A Department of Ecology Report

Restover Truck Stop Groundwater Monitoring, Results of February 2002 Sampling

Abstract

This progress report describes results of groundwater sampling at the Restover Truck Stop during February 2002. Samples were collected from one well, WDOE-6A, in the upper aquifer and analyzed for benzene, toluene, ethylbenzene, and total xylenes (BTEX), as well as for total petroleum hydrocarbons as gasoline (TPH-G). All four BTEX compounds were detected in the well, with an average total concentration of 254 ug/L. The TPH-G concentration in the well was 6,100 ug/L. Model Toxic Control Act cleanup standards were exceeded in WDOE-6A for benzene, ethylbenzene, and total xylene, as well as for TPH. Well WDOE-6A continues to have elevated BTEX concentrations.

Background

The Washington State Department of Ecology has conducted groundwater sampling at the Restover Truck Stop in Thurston County, Washington from 1987 to 2002 (Appendix A). To remediate soil and groundwater contamination, an Interim Action consisting of an air sparge/vapor extraction system (VES) was initiated in the summer of 1993. Operation of the VES was terminated in the fall of 1997, since BTEX concentrations had substantially decreased, and continued operation of the system was no longer cost efficient. In late 1998 and early 1999, the VES and most of the remaining monitoring wells were decommissioned. Currently the only well being monitored is WDOE-6A (Figure 1).

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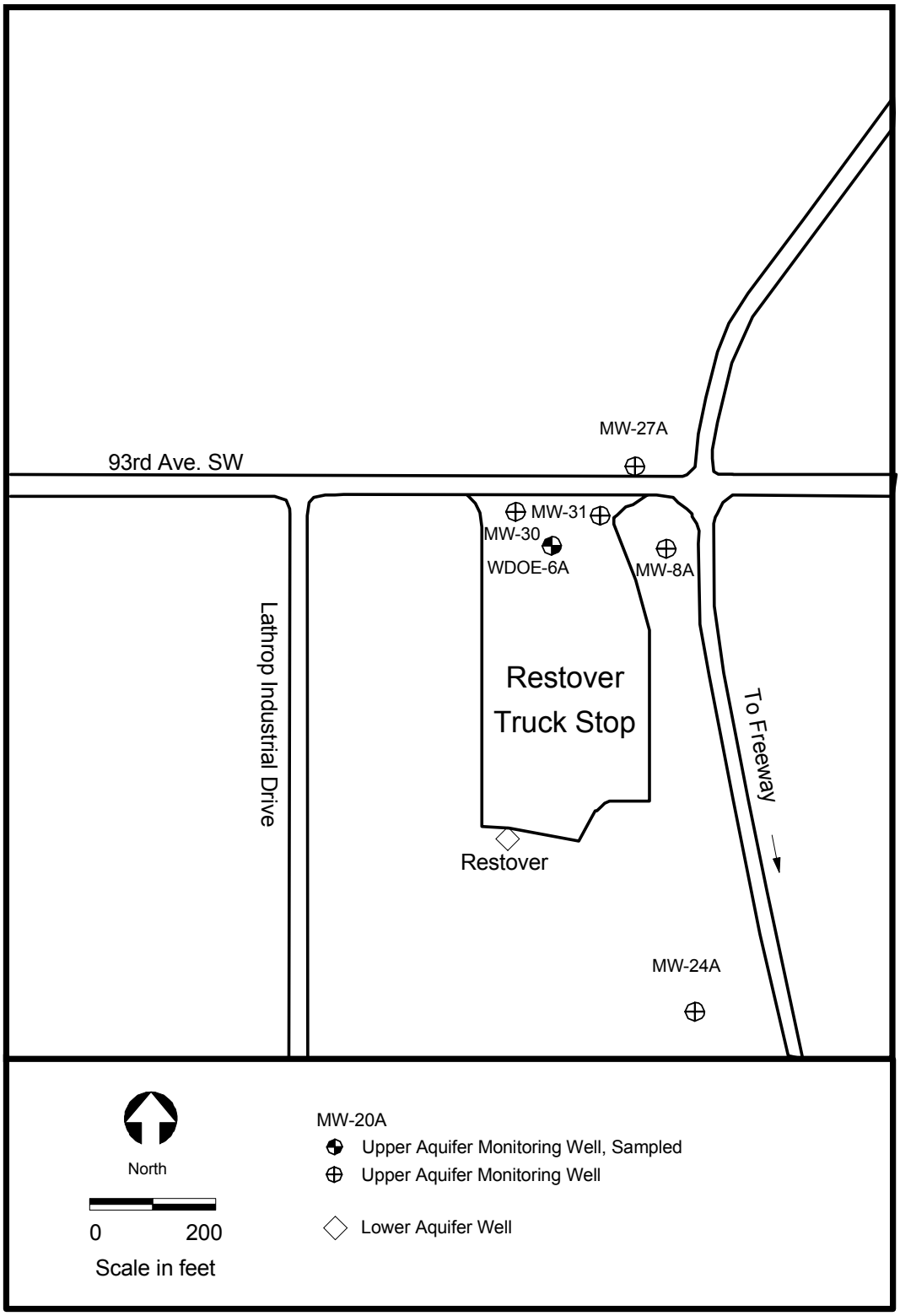

