

**Appendix I**

**Quality Assurance Review**

**River Terrace Remedial Investigation  
July, November, December 1999 and January 2000**



## I APPENDIX - QUALITY ASSURANCE REPORT

Review and validation of the analytical results generated during the RI/FS are discussed below. Data generated from soil and groundwater samples collected between July 1999 and January 2000 are included in this report. The data has been reviewed and validated to determine its suitability for use characterizing subsurface contaminant concentrations, evaluating natural attenuation of the contaminants, and monitoring background site conditions.

The data quality objectives established for the RI/FS are presented in the table below.

Data Quality Objectives

Method	Rationale
SW8260B - Volatiles	Data to be used to evaluate and assess halocarbon impacts to soil and groundwater.
EPA 610 - PAH AK102/AK103 - DRO and RRO	Water results generated for comparison to State of Alaska Water Quality Standards. Soil results generated for comparison to ADEC 18 AAC 75 Soil Cleanup Standards (under 40-inch precipitation zone, migration to groundwater criteria). Results must also be of sufficient quality to be legally defensible.
General Chemistry Parameters	Data used to evaluate occurrence of halocarbon natural attenuation.
Anion Cation Balance	Data used to evaluate aquifer characteristics at select wells.
Methane	Data used to evaluate methanogenic natural attenuation.
Total Organic Carbon	Data used to evaluate halocarbon natural attenuation.

### I.1 SUMMARY OF QA/QC PROCEDURES

The groundwater samples were reviewed and validated in accordance with the ADEC-approved RI/FS Work Plan Addendum and United States Environmental Protection Agency (USEPA) procedural guidance documents. The reference documents used include the USEPA *Environmental Data Verification and Validation EPA QA/G-8*, August 1999; the USEPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 540/R-94/012), 1994; and the USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540/R-94/013), 1994.

The groundwater results for samples collected by OASIS/Bristol for analysis of VOCs have also been compared to the VOC results for samples collected during the same period by Hart Crowser on behalf of Mr. Gary Hinkle, the site owner. The comparability of these results is discussed in greater detail in Section J.2.

This Quality Assurance Report (QAR) identifies problems with the project specific laboratory analytical data and describes the related affect on data usability. Data review and validation has been conducted using a two step process. The first step is performed by the analytical laboratory and is based on their standard operating and quality control procedures. After the laboratory analyses have been completed and the data have been reported, OASIS/Bristol JV performs the second step of the data review and validation

process, which is presented in this QAR. The data review and validation activities completed for all sample results generated during the RI/FS include:

- Initial review of sample handling procedures and analytical and field data for completeness, accuracy, holding time compliance, and quality control (QC) sample frequency compliance.
- Evaluation of trip blank and method blank sample results to identify systematic contamination.
- Statistical evaluation of accuracy and precision of field duplicate samples, laboratory control samples (LCS), and matrix spike/matrix spike duplicate (MS/MSD) samples.
- Assigning of data qualifier flags, as necessary, to reflect limitations identified by the data assessment process.
- Estimation of data completeness.

The data review and validation activities completed for soil and groundwater samples analyzed for chlorinated hydrocarbons using EPA method SW8260B and the drinking water sample analyzed using EPA method 524.2 during the RI/FS also include an evaluation of the following:

- Initial multi-point calibration results for the GC/MS.
- Mass-spectrometer tuning results.
- Continuing calibration verification sample results.
- Internal standard response and retention times for all samples analyzed.
- Raw data for volatile compound identification, and overall analytical system performance.

The quality control data evaluated herein provide information for identifying and defining qualitative and quantitative limitations associated with the analytical results. As a result of this review and validation, analytical data reported by the laboratory that does not meet the quality control and quality assurance requirements specified by the associated analytical methods will be qualified to indicate potential analytical bias, as necessary. A summary of the review and validation process is described in greater detail below.

#### **1.1.1 Sample Handling Procedures**

Proper sample handling techniques are required to ensure sample integrity. During review and validation, the sample handling procedures identified below are evaluated to determine potential effects on data quality:

- Review of field sample collection and preservation procedures to ensure they were completed in accordance with the requirements specified by the analytical methods.
- Review of chain-of-custody documentation to ensure control and custody of the samples was maintained.
- Review of sample holding times between sample collection, extraction, and analysis.
- Review of sample conditions upon receipt at the contract laboratory.

The analytical reports received from the laboratories were reviewed to evaluate compliance with the sample handling and holding time criteria.

## **I.1.2 Blank Samples**

### *I.1.2.1 Laboratory Blank Samples*

Laboratory blank samples (method and instrument blanks) are laboratory-prepared, analyte-free samples used to detect the introduction of contamination or other artifacts into the laboratory sample handling and analytical process. These blanks play an especially important role in sampling programs involving trace-level analyses or analytes that are common solvents found in a laboratory.

