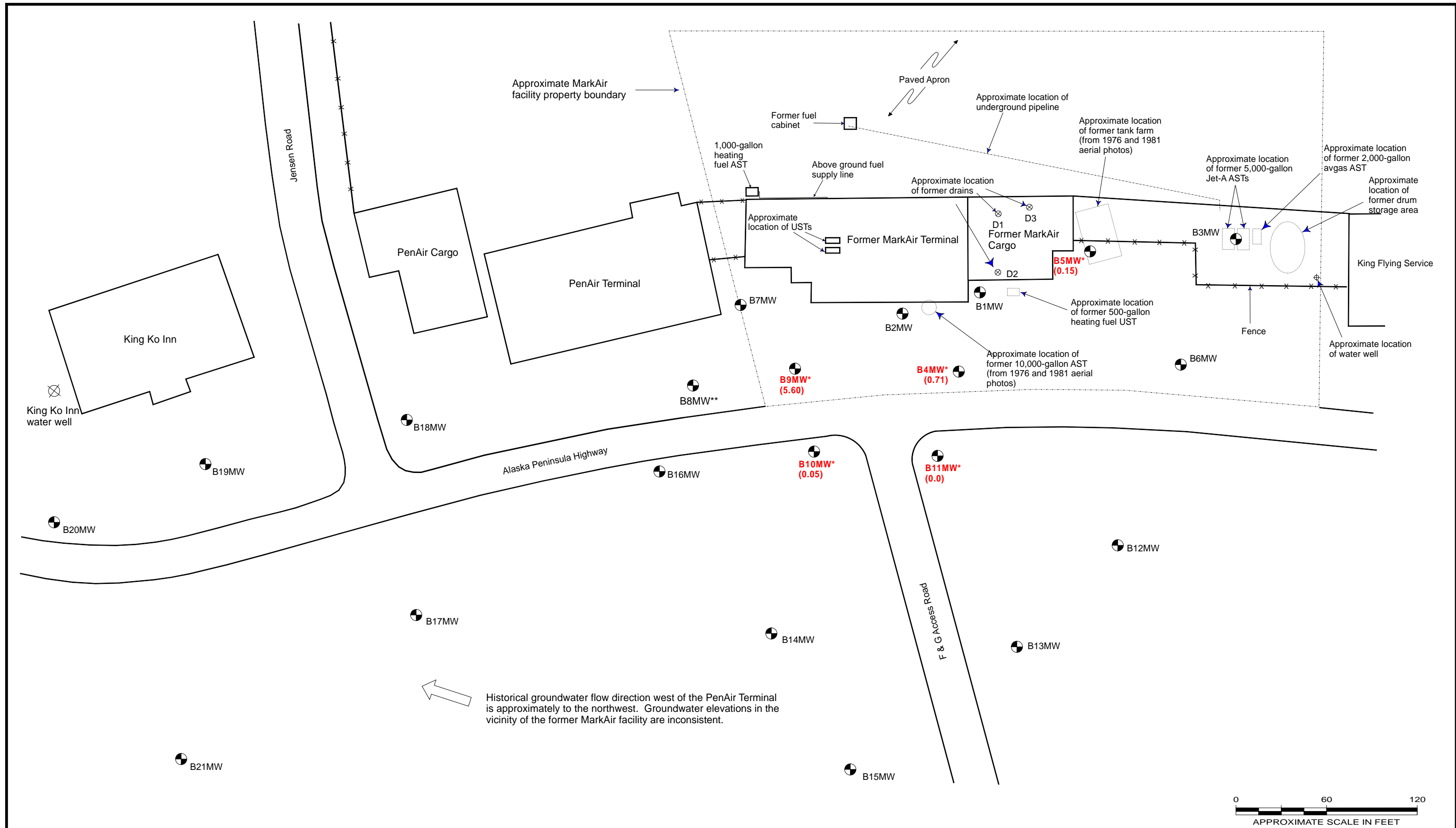
**VICINITY MAP**

June 2013



32-1-17490-002

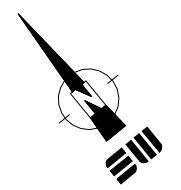
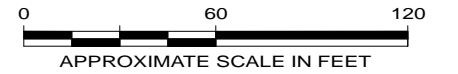
**SW SHANNON & WILSON, INC.**  
 Geotechnical & Environmental Consultants