Figure 1: Well Locations, Restover Truck Stop

Methods

Groundwater Sampling

In February, groundwater samples were collected from one upper aquifer monitoring well, WDOE-6A. The upper aquifer consists of recessional outwash. The Vashon Till (a regional aquitard) and advance outwash deposits that form a lower aquifer underlie this unit.

Sampling methods were consistent with those previously used on this project. The static water level was recorded prior to well purging. WDOE-6A was purged and sampled with a decontaminated, bottom-emptying teflon bailer. The well was purged until pH, specific conductance, and temperature readings stabilized, and a minimum of three well volumes had been removed. Sampling procedures are discussed in detail in Appendix B.

Analysis

Analytes, analytical method, and detection limits are listed for both field and laboratory parameters in Table 1. Monitoring well samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) as well as total petroleum hydrocarbons as gasoline (TPH-G).

Table 1: Analytical Methods for February 5, 2002 Samples

Analytes	Method	Reference	Detection Limit
Field			
Water Level	Solinst Well Probe	NA	0.01 feet
pH	Orion 25A Field Meter	NA	0.1 Std. Units
Temperature	Orion 25A Field Meter	NA	0.1 C
Specific Conductance	Beckman Conductivity Bridge	NA	10 umhos/cm
Laboratory			
BTEX	SW-846 Method 8260	U.S. EPA, 1986	1-5 ug/L
TPH-G	NWTPH-GX	Ecology, 2000	0.025 mg/L

In general, the quality of the data is acceptable. Quality control samples collected in the field consisted of a blind field duplicate, MW-6A, for BTEX and TPH-G. The numeric comparison of duplicate results is expressed as the relative percent difference (RPD). The RPD for the February duplicate samples was within 10% for BTEX and 13% for TPH-G. In addition to field quality control samples, method blanks and surrogate compound recoveries were performed in the laboratory and were within acceptable quality control limits. Toluene was detected in one method blank used for the diluted samples analyzed on February 13, 2002. This contamination did not affect the toluene results for the undiluted samples used in this report. Quality assurance and laboratory reporting sheets are presented in Appendix C.

Results

Field Observations

Depth-to-water measurements and purge volume, as well as pH, specific conductance, and temperature readings at the time of sampling, are listed in Table 2.

Table 2: Summary of Field Parameters Results for February 5, 2002

Monitoring Well	Total Depth (feet)[1]	Depth to Water (feet)[2]	pH (standard units)	Specific Conductance (umhos/cm)	Temperature (°C)	Purge Volume (gallons)
WDOE-6A	21.68	7.68	6.2	160	11.2	7

[1] Below ground surface.

[2] Measured from top of casing.

Analytical Results

Analytical results for BTEX and TPH-G from the February sampling, as well as Model Toxic Control Act (MTCA) groundwater cleanup standards, are shown in Table 3.

Table 3: Analytical Results (ug/L) for February 5, 2002

Monitoring Well	Benzene	Toluene	Ethylbenzene	Total Xylene	Total BTEX	TPH-G
MTCA Cleanup Standard	5.0	40.0	30.0	20.0		(Total TPH) 1000.0
WDOE-6A	19.4	8.8	69	158	255	5700
MW-6A (dup)*	17.6	8.4	68	159	253	6500

* MW-6A is a duplicate sample of WDOE-6A.

In February, all four BTEX compounds were detected in WDOE-6A with an average total concentration of 254 ug/L. The TPH-G concentration in well WDOE-6A averaged 6,100 ug/L.

Table 4 shows BTEX concentrations for select monitoring wells over the entire monitoring period (1987 to 2002). WDOE-6A continues to have BTEX concentrations that consistently exceed MTCA cleanup standards.

Table 4: Historical Restover Truck Stop BTEX Concentrations (ug/L) from May 1987 to February 2002

Well Number	May 1987	September 1987	October 1988	January 1989	July 1989	January 1990	August 1990	February 1991	August 1991	February 1992	July 1992
					Upper Aquifer						
WDOE-6A	6950	1180	5300	28000	7490	9870	5190	3460	2840	3830	2990
MW-8A	230[1]	388[1]	479[1]	334[1]	64[2]	20[2]	178[2]	19[2]	20[2]	9[2]	53[2]
MW-15A	1433	--	--	ND	218	--	285	122	--	--	--
MW-17	ND	ND	ND	ND	ND	--	--	ND	ND	--	2.7
MW-20A	126	--	--	--	--	20	1400	5	293	11	452
MW-30	-	-	-	-	-	-	-	-	-	-	-
MW-9A	727	--	--	--	--	--	--	--	--	--	--
					Lower Aquifer						
Restover	--	--	ND	ND	ND	ND	ND	ND	ND	ND	ND
Spencer	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND
MW-12	53	5	8	ND	4	ND	6	ND	--	--	--

Well Number	January 1993	July 1993	November 1993	January 1994	April 1994	August 1994	November 1994	February 1995	April 1995	August 1995	October 1995
					Upper Aquifer						
WDOE-6A	4784	2620	3070	6360	5242	3214	4624	2120	1829	638	646
MW-8A	47[2]	30[2]	41[2]	36[2]	4[2]	8[1]	32[2]	ND	ND	ND	ND
MW-15A	--	--	--	--	--	--	--	ND	--	2	--
MW-17	ND	--	--	--	--	--	--	--	--	--	--
MW-20A	--(Dry)	162	--(Dry)	ND	59	--(Dry)	ND	ND	ND	18	--(Dry)
MW-30	-	--	--(Dry)	--(Dry)	2400	--(Dry)	--(Dry)	8	8	7	ND
MW-31	-	-	-	-	-	-	-	-	-	--(Dry)	--(Dry)
MW-9A	--	--	--	--(Dry)	366	--	--	ND	--	1	--
					Lower Aquifer						
Restover	ND	0.4	--	ND	--	--	--	--	--	ND	--
Spencer	ND	ND	--	--	--	--	--	--	--	--	--
MW-12	--	1.7	--	--	--	--	--	1.1	--	Well Decommissioned	
MW-12A	-	-	-	-	-	-	-	-	-	0.5	--

ND: Compound Not Detected
-- : Compound Not Tested

[1] : Value is based on one sample.
[2] : Value represents the mean of duplicate samples.

Table 4 continued: Historical Restover Truck Stop BTEX Concentrations (ug/L) from May 1987 to February 2002

Well Number	February 1996	April 1996	August 1996	November 1996	February 1997	August 1997	February 1998	July 1998	January 1999	July 1999	January 2000	December 2000	February 2002
Upper Aquifer													
WDOE-6A	61	5900	488[2]	664[2]	310[2]	212[2]	214[2]	158[2]	412[2]	92[2]	233[2]	218[2]	254[2]
MW-8A	ND	ND	ND	5	ND	ND	ND	ND	ND	ND	ND	--	--
MW-15A	ND	--	--	--	ND	--	--	--	Well Decommissioned				
MW-17	--	--	--	--	--	--	--	--	Well Decommissioned				
MW-20A	ND	ND	1	6	ND	ND	ND	ND	Well Decommissioned				
MW-30	5	19	ND	1	ND	ND	2.5	ND	6.4	ND	11	--	--
MW-31	7.1	ND	--(Dry)	--(Dry)	ND	3.6	--	--(Dry)	1.1	1.5	ND	--	--
MW-9A	ND	--	--	--	ND	--	--	--	Well Decommissioned				
Lower Aquifer													
Restover	--	--	--	--	--	--	--	--	--	--	--	--	--
Spencer	--	--	--	--	--	--	--	--	--	--	--	--	--
MW-12													
MW-12A	ND	--	--	--	ND	--	--	--	Well Decommissioned				

ND: Compound Not Detected
-- : Compound Not Tested

[1] : Value is based on one sample.
[2] : Value represents the mean of duplicate samples.

Figure 2 shows BTEX concentrations for well WDOE-6A for the entire monitoring period. Concentrations in well WDOE-6A were relatively stable from August 1991 to February 1995.

Since February 1995, BTEX concentrations in well WDOE-6A have been gradually decreasing. In April 1996, high BTEX concentrations were detected in this well. There is no apparent explanation for this increase. The decrease in BTEX concentrations in 1995 coincides with operation of the VES which was initiated in the summer of 1993. Operation of the VES was terminated in the fall of 1997, since BTEX concentrations had substantially decreased. The VES and most of the remaining monitoring wells were decommissioned in the fall of 1998 and early 1999.

With the decommissioning of most of the monitoring wells and the continuing decrease of BTEX concentrations in well WDOE-6A, the monitoring program has been reduced to a five-year cycle. Well WDOE-6A will be sampled again in 2007.

Conclusions and Recommendations

1. Well WDOE-6A continues to have elevated BTEX concentrations. Since 1995, BTEX concentrations in this well have been gradually decreasing. Due to the decrease in total BTEX concentrations, the monitoring program has been reduced to a five-year cycle.

2. In February 2002, Model Toxic Control Act cleanup standards were exceeded in WDOE-6A for benzene, ethylbenzene, and total xylene, as well as for TPH.

3. Six monitoring wells remain at this site (Figure 1). If wells MW-8A, MW-24A, MW-27A, MW-30 and MW-31 are no longer to be used as part of the monitoring program, they should be properly decommissioned in accordance with Washington State regulations (Chapter 173-160 WAC)

References

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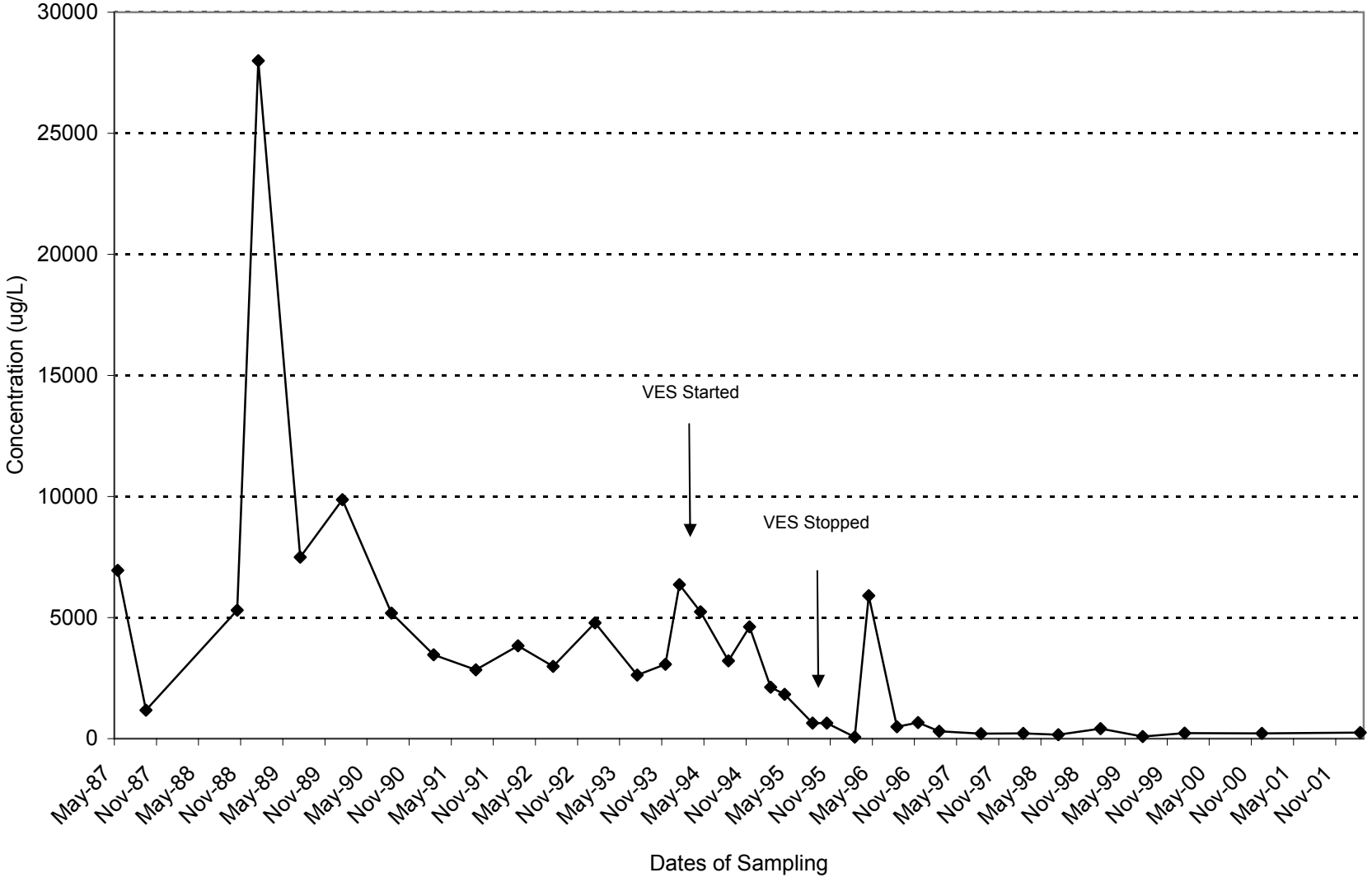

Figure 2: BTEX Concentrations in WDOE-6A from May 1987 to February 2002

Appendices

Appendix A

Studies at Restover Truck Stop
1988 through 2001

Chern, L., 1988. Sampling at the Restover Truck Stop - October 1988. Environmental Investigations Program, Washington State Department of Ecology, Olympia, WA.

Chern, L., 1989. Restover Truck Stop Monitoring Round II - January 1989. Environmental Investigations Program, Washington State Department of Ecology, Olympia, WA.

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Pub. No. 98-327.

Marti, P., 1999. Restover Truck Stop Ground Water Monitoring – January and July 1999. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. Pub. No. 99-336.

Marti, P., 2000. Restover Truck Stop Ground Water Monitoring, Results for January 2000 Sampling. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. Pub. No. 00-03-025.

Marti, P., 2001. Restover Truck Stop Ground Water Monitoring, Results of December 2000 Sampling. Environmental Assessment Program, Washington State Department of Ecology, Olympia, WA. Pub. No. 01-03-011.

Appendix B

Groundwater Sampling

In February 2002, samples for benzene, toluene, ethylbenzene, and xylene (BTEX), as well as total petroleum hydrocarbons as gasoline (TPH-G), were collected from one upper aquifer-monitoring well.

Prior to sampling, the static water level was measured using an electronic water level probe. The probe was rinsed with deionized water and wiped clean after the measurement. Well WDOE-6A was purged and sampled using a decontaminated, bottom-emptying teflon bailer. The well was purged until pH, specific conductance, and temperature readings stabilized, and a minimum of three well volumes had been removed. Purge water for WDOE-6A was returned to the well since the purge water barrel had been removed from the site.

The bailer used to sample WDOE-6A was pre-cleaned with sequential washes of Liquinox®, hot tap water, 10% nitric acid, distilled-deionized water, and pesticide-grade acetone. After cleaning, the bailer was air-dried and wrapped in aluminum foil. Samples for BTEX and TPH-G analysis were collected free of headspace and preserved with 1:1 hydrochloric acid.

Chain-of-custody procedures were followed in accordance with Manchester Laboratory protocol (Ecology, 2000). The Ecology/EPA Environmental Laboratory in Manchester analyzed all samples.

Appendix C

Quality Assurance

The data sheets for the following two case narratives are available in the printed copies of this report, but not in the electronic copies.

Manchester Environmental Laboratory

7411 Beach Dr E, Port Orchard, Washington 98366

Case Narrative

February 22, 2002

Subject: Volatiles Data

Sample(s): 02068032, 02068033, 02068034, 02068035, 02068036

Officer(s): Pam Marti

By: John Weakland

Volatiles Analysis

Analytical Method(s)

These samples were analyzed by SW-846 8260 for volatile organic compounds.

Holding Times

All samples were prepared and analyzed within the method holding times.

Instrument Tuning

Calibration against Bromofluorobenzene (BFB) is acceptable for the initial calibration, continuing calibration and all associated sample analyses.

Calibration

The average relative response factors for target analytes were above the minimum and % Relative Standard Deviations were within the maximum of 20% with notable exceptions. For the February 11 calibration, Dichlorodifluoromethane, Vinyl chloride, Chloroethane, Trichlorofluoromethane, Diethyl ether, Freon 113, 1-1-Dichloroethene, Carbon disulfide, 2,2-Dichloropropane, Tetrahydrofuran, Carbon tetrachloride, and 1,1-Dichloropropene exhibited responses below established QC limits and therefore the associated samples and blank are qualified with the flag UJ. For the February 13 calibration, Dichlorodifluoromethane, 1-1-Dichloroethene, and Tetrahydrofuran exhibited responses below established QC limits and therefore the associated samples and blanks are qualified and flagged with a UJ.

Blanks

Both method blanks ODBW2042 and ODBW2044 contained Acetone. The associated samples contained Acetone at a level less than 10 times the method blank and reported at the PQL and therefore no qualification was necessary. The method blank ODBW2044 contained Toluene.

This is attributed to the water source for the method blank and diluted samples. Consequently, the reporting limit for the diluted samples was raised and the analyte flagged with a UJ.

Surrogates

The surrogate recoveries were reasonable, acceptable, and within established QC limits. with the following exceptions. The percent recovery of the surrogate 1,2-Dichloroethane-$_{d4}$ for sample MW-27 (MEL #02068033) was slightly above established QC limits. The percent recovery of the surrogate Toluene-$_{d8}$ for LCS2042 was slightly above established QC limits. Since all of the other surrogates for the samples were within QC limits, no further action was required.

Matrix Spikes

Aliquots of sample MW-16A (MEL # 02068034) were analyzed as matrix spikes. The Percent Recovery and Relative Percent Difference precision data are reasonable, acceptable, and within established QC limits with following notable exceptions. For the February 11 analytical run, the percent recoveries of Acetone, Carbon disulfide, 2-Butanone, 4-Methyl-2-Pentanone, and 2-Hexanone were below established QC limits. For the February 13 analytical run, the percent recovery of Tetrachloroethene was slightly above established QC limits. Since the percent recoveries of all of these analytes were acceptable for the respective LCSs no qualification of the data was required.

Laboratory Control Samples

The percent recovery of Dichlorodifluoromethane for LCS2042 and LCS 2044 was below established QC limits. All other recovery data are reasonable, acceptable, and within established QC limits.

Comments

Data Qualifier Codes

U	-	The analyte was not detected at or above the reported result.
J	-	The analyte was positively identified. The associated numerical result is an estimate.
UJ	-	The analyte was not detected at or above the reported estimated result.
REJ	-	The data are unusable for all purposes.
NAF	-	Not analyzed for.
N	-	For organic analytes there is evidence the analyte is present in this sample.
NJ	-	There is evidence that the analyte is present. The associated numerical result is an estimate.
NC	-	Not calculated
E	-	The concentration exceeds the known calibration range.
bold	-	The analyte was present in the sample. (Visual Aid to locate detected compounds on report sheet.)

Manchester Environmental Laboratory

7411 Beach Dr E, Port Orchard Washington 98366

Case Narrative

February 8, 2001

Subject: Restover Truck Stop Project

Sample(s): 02068030-31

Officer(s): Pam Marti

By: Bob Carrell
Organics Analysis Unit

NWTPH-Gx ANALYSIS

Analytical Methods

A 0.25mL aliquot of each water sample was purged, the analytes were trapped then desorbed and analyzed by capillary gas chromatography using flame ionization detection (GC/FID) following Manchester Laboratory's standard operating procedure for the determination of NWTPH-Gx in water.

Holding Times

All samples were analyzed within the method holding times.

Blanks

No petroleum products were detected in the laboratory method blank at or above the practical quantitation limit, hence demonstrating that the system was free from contamination.

Surrogates

The 1,4-dibromo-2-methylbenzene and 1,4-difluorobenzene surrogate recoveries were acceptable.

Results and Comments

The data is useable as qualified.

Data Qualifier Codes

U	-	The analyte was not detected at or above the reported result.
J	-	The analyte was positively identified. The associated numerical result is an estimate.
UJ	-	The analyte was not detected at or above the reported estimated result.
REJ	-	The data are unusable for all purposes.
NAF	-	Not analyzed for.
N	-	For organic analytes there is evidence the analyte is present in this sample.
NJ	-	There is evidence that the analyte is present. The associated numerical result is an estimate.
NC	-	Not Calculated
E	-	This qualifier is used when the concentration of the associated value exceeds the known calibration range.