### *I.1.2.2 Trip Blanks*

Trip blank samples consist of analyte-free water taken from the laboratory to the sampling site, and returned to the laboratory unopened for analysis. A trip blank simulates a sample container and sample traveling to/from the field. It is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organic samples.

## **I.1.3 Laboratory Control Samples**

Laboratory control samples are used to assess analytical performance under a given set of standard conditions. These are synthetic samples containing some or all of the analytes of interest at known concentrations and prepared independently from calibration standards. The samples consist of laboratory control samples (LCS) and laboratory control sample duplicates (LCSD). Typically analyzed with each analytical batch, laboratory control samples may be used to estimate analytical accuracy and precision by comparing measured results to actual concentrations.

Laboratory control samples are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess laboratory's internal precision. The analytical precision is expressed by the relative percent difference (RPD) between the measurement result of the two duplicate samples.

## **I.1.4 Matrix Spike and Matrix Spike Duplicates**

Matrix spike samples are actual field samples to which known amounts of select compounds (one, or more, of the analytes of interest) are added. Both spiked and an unspiked aliquot are analyzed. The difference between the concentration of the spike compound(s) in the spiked and unspiked aliquots is compared to the amount of spike added before the extraction process. Since actual samples are used for the recovery determination, the matrix effects can be evaluated. Usually expressed as a percentage of the mass of the spiked amount, spike recovery is the measurement of accuracy anticipated for the sample matrix.

Matrix spike samples are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess sample reproducibility and the laboratory's internal precision. The analytical precision is expressed by the relative percent difference (RPD) between the measurement result of the two duplicate samples.

## **I.1.5 Surrogates**

Surrogate compounds are added to all samples being analyzed for organic constituents to evaluate analytical accuracy for each individual sample. The surrogate compounds are chemically similar to the analytes of interest but are not expected to be present in the field samples. Recovery of these surrogate compounds gives an estimate of the effectiveness of the extraction and analysis for each individual sample.

### **I.1.6 Field Duplicate Samples**

Field duplicate samples are collected simultaneously with or in immediate succession to a primary project sample. Duplicates are designed to replicate their primary samples. Duplicates are treated in the same manner as the primary sample during all phases of sample collection, handling, and analysis. Duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Duplicate field samples were collected and submitted blind to the laboratory at a frequency of ten percent for this program.

Quality assurance (QA) blind duplicate samples were collected during the July 1999 remedial investigation. These quality assurance duplicates were submitted to a separate laboratory for independent analysis to evaluate intra-laboratory precision. In addition to the QA samples, replicate split samples were collected during all of the RI/FS sampling events by the property owner's consultant Hart Crowser. These results provide a third level of quality assurance for evaluation of inter-laboratory precision. However, the QA blind duplicate samples were terminated following the July 1999 sampling event and the replicate split samples collected by Hart Crowser were substituted for the QA blind duplicate samples during the remainder of the RI/FS sampling activities.

The analytical results were reviewed for agreement with each other or their respective reporting limits and evaluated for comparability. Estimated results that have been quantified below the reporting limit and qualified with a "J" flag are not considered significant for the purpose of data agreement.

### **I.1.7 Reporting Limits**

The reporting limits are the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory conditions. For many analytes, the reporting limit analyte concentration is selected by the laboratory as the lowest non-zero standard in the calibration curve. Sample reporting limits vary based on sample matrix and dilution of the samples during analysis.

### **I.1.8 Completeness**

Completeness is calculated after the QC data have been evaluated, and the results applied to the measurement data. In addition to results identified as being outside of the QC limits established for the method, broken or spilled samples, or samples that could not be analyzed for any other reason are included in the assessment of completeness. The percentage of valid results is reported as completeness. The calculation of completeness is as follows:

$$\frac{T - (I + NC)}{T} \times (100 \%) = \text{Completeness}$$

Where: T = Total number of expected measurements.

I = Number of invalidated results.

NC = Number of results not collected (e.g., bottles broken, etc.).

### **I.1.9 Calibration Verification**

Calibration verification were performed for the gas chromatographic/mass spectrometry (GC/MS) analysis of soil and groundwater samples for volatile organic compounds using EPA methods 524.2 and SW8260B. Calibration of laboratory instrumentation is required

to generate results within accuracy control limits identified by the approved analytical methods. Instrument calibration using the GC/MS methods involves a complex process requiring proper tuning of the mass spectrometer, a multi-point calibration for each volatile organic compound, frequent analysis of calibration verification standards, and analysis of internal standards added to each sample. The instrument response generated from these calibration parameters are used to quantify the volatile compounds present in the associated samples. Successful calibration requires instrument response for each compound between 0 and 15% relative standard deviation. Calibration with QA/QC parameters outside the method specific control limits will cause excessive bias in the analytical results.