**Fig. 1**



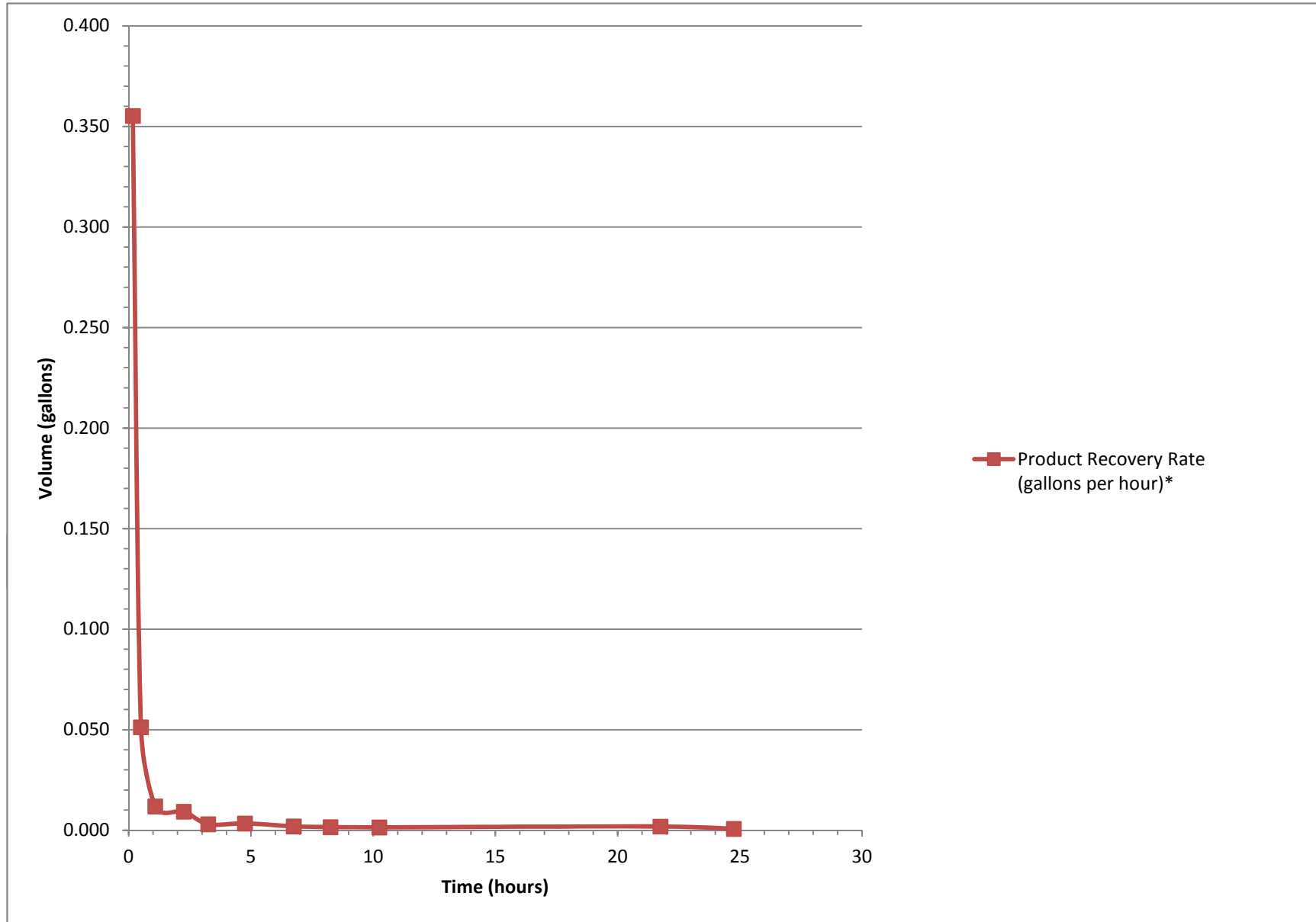
**LEGEND**

-  B1MW Approximate location of Monitoring Well B1MW.
-  B9MW\* (5.60) Well that historically contains product and measured product thickness in feet in June 2013.
- \*\* Well B8MW could not be located during previous field efforts (presumed destroyed by paving activities).