Calibration verification for less critical inorganic and other organic analytical methods was not performed. A review of basic QA/QC parameters should be sufficient to determine the integrity of these analytical results based on the intended use of the associated data.

#### **I.1.10 Data Qualification**

Data qualification is based on problems discovered during data review, evaluation, and validation. The analytical results are flagged with qualifiers to indicate potential problems exist, which affects the integrity of the reported results. The following is a list of data qualifiers typically used for validation of analytical data. A definition of the data qualifier meaning is also provided.

ND- The sample was analyzed for, but was not detected above the reported sample quantitation limit.

J - Indicates an estimated value. This flag is used circumstance where the analytical result value is questionable.

B - This flag is used when the analyte is found in an associated blank, as well as the sample. It indicates possible sample contamination is present and warns the data user to consider that the result may be a false positive.

H - This flag indicates that the recommended holding time for a sample was exceeded before analysis.

R - Indicates a rejected sample result. These sample results are considered to be unusable for the purposes of the project.

### **I.2 QC RESULTS FOR SAMPLE ANALYSES**

QC procedures associated with the RI/FS samples generally include the evaluation of sample holding times, blank samples, laboratory control samples, matrix spikes, surrogates, and field duplicate samples. In addition to these parameters, QC procedures for analysis of volatile organic compounds using EPA methods 524.2 and SW8260B also included an evaluation of instrument calibration parameters. Results of the data review, evaluation, and validation are presented below for the associated analytical methods.

The QA/QC data evaluated during this review and validation process indicate that the sample results are acceptable for their intended project use. Unless otherwise indicated, the analytical results meet the precision and accuracy requirements for the associated analytical methods. The QA/QC data indicate that the quality control mechanisms were generally effective in ensuring measurement data reliability within the expected limits of sampling and analytical error. Data qualified by the review and validation process have been appropriately flagged and are presented in Tables 6-6 and 6-8 of the report.

The total overall calculated completeness of the RI/FS data set is greater than 99 %.

### **I.2.1 Volatile Organic Compounds**

Soil and groundwater samples were analyzed for VOCs using EPA method SW8260B and a single drinking water sample from the artesian well was analyzed using EPA method 524.2. A description of the QA/QC discrepancies encountered during analysis are presented below.

The groundwater sample collected in October 1999 from MW-28 was analyzed following a sample containing high concentrations of PCE and mp-xylenes. Only these two compounds were detected in the sample from MW-28 and a subsequent trip blank sample analyzed following MW-28. Due to insufficient sample volume, a second groundwater sample from MW-28 was not available for re-analysis, however, a second trip blank sample was available and was re-analyzed. Volatile organic compounds were not detected in the second trip blank sample and these results indicated that carry-over had biased the sample results during the previous analysis. The carry-over provided a false positive response for PCE and mp-xylenes in sample MW-28. Since a sufficient volume of this primary MW-28 sample was not available for re-analysis, the replicate results for the groundwater sample collected by Hart Crowser from MW-28 has been presented in this report. The replicate results from this sample confirm these compounds were not present above the reporting limit in the primary sample and that the reported concentrations in the primary sample resulted from carry-over from a previous sample. The primary sample results for PCE and mp-xylenes are considered biased and have not been used to evaluate volatile organic compound concentrations at the temporary well location.

The groundwater sample collected from monitoring well MW-30 (99-RT-079-GW) in December 1999 required qualification of the dichlorodifluoromethane result due to quality control exceedances in the associated continuing calibration verification sample results. This result has subsequently been flagged 'J' as estimated.

The remaining VOC quality assurance/quality control (QA/QC) discrepancies were caused by holding time exceedances and calibration problems, which are described in greater detail below.

The qualified volatile organic compound results for the soil and groundwater samples collected during the RI/FS are presented in Tables 6-6 and 6-8.

#### I.2.1.1 Holding Times

The groundwater samples collected in July 1999 from MW-6, MW-7, and MW-20 were diluted and analyzed initially within holding times. However, the samples were reanalyzed undiluted beyond holding times to quantify vinyl chloride concentrations with lower detection limits. The vinyl chloride concentrations have been flagged 'JH' as estimated due to the holding time exceedance that may have biased the results lower than the true concentration.

The groundwater sample collected in October 1999 from MW-18 was reanalyzed for VOCs one day past the recommended holding time due to cis-1,2-DCE carry-over from a previous sample. All target analyte compound results for the reanalysis were non-detect. The cis-1,2-DCE result was flagged 'JH' due to the potential that the result has been bias lower than its true concentration.

The groundwater samples collected in October 1999 from monitoring wells MW-4A, MW-8, MW-9, MW-19, MW-20, MW-21, MW-25, and MW-25 (Duplicate) were analyzed seven or more days beyond their holding times. These samples were originally

analyzed within holding times, however the concentration of PCE, TCE, and cis-1,2-DCE exceeded the calibration range of the instrument and required reanalysis following dilution. The associated PCE, TCE, and cis-1,2-DCE results in these groundwater samples have been biased low by the holding time exceedance and have been flagged 'JH' as estimated. The reported concentrations of these compounds are lower than the true concentrations present in the samples when they were originally collected.

The groundwater sample collected in November 1999 from MW-15 was reanalyzed for VOCs one day past the recommended holding time due to sample purging inefficiencies by the analytical instrument during the initial analysis. Target analytes were not detected in this sample and the associated results were not qualified. Due to the absence of target analytes in this sample, historical analytical results from previous groundwater sampling events, and the limited holding time exceedance, it is unlikely that the results have been biased significantly.

All other samples were analyzed for VOCs within the USEPA recommended holding times.

#### 1.2.1.2 Calibrations

Six soil samples MW-15 (12-14'), MW-15 (12-14') DUP, MW-16 (10-12'), SB-01 (15-17'), SB-02 (15-17'), and SB-02 (20-22') collected in July 1999 required qualification of the PCE results due to quality control exceedances in the initial calibration. The exceedance has decreased the accuracy of the reported PCE results below standards established for the analytical method due to the poor precision observed in the results of the multi-point calibration. The concentration of PCE in these samples has been flagged 'J' as estimated due to the additional bias associated with the reported results.

The groundwater sample collected in November 1999 from MW-14 and MW-31 required qualification of the dichlorofluoromethane results due to quality control exceedances in the associated continuing calibration verification sample. A continuing calibration standard is run daily to verify the analytical instrument is meets criteria established during its initial calibration before groundwater samples are analyzed. The concentration for this compound has been flagged 'J' as estimated due to excessive bias in the associated result resulting from analytical precision outside the criteria established by the analytical method.

The soil samples collected in October 1999 from soil gas points SG-1, SG-2, SG-6, SG-8, SG-12, SG-14, SG-18, SG-20, MW-28, MW-31, and MW-32, required qualification of all PCE results due to quality assurance criteria that slightly exceeded acceptable limits in the associated initial calibration for this compound. The exceedance has decreased the accuracy of the reported PCE results below standards established for the analytical method due to the poor precision observed in the results of the multi-point calibration. The concentration of PCE in these samples has been flagged 'J' as estimated due to the additional bias associated with the reported results.

Additional bias is present in the results for the soil sample from SG-20 collected in October 1999. The additional bias is the result of internal standard quality control exceedances encountered during sample analysis. Internal standards are added to each sample and their analytical response is used for quantification of the target analytes. When internal standard recovery exceeds the control limits established by the analytical method, the reported results do not reflect analyte concentrations within the accuracy constraints of the analytical method. In addition to the bias from the internal standard recovery, the PCE concentration reported in this sample was also biased by

the exceedance of initial calibration precision observed for PCE during the instruments initial multi-point calibration. The reported PCE results in this sample were affected by initial calibration and internal standard discrepancies and have been flagged 'J' as estimated due to excessive bias.

#### 1.2.1.3 Duplicates

Duplicate results have been statistically evaluated using RPD techniques in accordance with SW846 methodology.

Quality assurance duplicate samples submitted to an independent laboratory generated results that exceeded the precision criteria (%RPD <20) specified by the work plan. The %RPD values for the groundwater sample results ranged from 0 to 195 %. The %RPD values for the soil sample results ranged from 0 to 118 %. The elevated %RPD values could not be directly linked with deficiencies in the sample collection and analytical process. Therefore, they are primarily attributed to differences in the samples caused by the heterogeneity of the soil and differences in groundwater matrices. The actual %RPD values calculated for the duplicate samples are presented in Table J-1. The %RPD values in excess of 20% are highlighted and indicate the precision of the reported concentrations exceeds the desired reproducibility. Therefore, to be conservative and account for the differences, the highest concentration of each constituent has been used to evaluate site conditions.

Groundwater samples collected for VOC analysis by Hart Crowser on behalf of the property owner have been reviewed to determine comparability of the associated results collected by OASIS/Bristol. The results reported by Hart Crowser's contract laboratory were, in general, lower than the results for samples collected by OASIS/Bristol, with only a few exceptions. RPD values exceeded 20% for cis-1,2-DCE, trans-1,2-DCE, and/or TCE upon comparison of the groundwater samples collected from MW-4A, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-12, MW-19, MW-20, and MW-26. Cis-1,2-DCE was detected at a concentration greater than 10 times its method reporting limit in the sample collected by OASIS/Bristol and was reported non-detect in the sample collected by Hart Crowser.

RPD values for PCE exceeded 20% in all but one sample collected from MW-5. The PCE results from this monitoring well had an RPD of 16.2%. All other PCE results were not comparable and RPD values ranged from 24.4 to 194.9%. Upon comparison, the PCE results for samples collected by Hart Crowser were approximately one-half the concentration of the OASIS/Bristol sample results. The cause for the difference in analytical results was not readily apparent based on the limited data package provided by Hart Crowser's contract laboratory.

To limit potential sample bias, all of the split samples collected by OASIS/Bristol and Hart Crowser were collected concurrently using a single-use disposable bailer containing groundwater from each of the associated monitoring wells. A single bailer, filled once with groundwater, was used to dispense 40-milliliter aliquots of the sample to containers provided by both OASIS/Bristol and Hart Crowser. Sample transfer from the bailer to the sample containers was staggered. One OASIS/Bristol vial was filled followed by a Hart Crowser vial, a second OASIS/Bristol vial and a final Hart Crowser vial. Based on this information and completion of the review and validation of the data generated by OASIS/Bristol, it appears that sample handling, holding times, or laboratory analytical procedures have caused low bias in the Hart Crowser results. The primary cause of the difference between these concentrations is attributed to the difference in holding times

between analysis of the two sets of samples. The Hart Crowser replicate samples were analyzed on the 13<sup>th</sup> and 14<sup>th</sup> day of the 14-day holding time required by the analytical method. The OASIS/Bristol samples were generally analyzed between day 6 and day 9 of the 14-day holding time. A summary of analytical results and their associated RPD values are presented Table J-1. To be conservative, the highest reported compound concentration has been used during the evaluation of site conditions.

### **1.2.2 Diesel and Residual Range Organics**

Samples were analyzed for diesel range organics (DRO) using State of Alaska method AK102 and residual range organics (RRO) using State of Alaska method AK103. All QA/QC analytical results met established criteria and qualification was not required. The completeness for these analyses was 100%. Relative percent difference values were not calculated for duplicate DRO samples due to the low analyte response observed in the associated samples. EPA validation protocols prohibit the use of RPD values when concentrations are reported less than 10 times the method reporting limit.

### **1.2.3 Polynuclear Aromatic Hydrocarbons**

Groundwater samples were analyzed for Polynuclear Aromatic Hydrocarbons (PAH) using EPA method 610. All QA/QC analytical results met established criteria and qualification was not required. The completeness for these analyses was 100%. Relative percent difference values were not calculated due to the low analyte response observed in the associated samples.

### **1.2.4 Methane**

Groundwater samples were analyzed for methane using EPA method RSK 175 and ASTM method D1945-M. These methods are designed to determine relative amounts of methane in a water sample by the analysis of headspace vapor. Samples are injected into a gas chromatograph and quantified using a flame ionization or an electron capture detector. All QA/QC analytical results met established criteria and qualification was not required. The completeness for the methane analysis was 100%. Duplicate samples collected for methane analysis were evaluated to determine analytical precision. The calculated RPD values ranged from 0 to 23.3%. A summary of the RPD values for the intrinsic remediation parameters is presented in Table J-2. Only the groundwater sample collected from MW-6 in July 1999 had an RPD value that exceeded 20%. To be conservative, an average of the primary and duplicate results for this sample have been used to evaluate site conditions.

### **1.2.5 Inorganic Ions (Alkalinity, Chloride, Sulfate; Nitrate-Nitrite)**

Groundwater samples were analyzed for alkalinity using EPA method 310.1, chloride and sulfate using EPA method 300, and nitrate-nitrite using EPA method 353.2. Recovery of fluoride in one laboratory control spike (LCS) sample was below acceptable limits requiring estimation of the associated data in samples collected from MW-11 and MW-24 in December 1999. All other analytical results met established QA/QC requirements and required no flagging. The completeness for these analyses was 99%. An evaluation of duplicate sample precision is summarized in Table J-2. The RPD values were below 20% in all samples except MW-6 collected in July 1999 and analyzed for chloride and sulfate. The RPD value for chloride was 120% and for sulfate 24.7%. To be conservative, an average of the primary and duplicate results for this sample and these analytes have been used to evaluate site conditions.

### **I.2.6 Total Organic Carbon**

Total organic carbon (TOC) analysis was performed on groundwater samples using EPA method SW9060. All QA/QC analytical results met established criteria and qualification was not required. The completeness for the TOC analysis was 100%. Analysis of the groundwater sample from MW-25 and its associated duplicate did not meet the RPD limit of 20% established in the work plan for this analysis. The RPD for this analysis was 22.0%. To be conservative, the average of the two reported values has been used to evaluate site conditions.

### **I.2.7 Dissolved Metals**

Groundwater samples were analyzed for dissolved metals (calcium, magnesium, potassium, and sodium) using EPA method SW 6010B. In general, the sample results met the established DQOs. However, the serial dilution for potassium was not within established control limits, which affected all reported potassium results in samples MW-11 and MW-24 collected in December 1999. These potassium values have been qualified "E" as estimated. Matrix spike sample results for all four metals did not meet established limits due to high concentrations of the target analytes in the associated samples. In accordance with USEPA standard data validation procedures, the associated sample results did not require qualification. All remaining QA/QC analytical results met established criteria. The completeness for the dissolved metals analysis was 90%.

### **I.2.8 Reference Documents**

Reference documents outlining the laboratory procedures and quality control requirements of the methods mentioned in this document are shown below:

#### **SW 6010B, SW 8260B and SW 9060:**

*USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, September 1994 (SW-846).

#### **E310.1 and E353.2:**

*Methods for Chemical Analysis of Water and Wastes (MCAWW)*, March 1983 (EPA /600 /4-79-020).

*Methods for the Determination of Inorganic Substances in Environmental Samples*, August 1993 (EPA /600 /R-93-100).

**E524.2:**

*Drinking Water Methods from Methods for the Determination of Organic Compound in Drinking Water Supplement II, August 1992 (EPA /600 /R-92 /129).*

**E610:**

*Determination of Polynuclear Aromatic Hydrocarbons in Industrial and Municipal Wastes, September 1982 (EPA-600/4-82-025).*

**AK102/AK103:**

*Determination of Diesel Range Organic Hydrocarbons and Determination of Residual Range Organic Hydrocarbons, Alaska Department of Environmental Conservation, June 1998.*

**RSK-175:**

*Sample Procedure and Calculations for Dissolved Gas Analysis in Water Samples using A GC Headspace Equilibration Technique, August 1994 (RSKSOP-175); and*

*USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, September 1994 (SW-846).*

**ASTM D 1945-M:**

*American Society for Testing & Materials, Volume .05, Gaseous Fuels Coals & Coke, 1998.*



**Table I-1**  
**RI/FS Soil and Groundwater Volatile Organic Sampling Results**  
**Data Comparison Summary - River Terrace RV Park, Soldotna, Alaska**  
(all results expressed as mg/L, unless otherwise specified)

Well ID	OASIS or HC	Date Sampled	Depth or Time Sampled	Vinyl Chloride	%RPD	1,1-DCE	%RPD	C-1,2-DCE	%RPD	T-1,2-DCE	%RPD	TCE	%RPD	PCE	%RPD
<b>Soil Sample Duplicate Results</b>															
MW-19	OASIS	6/25/99	12-14'	ND		ND		500		7		98		890	
	OASIS	6/25/99	12-14'	ND		ND		480	4.1	ND		130	28.1%	650	29.7%
	OASIS	6/25/99	12-14'	ND		ND		190	79.5%	ND		52	49.3%	200	118.3%
MW-20	OASIS	6/25/99	5-7'	ND		ND		430		ND		100		120	
	OASIS	6/25/99	5-7'	ND		ND		620	36.2%	6		130	26.1%	190	45.2%
	OASIS	6/25/99	5-7'	ND		ND		380	48.0%	6		140	33.3%	140	30.3%
MW-34	OASIS	1/13/00	10-12'	ND		ND		ND		ND		ND		ND	
	OASIS	1/13/00	10-12'	ND		ND		ND		ND		ND		ND	
<b>Groundwater Sample Duplicate Results</b>															
MW-3A	OASIS	12/14/99		ND		ND		ND		ND		ND		0.0013	
	Hart Crowser	12/14/99	1000	ND		ND		ND		ND		ND		ND	
MW-4A	OASIS	12/14/99		ND		ND		1		ND		0.15		1.2	
	Hart Crowser	12/14/99	1830	ND		ND		0.723	32.2%	0.0127		0.112	29.0%	0.507	81.2%
MW-5	OASIS	12/15/99		ND		ND		0.11		0.0032		0.0075		0.028	
	Hart Crowser	12/15/99	915	ND		ND		ND	ERROR	ND		0.00778		0.0238	16.2%
MW-6	OASIS	12/15/99		ND		ND		0.95		0.01		0.18		0.56	
	Hart Crowser	12/15/99	1005	ND		ND		0.674	34.0%	0.00924	7.9%	0.127	34.5%	0.25	76.5%
MW-7	OASIS	12/15/99		ND		ND		0.48		0.0041		0.044		0.26	
	Hart Crowser	12/15/99	935	ND		ND		0.324	38.8%	0.00343		0.0451	2.5%	0.0846 (J)	101.8%
MW-8	OASIS	12/15/99		ND		ND		0.7		0.0055		0.11		0.25	
	Hart Crowser	12/15/99	1005	ND		ND		0.62	12.1%	0.00298		0.087	23.4%	0.17	38.1%
MW-9	OASIS	12/14/99		ND		ND		1.3		0.012		0.29		1.8	
	Hart Crowser	12/14/99	1745	0.00298		0.00201		1.04	22.2%	0.0106	12.4%	0.222	26.6%	0.833	73.5%
MW-10	OASIS	12/15/99		ND		ND		0.47		0.0034		0.085		0.97	
	Hart Crowser	12/15/99	1220	ND		ND		0.369	24.1%	0.00132		0.068	22.2%	0.519	60.6%
MW-11	OASIS	12/14/99		ND		ND		ND		ND		ND		0.034	
	Hart Crowser	12/14/99	1355	ND		ND		ND		ND		ND		0.0262	25.9%
MW-12	OASIS	12/15/99		ND		ND		0.46		0.0036		0.079		0.098	
	Hart Crowser	12/15/99	1155	ND		ND		0.0079	193.2%	0.00157		0.00128	193.6%	0.00126	194.9%
MW-13	OASIS	12/15/99		ND		ND		0.014		ND		0.0039		0.09	
	Hart Crowser	12/15/99	1130	ND		ND		0.0158	12.1%	ND		0.00428		0.0557	47.1%
MW-14	OASIS	12/14/99		ND		ND		0.0026		ND		0.0022		0.029	
	Hart Crowser	12/14/99	1600	ND		ND		0.00276	6.0%	ND		0.00207		0.0227	24.4%
MW-16	OASIS	10/27/99		ND		ND		9.3		0.7		37		2500	
	OASIS	10/27/99	NA	ND		ND		9.5		0.7		35	5.6%	2200	12.8%
MW-16	OASIS	12/14/99		ND		ND		11		ND		53		2400	
	OASIS	12/14/99	NA	ND		ND		11		ND		49	7.8%	2700	11.3%
MW-16	OASIS	12/14/99		ND		ND		0.011		ND		0.049		2.7	
	Hart Crowser	12/14/99	1440	ND		ND		0.0119	7.9%	ND		0.0541	9.9%	1.95	31.8%
MW-19	OASIS	12/14/99		ND		ND		0.53		0.0048		0.073		0.12	
	Hart Crowser	12/14/99	1705	ND		ND		0.41	25.5%	0.00432		0.0539	30.1%	0.0599	66.8%
MW-20	OASIS	10/27/99		ND		ND		4600		860		750		ND	
	OASIS	10/27/99	NA	ND		ND		3400	30.0%	680	23.4%	700	6.9%	ND	
	OASIS	10/27/99	NA	ND		ND		3400	0.0%	710	4.3%	630	10.5%	ND	
MW-20	OASIS	12/14/99		ND		ND		2300		ND		ND		660	
	OASIS	12/14/99	NA	ND		ND		2300		ND		ND		670	
MW-20	OASIS	12/14/99		ND		ND		2.3		0.025		0.43		0.67	
	Hart Crowser	12/14/99	1640	ND		0.00193		1.79	24.9%	0.0192	26.2%	0.278	42.9%	0.312	72.9%
MW-21	OASIS	9/3/99		ND		ND		220		2		79		350	
	OASIS	9/3/99	NA	ND		ND		210	4.7%	2		78	1.3%	330	5.9%
MW-21	OASIS	12/13/99		ND		ND		0.067		0.0015		0.03		0.14	
	Hart Crowser	12/13/99	1710	ND		ND		0.0693	3.4%	ND		0.0287	4.4%	0.102	31.4%
MW-22	OASIS	12/13/99		ND		ND		ND		ND		ND		0.0064	
	Hart Crowser	12/13/99	1650	ND		ND		ND		ND		ND		0.0049	26.5%
MW-23	OASIS	12/13/99		ND		ND		ND		ND		ND		0.012	
	Hart Crowser	12/13/99	1630	ND		ND		ND		ND		ND		0.0082	37.6%
MW-24	OASIS	12/14/99		ND		ND		0.25		ND		0.041		0.079	
	Hart Crowser	12/14/99	1100	ND		ND		0.275	9.5%	ND		0.0389	5.3%	0.0571	32.2%
MW-25	OASIS	10/27/99		ND		ND		4.4		ND		8.3		300	
	OASIS	10/27/99	NA	ND		ND		4.6	4.4%	ND		8.8	6.0%	290	3.9%
MW-25	OASIS	12/14/99		ND		ND		8.4		ND		13		500	
	OASIS	12/14/99	NA	ND		ND		7.9	6.0%	ND		12	8.0%	460	1.3%
MW-25	OASIS	12/14/99		ND		ND		0.0087		ND		0.012		0.46	
	Hart Crowser	12/14/99	915	ND		ND		0.0079		ND		0.0124	3.3%	0.349	27.4%
MW-26	OASIS	12/14/99		ND		ND		0.71		0.022		0.04		0.2	
	Hart Crowser	12/14/99	1025	ND		ND		0.705	0.7%	0.011	66.7%	0.0412	3.0%	0.156	24.7%
MW-27	OASIS	12/14/99		ND		ND		0.0013		ND		ND		ND	
	Hart Crowser	12/14/99	1135	ND		ND		0.00119		ND		ND		ND	
MW-29	OASIS	11/8/99		ND		ND		ND		ND		ND		6.6	
	OASIS	11/8/99	NA	ND		ND		ND		ND		ND		11	50.0%
MW-29	OASIS	12/13/99		ND		ND		ND		ND		ND		0.012	
	Hart Crowser	12/13/99	1515	ND		ND		ND		ND		ND		0.0082	37.6%
MW-30	OASIS	12/13/99		ND		ND		ND		ND		ND		ND	
	Hart Crowser	12/13/99	1415	ND		ND		ND		ND		ND		ND	
MW-31	OASIS	12/13/99		ND		ND		ND		ND		ND		0.002	
	Hart Crowser	12/13/99	1440	ND		ND		ND		ND		ND		0.00158	
MW-32	OASIS	12/13/99		ND		ND		ND		ND		ND		ND	
	Hart Crowser	12/13/99	1545	ND		ND		ND		ND		ND		ND	
MW-34	OASIS	1/14/00		ND		ND		ND		ND		ND		ND	
	OASIS	1/14/00	NA	ND		ND		ND		ND		ND		ND	

Notes:  
 RPD values are not calculated for samples that were non-detect or had results less than 10 times the method reporting limit.  
 An ERROR is indicated when the split samples yield conflicting non-detect and positive response results.  
 %RPD = Relative Percent Difference  
 NA = Not Applicable or Not Available  
 ND = Non Detect  
 RPD value greater than 20%

**Table I-2**  
**R/FS Intrinsic Remediation Parameters - Groundwater Sampling Results**  
**Data Comparison Summary - River Terrace RV Park, Soldotna, Alaska**  
(all results expressed as mg/L, unless otherwise specified)

Well ID	OASIS or HC	Date Sampled	Depth or Time Sampled	Methane	Chloride			Sulfate			Nitrate & Nitrite as Nitrogen			Alkalinity			Total Organic Carbon		
					%RPD	Concentration	%RPD	Concentration	%RPD	Concentration	%RPD	Concentration	%RPD	Concentration	%RPD	Concentration	%RPD	Concentration	%RPD
MW-6	OASIS	7/8/99	NA	1,900	23.3%	3,800	15,800	ND	107,000	21,500	ND	107,000	21,500	0.0%	21,500	0.0%	21,500	0.0%	21,500
MW-16	OASIS	10/27/99	NA	2	0.0%	46,100	19,100	700	81,000	7,400	700	81,000	7,400	1.4%	7,300	1.4%	7,300	1.4%	7,300
MW-20	OASIS	7/8/99	NA	1,700	19.4%	19,800	7,600	ND	136,000	31,300	ND	136,000	31,300	2.8%	32,300	2.8%	32,300	2.8%	32,300
MW-25	OASIS	10/27/99	NA	1,400	ERROR	43,000	10,300	2,200	76,000	4,600	2,200	76,000	4,600	22.0%	7,200	22.0%	7,200	22.0%	7,200

**Notes:**

RPD values are not calculated for samples that were non-detect or had results less than 10 times the method reporting limit. An ERROR is indicated when the split samples yield conflicting non-detect and positive response results.

%RPD = Relative Percent Difference

NA = Not Applicable or Not Available

ND = Non Detect

RPD value greater than 20%