Former MarkAir Facility King Salmon, Alaska	
<b>SITE PLAN</b>	
June 2013	32-1-17490-002
 SHANNON & WILSON, INC. Geotechnical & Environmental Consultants	
<b>Fig. 2</b>	





\* = Only includes volume inside of casing; does not consider recovery in the sand pack.

**ATTACHMENT 1**  
**FIELD LOGS**

Table 1 - Free-Phase Product Recovery and Monitoring Log

B4MW					B5MW					B9MW				
Date/Time	Vol. (gal.)	DTP (ft)	DTW (ft)	PT (ft)	Date/Time	Vol. (gal.)	DTP (ft)	DTW (ft)	PT (ft)	Date/Time	Vol. (gal.)	DTP (ft)	DTW (ft)	PT (ft)
6/6/13 1104	0.5	17.19	17.90	0.71	6/6/13 1108	0.5	15.74	15.89	0.15	6/6/13 1112	7.5	26.08	31.68	5.6
1340	-	18.18	18.35	0.17	1405	-	16.16	16.31	0.15	6/6/13 1245	-	38.09	38.59	0.5
										6/6/13 1255	-	27.36	28.23	0.87
										6/6/13 1315	-	27.04	28.07	1.03
										6/6/13 1350	-	26.90	28.01	1.11
										6/6/13 1500	-	26.82	28.06	1.24
										6/6/13 1600	-	26.80	28.10	1.3
										6/6/13 1730	-	26.79	28.19	1.4
										6/6/13 1930	-	26.74	28.22	1.48
										6/6/13 2100	-	26.74	28.30	1.56
										6/6/13 2300	-	26.74	28.39	1.65
										6/7/13 1030	-	26.73	28.63	2.19
										6/7/13 1330	-	26.73	28.73	2

Notes:  
 Vol. = Volume of product removed from well  
 gal. = gallons  
 ft = feet  
 DTP = Depth to product  
 DTW = Depth to water  
 PT = Product thickness (DTW - DTP)

Table 1 - Free-Phase Product Recovery and Monitoring Log

B10MW					B11MW					Notes
Date/Time	Vol. (gal.)	DTP (ft)	DTW (ft)	PT (ft)	Date/Time	Vol. (gal.)	DTP (ft)	DTW (ft)	PT (ft)	
6/6/13 1100	0.1	16.90	16.95	0.05	6/6/13 1052	0	-	14.54	0	Well B10MW was difficult to find
1324	-	-	17.0	0						

Notes:  
 Vol. = Volume of product removed from well  
 gal. = gallons  
 ft = feet  
 DTP = Depth to product  
 DTW = Depth to water  
 PT = Product thickness (DTW - DTP)

**ATTACHMENT 2**  
**IMPORTANT INFORMATION ABOUT YOUR**  
**GEOTECHNICAL/ENVIRONMENTAL REPORT**



Date: June 2013  
To: ADEC  
Re: Former MarkAir Facility, King Salmon,  
Alaska

## **Important Information About Your Geotechnical/Environmental Report**

### **CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.**

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

### **THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.**

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors, which were considered in the development of the report, have changed.

### **SUBSURFACE CONDITIONS CAN CHANGE.**

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

### **MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.**

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

## **A REPORT'S CONCLUSIONS ARE PRELIMINARY.**

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

## **THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.**

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

## **BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.**

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

## **READ RESPONSIBILITY CLAUSES CLOSELY.**

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the  
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland