SEMI-ANNUAL GROUNDWATER MONITORING REPORT

September 2011

Environmental Waste Solutions Camden Class II Landfill
TDSWM Permit Number IDL 03-0212
Camden, Tennessee

Prepared for:
House Engineering, LLC.
7308 River Park Drive
Nashville, Tennessee 37221

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JAN 18 2012
JACKSON E.A.C

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Prepared for:
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7308 River Park Drive
Nashville, Tennessee 37221

Prepared by:
Civil & Environmental Consultants, Inc.
405 Duke Drive, Suite 270
Franklin, Tennessee 37067
CEC Project No. 101-301
December 12, 2011

TENNESSEE
MICHAEL JOHNSON
#4776
LICENSED PROFESSIONAL GEOLOGIST

Michael Johnson, P.G.
Project Manager

Greg Kugler
Vice President

EXECUTIVE SUMMARY:

This report documents the second semi-annual monitoring event of 2011 for the Environmental Waste Solutions, LLC (EWS) Class II Landfill which is registered with the Tennessee Division of Solid Waste Management (TDSWM) permit number IDL 03-0212. The EWS Camden Class II Landfill is located in Benton County at 200 Omar Circle, Camden, Tennessee (latitude 36°03'16" N/ longitude 88°05'16" W). The groundwater monitoring event was performed on September 14, 2011.

Representative groundwater samples were collected from monitor wells MW-1 and MW-3. MW-2 was not sampled because the well went dry upon purging and the recharge volume was insufficient to collect a sample. The groundwater samples were analyzed for Appendix I inorganics and a short list of ions.

Upon request from TDSWM, a second attempt was made to collect a sample from MW-2 on November 10, 2011. Mr. Michael David of TDWSM (Jackson Field Office) accompanied CEC on site to observe sampling procedures and potentially collect a duplicate set of samples for internal purposes. Upon purging the initial well volume, MW-2 again went dry and did not readily recharge. Field personnel, with the concurrence of TDSWM, decided to reconvene at the well later in the day to check again for recharge and potentially collect a sample. Upon returning to the well at the specified time, it was determined that approximately 4 inches of water had recharged into the well, which is not sufficient volume to collect a complete set of samples for analysis, however, the available recharge water was transferred to laboratory supplied bottles and partial analysis including Chloride, Nitrate, Sulfate and Fecal Coliform were performed by the laboratory. The TDSWM did not collect a duplicate sample for analysis due to insufficient volume.

Laboratory analytical results for the groundwater samples collected from the facility monitor wells for the Class II Landfill indicated that no Appendix I listed constituents were detected above their respective maximum contaminant level (MCL), with the exception of one inorganic compound (Arsenic). Arsenic was detected in MW-1 at a concentration of (0.091 mg/l). The MCL for Arsenic is (0.01 mg/l). Concentrations of Arsenic observed in monitor well MW-1 have historically been above the MCL and are likely naturally occurring since there is no immediate development up-gradient of the well.

Review of the statistical analysis performed on the available data indicated that there were six statistically significant increases (SSI's) over background data. The SSI's over background data included Arsenic (MW-1), Aluminum (MW-1), Mercury (MW-1), Vanadium (MW-1), and Chloride (MW-1, MW-2 and MW-3). The SSI's in MW-1 are not indicative of groundwater contamination associated with facility operations, however, due to its location as the up-gradient monitoring point.

Trend analysis utilizing the limited data available from the monitoring events showed slightly increasing concentrations of Arsenic in MW-1 and Chloride in MW-2. No other distinct trends are observed in the analysis.

As previously reported, the increasing trend in Chloride within MW-2 would ostensibly indicate the possibility of leachate migration through the composite liner system in the waste cell situated directly up-gradient of MW-2. However, the increasing trend of Chloride within MW-2 was somewhat surprising due to the age of the landfill and the installation of a double composite liner system at the base of the landfill. Therefore, a further evaluation was performed to determine if other factors could be influencing the concentration of Chloride in MW-2.

Based upon the results of the evaluation the impacts of Chloride and Aluminum in MW-2 could possibly be more attributable to the recent problems with overflows from the Camden sanitary sewer system rather than impacts from leachate migration. To further evaluate potential impacts to MW-2 from the Camden sanitary sewer system, a fecal coliform sample was collected and analyzed from MW-2 during the November 10, 2011 sample event. The reported result of 99 Colony Forming Units (CFU)/100ml further indicates potential impacts to groundwater in the vicinity of MW-2 from the Camden Sanitary Sewer System. According to information obtained from The USEPA National Primary Drinking Water Regulations, the presence of Fecal Coliforms is an indicator that the water may be contaminated with human or animal wastes.

The next semi-annual monitoring event is tentatively scheduled for January, 2012.

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Appendices

I Introduction

A. Site Location

EWS, LLC. manages the Camden Class II landfill located just off highway US 70 at 200 Omar Circle, Camden, Tennessee. The site can be located on the Camden, Tennessee USGS quadrangle at north latitude 36° 3' 16" and west longitude 88° 05' 16" at an average elevation of 400 feet above mean sea level datum (MSL). The location of the facility is indicated in **Figure 1 - Site Vicinity Map, Appendix A.** The landfill footprint can be viewed in **Figure 2 - Site Map, Appendix A.**

B. Current Activities

The EWS Camden Class II Landfill currently receives secondary aluminum smelter waste for disposal including aluminum dross and salt cakes.

The original Class IV Landfill Permit issued to the site was canceled by the EWS prior to acceptance of waste.

II Aquifer Characteristics

A. Geologic and Aquifer Characteristics

The extensive reworking of the site as a result of the excavation of chert for local road and fill projects has significantly impacted the original site geology. However, the large cuts within the site boundaries have exposed the underlying geologic formations. Based upon a review of the Tennessee Division of Geology (TDOG) Geologic Map and site observations it appears that the site is within the Camden and Harriman Formations. It is reported by the TDOG that the Camden and Harriman Formations are lithologically identical, and not enough fossils are present to form a convenient basis for subdivision.

Camden and Harriman Formations

The Camden and Harriman Formations are described as follows:
Chert, gray with specks and mottlings of very light-gray and yellowish-gray (surfaces stained pale to dark yellowish-orange), bedded and blocky (beds 2 to 8 inches thick), dense, conchoidal fracture, contains pods of white to light gray tripolitic clay, locally stained yellow and brown, fossiliferous. Locally, especially near the top, fragments of chert are cemented into large masses and beds of breccia by dark-brown to moderate-red limonite.

Groundwater potentiometric data collected from the uppermost water bearing zone across the entire proposed waste area footprint during the 1999 and 2006 hydrogeological investigations indicate that the uppermost aquifer is sloped to the southwest. Comparisons of the water bearing zone elevations to static groundwater elevations for both indicate an unconfined aquifer.

B. Monitor Well Integrity & Static Water Levels

The groundwater monitoring network for the Class II Landfill consists of monitor wells MW-1, MW-2, and MW-3. Monitor well MW-1 serves as an up-gradient monitoring point while monitor wells MW-2 and MW-3 serve as down-gradient monitoring points.

The integrity of each monitor well is checked during each sampling event prior to groundwater collection. The physical condition of each wellhead is observed and noted along with the condition and ability of any and all locking mechanisms for each monitor well. Once the watertight seal is removed from the top of each monitor well's casing, the well is allowed to de-pressurize. A decontaminated electronic probe is slowly lowered into the monitor well to establish the distance between the established top of casing and the elevation of free groundwater. The distance is then re-checked to ensure that the measurement is of actual static water level and the groundwater is not rising or falling in the monitor well. The electronic probe is capable of determining this distance to within one, one-hundredth of one foot (0.01 foot). This distance is written in the site-specific field book as depth-to-water. Upon collection of this data, the electronic water level probe is removed from the monitor well and decontaminated from contact with the well casing / screen and groundwater.

The following equation is used to determine the elevation of groundwater at each well:

Established Top of Casing Elevation – Depth to Water = Groundwater Elevation

Top of casing elevation has been determined by a licensed land surveyor and is referenced to Mean Sea Level Datum of the World Geodetic Survey of 1984. Groundwater elevations are listed in **Table 1 - Field Parameters & Potentiometric Data, Appendix A.**

C. Groundwater Flow Direction

Groundwater flow at the landfill appears to flow in a southwesterly direction towards Charlie Creek. Groundwater flow in the vicinity of the

Class II Landfill appears to flow from a topographic high north, northeast of the landfill toward the southwest where monitor wells MW-2 and MW-3 are positioned to intercept any possible groundwater contaminants leaching from the landfill.

D. Potentiometric Gradient

The Potentiometric surface of the first aquifer occurring beneath the Class II Landfill occurs at approximately twenty-two (24) feet below ground surface at the up-gradient monitor well MW-1 to approximately seven (10) feet below ground surface at monitor well MW-2. The groundwater potentiometric data interpreted from the 1999 and 2006 hydrogeolgical investigations conducted at the site for the uppermost aquifer indicate that the uppermost water bearing zone is sloped to the southwest. Comparisons of water bearing zone elevations to static groundwater elevations for both investigations indicate an unconfined aquifer. The potentiometric gradient calculated from groundwater elevation data collected on September 14, 2011 is approximately 2.2% slope.

The potentiometric gradient is calculated according to the following formula:

$$\frac{\text{Highest GW. Elev.} - \text{Lowest GW. Elev.}}{\text{Horizontal Distance Between the Potentiometric Contours}} * 100 = \text{Pot. Grad.}$$

$$\frac{(391.45\text{' at MW-1}) - (369.75\text{' at MW-2})}{1{,}000\text{'}} * 100 = 2.2\%$$

The above calculation assumes a perpendicular gradient between the potentiometric contours drawn between MW-1 to MW-2. These assumptions may provide an artificially higher potentiometric gradient than is likely occurring at the site.

E. Hydraulic Conductivity

Hydraulic conductivity estimations within the first aquifer occurring beneath either landfill have not been determined at this time.

III Groundwater Sampling Procedures

A. Instrumentation

Depth to groundwater measurements are collected using a Solinst® electronic water level indicator, model # 122. A YSI 556 Multi-parameter probe is used to record pH, specific conductance, temperature, dissolved oxygen and ORP during groundwater sampling events at the landfill. A LaMotte model 2020 turbidity meter or equivalent is used to collect turbidity readings. Each instrument is either checked against known standards or calibrated as per manufacturers' specifications prior to the commencement of sampling activities.

B. Purging and Collection of Field Parameter Values

The total volume of groundwater residing in each monitor well is calculated by subtracting the depth to water from the total depth of each well. This linear distance is next multiplied by 0.163 gallons per foot in a 2 inch (I.D.) monitor well. For purging, a disposable polyethylene bailer with sufficient nylon twine is slowly lowered into the water column. The bailer is allowed to completely submerse into the water column prior to extracting the bailer from the monitor well. The first bailer of purged groundwater is collected in a clean, high-density polyethylene (HDPE) reservoir where it is observed for Temperature, pH, specific conductance, dissolved oxygen, oxidation-reduction potential (ORP) and turbidity. These values are noted in the site specific field book as V_0 and then the collected groundwater is discarded onto the ground, away from the monitor well. Groundwater shall be purged using either a decontaminated down-well pump using new tubing or using new tubing connected to a peristaltic pump or in the case of a pump malfunction, a new disposable bailer.

Presently, bailers are not used at the EWS Camden Class II Landfill. However, if bailers are used due to pump malfunction, bailers shall be constructed of either polyethylene or Teflon. Bailers shall be factory decontaminated and sealed as to allow no environmental contaminants to interact with the bailer. New nylon twine shall be fixed to each bailer via a tied knot.

The collected groundwater will be decanted into a flow-through cell where it will be observed for pH, specific conductance, temperature, and turbidity. These values will be noted in the site specific field book as V_0 and then the collected groundwater will be poured onto the ground, down-gradient from the monitor well.

Groundwater shall be purged from the monitor well for a specific period of time that allows for a new volume of water to have passed into the flow-through cell. Once this volume of water has been purged, the field chemistry parameters will again be observed and recorded in the field book as V_1. This procedure for purging groundwater continues for an additional well volume, if sufficient groundwater is available. After the second purged well volume has been observed for field parameter values, the values are checked against values for V_1. If the pH and specific conductance values for each volume purged vary no more than 10% from V_1 to V_2 and the temperature has stabilized to within one degree Celsius, preparations are made to collect a groundwater sample for submittal to an analytical laboratory. If the field parameters have not stabilized, the purging procedure shall continue until either one of the following conditions are met:

1. Field stabilization occurs,
2. Well is purged dry, or
3. Five well volumes have been purged.

If the monitor well is purged dry, then the recharging groundwater shall be collected within twenty-four hours.

Field parameter values are presented in **Table 1 – Groundwater Field Data, Appendix A.** A detailed account of each purge and sample procedure conducted at each monitor well is presented in **Appendix B.**

C. Sample Collection & Preservation

Groundwater samples are collected from monitor wells once field parameter data indicates that stagnant water has been purged from the well. Groundwater is placed in laboratory supplied sample vessels in the following order if analyzed: Appendix I volatile organic constituents (VOCs) (Method V8260) – two (2), forty (40) milliliter (ml) amber glass vials with screw caps and Teflon septa preserved with hydrochloric (HCl) acid; Appendix I volatiles (Method SV8011) – two (2), forty (40) ml clear glass vials preserved with sodium thiosulfate (NaThio); Appendix I inorganics – one (1), five-hundred (500) ml HDPE jar preserved with nitric (HNO3) acid. Groundwater samples are collected in decreasing order of susceptibility to volatilization. All groundwater samples placed in VOC vials are sealed with no air-space or trapped air bubbles.

D. Quality Assurance & Quality Control

Civil and Environmental Consultants, Inc. (CEC) procured a sealed VOC trip blank along with the laboratory prepared groundwater sample vessels from Environmental Science Corporation (ESC) prior to commencement of field sampling activities. The sample 'kit' was inspected to ensure that all requested sample vessels were present and accounted for prior to transport to site.

The sealed VOC trip blank was present during the collection of each and every groundwater sample collected from the monitor wells and springs at the landfill. Each sample was placed on ice in a laboratory supplied cooler immediately after collection. Upon the collection of the final groundwater sample, the trip blank was placed on ice in the sample cooler. The sample coolers were delivered to ESC on September 15, 2011.

A field blank and equipment blank were collected in the vicinity of the operating Class II Landfill next to monitoring well MW-1. The field blank was collected by pouring deionized water, created in the CEC office by a series of ion exchange cartridges, into a duplicate set of sample bottles. Thereby, allowing any airborne contaminants a chance to enter the field blank sample. An equipment blank was also collected during the monitoring event from the decontaminated Grundfos pump after use on MW-1.

E. Sample Chain-of-Custody

A sample Chain-of-Custody (COC) traveled along with each sample kit from ESC to EWS and finally back to ESC for the sampling events. The CEC SOP for Chain of Custody 07-01-01 may be found in **Appendix F**.

IV Laboratory Analytical Procedures

A. Analytical Methods

All laboratory analyses for the September and November 2011 monitoring events were completed by Environmental Science Corporation in Mt. Juliet, Tennessee. The analytical methods chosen for this monitoring event are the most appropriate procedures as directed by the Tennessee Division of Solid Waste Management (TN-DSWM) and the United States Environmental Protection Agency's publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (3rd Edition)*.

The SW-846 methods used for the analysis of groundwater were as follows:

Method 6010b	Inductively Coupled Plasma (ICP) – Atomic Emission Spectrometry
Method 6020	ICP – Mass Spectrometry
Method 7470A	Mercury in Liquid Waste – Manual Cold Vapor Technique
Method 8011	1,2-dibromoethane & 1,2 dibromo-3-chloropropane by Micro-extraction and Gas Chromatography
Method 8260B	Volatile Organic Compounds by Gas Chromatograph / Mass Spectrometry
Method 9056	Determination of Inorganic Anions by Ion Chromatography (Fluoride)
Method 9222D	Fecal Coliform Membrane Filter Procedure

B. Analytical Results

Laboratory reports from the analysis of groundwater samples collected from the EWS Camden Class II Landfill during the September and November monitoring events were prepared by ESC and reported to CEC on September 27 and November 16, 2011. Copies of the laboratory reports are located in **Appendix C – Laboratory Analytical Reports**. Constituent values from all laboratory analysis along with applicable maximum contaminant levels (MCLs) are presented in **Table 2 – Analytical Results, Appendix A**.

C. Quality Control Qualifier Codes

The EPA Contract Laboratory Program states that sample and result qualifiers should be utilized as part of a total quality control process. ESC complies with this directive and reports all qualifiers along with explanations of QC qualifier codes. One QC qualifier code was indicated during the laboratory analysis of groundwater samples during this monitoring event and can be viewed along with the **Laboratory Analytical Reports, Appendix C**.

V Statistical Analysis

A. Applicable Methods

The Rules of Tennessee Department of Environment and Conservation, Division of Solid Waste Management Chapter 1200-1-7-.04 states, in part, that each landfill must conduct and report statistical analysis as part of the evaluation of groundwater monitoring data. Several methods may be employed for this endeavor. EWS Camden Class II Landfill has chosen to use Inter and intra-well non-parametric prediction limit analysis (NPPL) at this time.

Additional statistical analyses were employed during this monitoring event. First, the distribution of the data was evaluated for normality. For all wells, the data was not normally distributed; therefore, non-parametric statistical methods were chosen. Inter and intra-well non-parametric prediction limit analyses (NPPL) were deemed appropriate for this data set. Inter-well analyses compared the concentrations observed at the down-gradient monitoring locations to the concentrations observed at the up-gradient monitoring location during this monitoring event. For the Class II Landfill, monitor well MW-1 was considered as background. Intra-well analysis was also utilized at MW-1 to compare the concentrations observed during the September 2011 groundwater sampling event to the established background data set.

The percentage of inter-well background non-detects for each parameter determines the primary statistical method utilized for each parameter. If the percentage of non-detects in the background samples is less than 50%, Shewart-CUSUM control charts are utilized. If more than 50% background non-detects exist for the given parameter, non-parametric inter-well prediction limit analysis is conducted on the data.

The computer program ChemStat was used for all statistical computations. Worksheets indicating inter-well and intra-well statistical analysis sheets and time versus concentration charts may be viewed in **Appendix D, Statistical and Trend Analysis.**

B. Results

Review of the statistical analysis performed on the available data indicated that there were six statistically significant increases (SSI's) over background data. The SSI's over background data included Arsenic (MW-1), Aluminum (MW-1), Mercury (MW-1), Vanadium (MW-1), and Chloride (MW-1, MW-2 and MW-3). The SSI's identified in MW-1 are not indicative of groundwater contamination associated with facility operations, however, due to its location as the up-gradient monitoring point.

Trend analysis utilizing the limited data available from the monitoring events showed slightly increasing concentrations of Arsenic in MW-1 and Chloride in MW-2. No other distinct trends are observed in the analysis.

VI Conclusions and Recommendations

Representative groundwater samples were collected from monitor wells MW-1 and MW-3 on September 14, 2011. MW-2 was not sampled because the well went dry upon purging and the recharge volume was insufficient to collect a sample. The groundwater samples were analyzed for Appendix I inorganics and a short list of ions.

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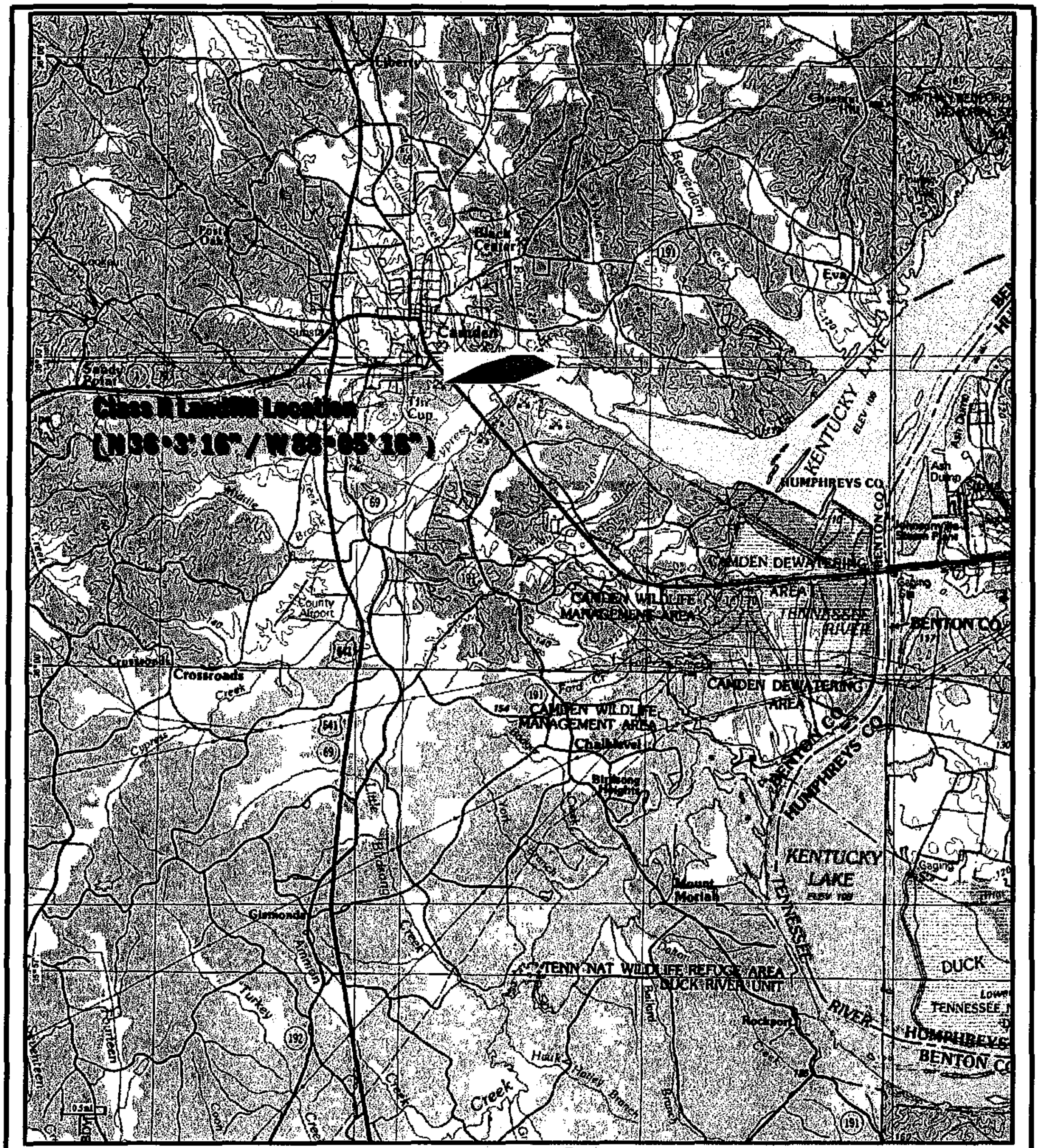
Based upon the results of the evaluation the impacts of Chloride and Aluminum in MW-2 could possibly be more attributable to the recent problems with overflows from the Camden sanitary sewer system rather than impacts from leachate migration. To further evaluate potential impacts to MW-2 from the Camden sanitary sewer system, a fecal coliform sample was collected and analyzed from MW-2 during the November 10, 2011 sample event. The reported result of 99 Colony Forming Units (CFU)/100ml further indicates potential impacts to groundwater in the vicinity of MW-2 from the Camden Sanitary Sewer System. According to information obtained from The USEPA National Primary Drinking Water Regulations, the presence of Fecal Coliforms is an indicator that the water may be contaminated with human or animal wastes.

The next semi-annual monitoring event is tentatively scheduled for January, 2012.

Appendix A
Maps & Tables



Source: USGS Camden Quadrangle

NORTH

FIGURE 1: SITE LOCATION MAP

CEC PROJECT 101-301	DATE 7/16/10	**Civil & Environmental Consultants, Inc.**
	DWN. BY: JKH	405 Duke Drive, Suite 270 Franklin, TN 37067
SHEET 1 OF 1	CHKD. BY: MKH	(615) 333-7797 (800) 763- Pittsburgh, PA Cincinnati, OH Columbus, Indianapolis, IN Chicago, IL Export, PA St. Louis, MO, Detroit, MI
	SCALE: Not To Scale	

Table 1
Environmental Waste Solutions Camden Class II Landfill IDL 03-0212
Groundwater Field Data

Boring/Monitoring Well/ Piezometric Well	Date	Sample Time	Top of Casing Elevation Feet MSL	Purge Method	Bottom of Well Elevation Feet	Well Diameter Feet	Well Volume Gallons	Depth to Water Feet MSL	Potentiometric Surface	Temperature Degrees C	Specific Conductance micromhos/cm	pH SU	Dissolved Oxygen mg/l	Oxidation Reduction Potential Millivolts	Turbidity NTU
B11/MW-1	9/14/2011	12:30	415.363	Grundfos	382.263	0.17	1.6	23.91	391.45	16.49	255	5.47	1.07	35.2	498
B12/MW-2	9/14/2011	NS	380.146	Peristaltic	367.696	0.17	0.3	10.40	369.75	22.84	769	5.68	1.69	152.5	65.8
B13/MW-3	9/14/2011	12:00	392.49	Peristaltic	369.66	0.17	0.4	20.71	371.78	19.72	213	4.94	3.88	252.9	>1000

Appendix B
Field Reports

9/14/11 Sunny 85° EWS CAMDEN, TN
M. JOHNSON CEC

9:20 Arrive on site, check in. Obtain well keys from FRONT DESK.

9:15 SET UP AT MW-2
TD = 12.40 FROM TOC DTW = 10.40 WC = 2.0
V = 0.33 gal

V0	T	Cond	DO	pH	Orp	Turb
0	22.84	769	1.69	5.68	152.5	65.8

9:35 DRY @ 0.3 gals
13:15 Return to check water level - no recharge

9:50 SET UP AT MW-3
TD = 27.0' DTW = 20.71 WC = 6.29 V = 1.0g

V	T	COND	DO	pH	Orp	Turb
0	20.51	216	4.80	5.20	207.9	175
1	19.22	213	3.88	4.94	252.9	>1000

Dry @ 1.25 gal
12:00 Collect MW-3 TURB >1000

10 30 SET UP AT MW-1
TD = 30.50 DTW = 23.91 WC = 6.59 V = 1.1 gal

V	T	Cond	DO	pH	Orp	turb
0	17.48	184	1.46	5.46	45.3	189
1	16.61	271	1.36	5.46	29.0	>1000
2	16.50	254	1.04	5.47	34.2	>1000
3	16.49	255	1.07	5.47	35.2	>1000

12:30 Collect MW-1 & Duplicate Final Turb = 478

11/10/11
9:10 M. Johnson CEC, M. David TDEC on site
MW-2 DTW 10.05 TD = 12.40 WC = 2.35
V = 0.38g

V	T	Cond	DO	pH	Orp	turb
0	17.43	0.362	4.52	6.64	124.5	>1000

9:30 Well MW-2 Dry @ ~1 volume
Discuss time schedule to reconvene on site to attempt sample collection if water recharge is sufficient. Time decided upon is 2:00pm

1:45 Return to site
1:50 M. David on site
1:55 Attempt to collect Sample from MW-2
Will collect Cl, NO_3 & SO_4 First then fecal Coliform, then metals if enough volu

2:00 Collected 125ml (Cl, NO_3 & SO_4)
~50ml fecal Coliform
Well Dry again Place Sample collected on ice & dissassemble equipment, Lock wel
& depart site ~ 2:30

Appendix C
Laboratory Analytical Reports

ESC
L·A·B S·C·I·E·N·C·E·S
YOUR LAB OF CHOICE

12065 Lebanon Rd.
Mt. Juliet, TN 37122
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1-800-767-5859
Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

Mr. Michael Johnson
Civil & Environmental Consultants - TN
405 Duke Drive, Suite 270
Franklin, TN 37067

Report Summary

Tuesday September 27, 2011

Report Number: L536312
Samples Received: 09/15/11
Client Project: 101-301

Description: EWS - Camden

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Alan Harvill

T. Alan Harvill , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704, ND - R-140
NJ - TN002,NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032008A,
TX - T104704245, OK-9915, PA - 68-02979

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.
Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

Where applicable, sampling conducted by ESC is performed per guidance provided in laboratory standard operating procedures: 060302, 060303, and 060304.

ESC
L·A·B S·C·I·E·N·C·E·S
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Tax I.D. 62-0814289

Est. 1970

REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-01

Date Received : September 15, 2011
Description : EWS - Camden

Site ID :

Sample ID : MW-1

Project # : 101-301

Collected By : M. Johnson
Collection Date : 09/14/11 12:30

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	3.1	1.0	mg/l	9056	09/16/11	1
Nitrate	BDL	0.10	mg/l	9056	09/16/11	1
Sulfate	6.6	5.0	mg/l	9056	09/16/11	1
Ammonia Nitrogen	0.17	0.10	mg/l	350.1	09/26/11	1
Antimony	BDL	0.0010	mg/l	6020	09/16/11	1
Antimony,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Arsenic	0.091	0.0010	mg/l	6020	09/16/11	1
Arsenic,Dissolved	0.0042	0.0010	mg/l	6020	09/25/11	1
Barium,Dissolved	0.014	0.0050	mg/l	6020	09/25/11	1
Beryllium	BDL	0.0010	mg/l	6020	09/16/11	1
Beryllium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Cadmium	BDL	0.00050	mg/l	6020	09/16/11	1
Cadmium,Dissolved	BDL	0.00050	mg/l	6020	09/25/11	1
Copper	0.0077	0.0020	mg/l	6020	09/16/11	1
Copper,Dissolved	BDL	0.020	mg/l	6020	09/25/11	1
Lead	0.0038	0.0010	mg/l	6020	09/16/11	1
Lead,Dissolved	0.0012	0.0010	mg/l	6020	09/25/11	1
Selenium	BDL	0.0010	mg/l	6020	09/16/11	1
Selenium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Thallium	BDL	0.0010	mg/l	6020	09/16/11	1
Thallium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Zinc	0.022	0.010	mg/l	6020	09/16/11	1
Zinc,Dissolved	0.014	0.010	mg/l	6020	09/25/11	1
Mercury	0.00073	0.00020	mg/l	7470A	09/16/11	1
Mercury,Dissolved	BDL	0.00020	mg/l	7470A	09/23/11	1
Aluminum	11.	0.10	mg/l	6010B	09/26/11	1
Aluminum,Dissolved	BDL	0.10	mg/l	6010B	09/23/11	1
Barium	0.074	0.0050	mg/l	6010B	09/26/11	1
Boron	BDL	0.20	mg/l	6010B	09/26/11	1
Boron,Dissolved	BDL	0.20	mg/l	6010B	09/23/11	1
Calcium	4.0	0.50	mg/l	6010B	09/26/11	1
Calcium,Dissolved	3.7	0.50	mg/l	6010B	09/23/11	1
Chromium	0.022	0.010	mg/l	6010B	09/26/11	1
Chromium,Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1
Cobalt	0.029	0.010	mg/l	6010B	09/26/11	1
Cobalt,Dissolved	0.025	0.010	mg/l	6010B	09/23/11	1
Iron	28.	0.10	mg/l	6010B	09/26/11	1
Iron,Dissolved	3.7	0.10	mg/l	6010B	09/23/11	1
Magnesium	3.5	0.10	mg/l	6010B	09/26/11	1
Magnesium,Dissolved	2.9	0.10	mg/l	6010B	09/23/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

Date Received : September 15, 2011
Description : EWS - Camden

Sample ID : MW-1

Collected By : M. Johnson
Collection Date : 09/14/11 12:30

ESC Sample # : L536312-01

Site ID :

Project # : 101-301

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Manganese	0.76	0.010	mg/l	6010B	09/26/11	1
Manganese, Dissolved	0.74	0.010	mg/l	6010B	09/23/11	1
Nickel	BDL	0.020	mg/l	6010B	09/26/11	1
Nickel, Dissolved	BDL	0.020	mg/l	6010B	09/23/11	1
Potassium	2.8	0.50	mg/l	6010B	09/26/11	1
Potassium, Dissolved	1.2	0.50	mg/l	6010B	09/23/11	1
Silver	BDL	0.010	mg/l	6010B	09/26/11	1
Silver, Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1
Sodium	3.2	0.50	mg/l	6010B	09/26/11	1
Sodium, Dissolved	3.2	0.50	mg/l	6010B	09/23/11	1
Vanadium	0.028	0.010	mg/l	6010B	09/26/11	1
Vanadium, Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-02

Date Received : September 15, 2011
Description : EWS - Camden

Site ID :

Sample ID : MW-3

Project # : 101-301

Collected By : M. Johnson
Collection Date : 09/14/11 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	15.	1.0	mg/l	9056	09/16/11	1
Nitrate	BDL	0.10	mg/l	9056	09/16/11	1
Sulfate	7.3	5.0	mg/l	9056	09/16/11	1
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	09/26/11	1
Antimony	BDL	0.0010	mg/l	6020	09/16/11	1
Antimony,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Arsenic	0.0028	0.0010	mg/l	6020	09/16/11	1
Arsenic,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Barium,Dissolved	0.034	0.0050	mg/l	6020	09/25/11	1
Beryllium	BDL	0.0010	mg/l	6020	09/16/11	1
Beryllium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Cadmium	BDL	0.00050	mg/l	6020	09/16/11	1
Cadmium,Dissolved	0.00050	0.00050	mg/l	6020	09/25/11	1
Copper	0.011	0.0020	mg/l	6020	09/16/11	1
Copper,Dissolved	BDL	0.020	mg/l	6020	09/25/11	1
Lead	0.0072	0.0010	mg/l	6020	09/16/11	1
Lead,Dissolved	0.0013	0.0010	mg/l	6020	09/25/11	1
Selenium	BDL	0.0010	mg/l	6020	09/16/11	1
Selenium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Thallium	BDL	0.0010	mg/l	6020	09/16/11	1
Thallium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Zinc	0.024	0.010	mg/l	6020	09/16/11	1
Zinc,Dissolved	0.014	0.010	mg/l	6020	09/25/11	1
Mercury	BDL	0.00020	mg/l	7470A	09/16/11	1
Mercury,Dissolved	BDL	0.00020	mg/l	7470A	09/23/11	1
Aluminum	17.	0.10	mg/l	6010B	09/26/11	1
Aluminum,Dissolved	BDL	0.10	mg/l	6010B	09/23/11	1
Barium	0.15	0.0050	mg/l	6010B	09/26/11	1
Boron	BDL	0.20	mg/l	6010B	09/26/11	1
Boron,Dissolved	BDL	0.20	mg/l	6010B	09/23/11	1
Calcium	8.3	0.50	mg/l	6010B	09/26/11	1
Calcium,Dissolved	7.5	0.50	mg/l	6010B	09/23/11	1
Chromium	0.018	0.010	mg/l	6010B	09/26/11	1
Chromium,Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1
Cobalt	BDL	0.010	mg/l	6010B	09/26/11	1
Cobalt,Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1
Iron	7.4	0.10	mg/l	6010B	09/26/11	1
Iron,Dissolved	BDL	0.10	mg/l	6010B	09/23/11	1
Magnesium	3.5	0.10	mg/l	6010B	09/26/11	1
Magnesium,Dissolved	2.7	0.10	mg/l	6010B	09/23/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-02

Site ID :

Project # : 101-301

Date Received : September 15, 2011
Description : EWS - Camden

Sample ID : MW-3

Collected By : M. Johnson
Collection Date : 09/14/11 12:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Manganese	0.056	0.010	mg/l	6010B	09/26/11	1
Manganese,Dissolved	0.022	0.010	mg/l	6010B	09/23/11	1
Nickel	BDL	0.020	mg/l	6010B	09/26/11	1
Nickel,Dissolved	BDL	0.020	mg/l	6010B	09/23/11	1
Potassium	4.5	0.50	mg/l	6010B	09/26/11	1
Potassium,Dissolved	1.8	0.50	mg/l	6010B	09/23/11	1
Silver	BDL	0.010	mg/l	6010B	09/26/11	1
Silver,Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1
Sodium	5.4	0.50	mg/l	6010B	09/26/11	1
Sodium,Dissolved	5.3	0.50	mg/l	6010B	09/23/11	1
Vanadium	0.029	0.010	mg/l	6010B	09/26/11	1
Vanadium,Dissolved	BDL	0.010	mg/l	6010B	09/23/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-03

Date Received : September 15, 2011
Description : EWS - Camden

Site ID :

Sample ID : DUPLICATE

Project # : 101-301

Collected By : M. Johnson
Collection Date : 09/14/11 00:00

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	3.1	1.0	mg/l	9056	09/16/11	1
Nitrate	BDL	0.10	mg/l	9056	09/16/11	1
Sulfate	6.3	5.0	mg/l	9056	09/16/11	1
Ammonia Nitrogen	0.18	0.10	mg/l	350.1	09/26/11	1
Antimony	BDL	0.0010	mg/l	6020	09/16/11	1
Antimony,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Arsenic	0.11	0.0010	mg/l	6020	09/16/11	1
Arsenic,Dissolved	0.0058	0.0010	mg/l	6020	09/25/11	1
Barium,Dissolved	0.017	0.0050	mg/l	6020	09/25/11	1
Beryllium	BDL	0.0010	mg/l	6020	09/16/11	1
Beryllium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Cadmium	BDL	0.00050	mg/l	6020	09/16/11	1
Cadmium,Dissolved	0.00057	0.00050	mg/l	6020	09/25/11	1
Copper	0.0091	0.0020	mg/l	6020	09/16/11	1
Copper,Dissolved	BDL	0.020	mg/l	6020	09/25/11	1
Lead	0.0047	0.0010	mg/l	6020	09/16/11	1
Lead,Dissolved	0.0014	0.0010	mg/l	6020	09/25/11	1
Selenium	BDL	0.0010	mg/l	6020	09/16/11	1
Selenium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Thallium	BDL	0.0010	mg/l	6020	09/16/11	1
Thallium,Dissolved	BDL	0.0010	mg/l	6020	09/25/11	1
Zinc	0.025	0.010	mg/l	6020	09/16/11	1
Zinc,Dissolved	0.012	0.010	mg/l	6020	09/25/11	1
Mercury	0.00071	0.00020	mg/l	7470A	09/16/11	1
Mercury,Dissolved	BDL	0.00020	mg/l	7470A	09/23/11	1
Aluminum	8.6	0.10	mg/l	6010B	09/17/11	1
Aluminum,Dissolved	BDL	0.10	mg/l	6010B	09/24/11	1
Barium	0.059	0.0050	mg/l	6010B	09/17/11	1
Boron	BDL	0.20	mg/l	6010B	09/17/11	1
Boron,Dissolved	BDL	0.20	mg/l	6010B	09/24/11	1
Calcium	3.8	0.50	mg/l	6010B	09/17/11	1
Calcium,Dissolved	3.7	0.50	mg/l	6010B	09/24/11	1
Chromium	0.016	0.010	mg/l	6010B	09/17/11	1
Chromium,Dissolved	BDL	0.010	mg/l	6010B	09/24/11	1
Cobalt	0.033	0.010	mg/l	6010B	09/17/11	1
Cobalt,Dissolved	0.025	0.010	mg/l	6010B	09/24/11	1
Iron	33.	0.10	mg/l	6010B	09/17/11	1
Iron,Dissolved	4.8	0.10	mg/l	6010B	09/24/11	1
Magnesium	3.4	0.10	mg/l	6010B	09/17/11	1
Magnesium,Dissolved	2.9	0.10	mg/l	6010B	09/24/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)

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REPORT OF ANALYSIS

September 27, 2011

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

Date Received : September 15, 2011
Description : EWS - Camden

Sample ID : DUPLICATE

Collected By : M. Johnson
Collection Date : 09/14/11 00:00

ESC Sample # : L536312-03

Site ID :

Project # : 101-301

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Manganese	0.84	0.010	mg/l	6010B	09/17/11	1
Manganese,Dissolved	0.72	0.010	mg/l	6010B	09/24/11	1
Nickel	BDL	0.020	mg/l	6010B	09/17/11	1
Nickel,Dissolved	BDL	0.020	mg/l	6010B	09/24/11	1
Potassium	2.4	0.50	mg/l	6010B	09/17/11	1
Potassium,Dissolved	1.3	0.50	mg/l	6010B	09/24/11	1
Silver	BDL	0.010	mg/l	6010B	09/17/11	1
Silver,Dissolved	BDL	0.010	mg/l	6010B	09/24/11	1
Sodium	3.4	0.50	mg/l	6010B	09/17/11	1
Sodium,Dissolved	3.2	0.50	mg/l	6010B	09/24/11	1
Vanadium	0.024	0.010	mg/l	6010B	09/17/11	1
Vanadium,Dissolved	BDL	0.010	mg/l	6010B	09/24/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-04

Date Received : September 15, 2011
Description : EWS - Camden

Site ID :

Sample ID : FIELD BLANK

Project # : 101-301

Collected By : M. Johnson
Collection Date : 09/14/11 12:40

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	BDL	1.0	mg/l	9056	09/16/11	1
Nitrate	BDL	0.10	mg/l	9056	09/16/11	1
Sulfate	BDL	5.0	mg/l	9056	09/16/11	1
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	09/27/11	1
Antimony	BDL	0.0010	mg/l	6020	09/16/11	1
Arsenic	BDL	0.0010	mg/l	6020	09/16/11	1
Beryllium	BDL	0.0010	mg/l	6020	09/16/11	1
Cadmium	BDL	0.00050	mg/l	6020	09/16/11	1
Copper	BDL	0.0020	mg/l	6020	09/16/11	1
Lead	BDL	0.0010	mg/l	6020	09/16/11	1
Selenium	BDL	0.0010	mg/l	6020	09/16/11	1
Thallium	BDL	0.0010	mg/l	6020	09/16/11	1
Zinc	BDL	0.010	mg/l	6020	09/16/11	1
Mercury	BDL	0.00020	mg/l	7470A	09/16/11	1
Aluminum	BDL	0.10	mg/l	6010B	09/16/11	1
Barium	BDL	0.0050	mg/l	6010B	09/16/11	1
Boron	BDL	0.20	mg/l	6010B	09/16/11	1
Calcium	BDL	0.50	mg/l	6010B	09/16/11	1
Chromium	BDL	0.010	mg/l	6010B	09/16/11	1
Cobalt	BDL	0.010	mg/l	6010B	09/16/11	1
Iron	BDL	0.10	mg/l	6010B	09/16/11	1
Magnesium	BDL	0.10	mg/l	6010B	09/16/11	1
Manganese	BDL	0.010	mg/l	6010B	09/16/11	1
Nickel	BDL	0.020	mg/l	6010B	09/16/11	1
Potassium	BDL	0.50	mg/l	6010B	09/16/11	1
Silver	BDL	0.010	mg/l	6010B	09/16/11	1
Sodium	BDL	0.50	mg/l	6010B	09/16/11	1
Vanadium	BDL	0.010	mg/l	6010B	09/16/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

September 27, 2011

ESC Sample # : L536312-05

Date Received : September 15, 2011
Description : EWS - Camden

Site ID :

Sample ID : EQUIPMENT BLANK

Project # : 101-301

Collected By : M. Johnson
Collection Date : 09/14/11 12:55

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	BDL	1.0	mg/l	9056	09/16/11	1
Nitrate	BDL	0.10	mg/l	9056	09/16/11	1
Sulfate	BDL	5.0	mg/l	9056	09/16/11	1
Ammonia Nitrogen	BDL	0.10	mg/l	350.1	09/26/11	1
Antimony	BDL	0.0010	mg/l	6020	09/16/11	1
Arsenic	BDL	0.0010	mg/l	6020	09/16/11	1
Beryllium	BDL	0.0010	mg/l	6020	09/16/11	1
Cadmium	BDL	0.00050	mg/l	6020	09/16/11	1
Copper	BDL	0.0020	mg/l	6020	09/16/11	1
Lead	BDL	0.0010	mg/l	6020	09/16/11	1
Selenium	BDL	0.0010	mg/l	6020	09/16/11	1
Thallium	BDL	0.0010	mg/l	6020	09/16/11	1
Zinc	BDL	0.010	mg/l	6020	09/16/11	1
Mercury	BDL	0.00020	mg/l	7470A	09/16/11	1
Aluminum	BDL	0.10	mg/l	6010B	09/16/11	1
Barium	BDL	0.0050	mg/l	6010B	09/16/11	1
Boron	BDL	0.20	mg/l	6010B	09/16/11	1
Calcium	BDL	0.50	mg/l	6010B	09/16/11	1
Chromium	BDL	0.010	mg/l	6010B	09/16/11	1
Cobalt	BDL	0.010	mg/l	6010B	09/16/11	1
Iron	BDL	0.10	mg/l	6010B	09/16/11	1
Magnesium	BDL	0.10	mg/l	6010B	09/16/11	1
Manganese	BDL	0.010	mg/l	6010B	09/16/11	1
Nickel	BDL	0.020	mg/l	6010B	09/16/11	1
Potassium	BDL	0.50	mg/l	6010B	09/16/11	1
Silver	BDL	0.010	mg/l	6010B	09/16/11	1
Sodium	BDL	0.50	mg/l	6010B	09/16/11	1
Vanadium	BDL	0.010	mg/l	6010B	09/16/11	1

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
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Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L536312-01	WG556795	SAMP	Ammonia Nitrogen	R1871537	P1
	WG557170	SAMP	Barium,Dissolved	R1870774	B2
	WG557170	SAMP	Copper,Dissolved	R1870774	B2
L536312-02	WG557170	SAMP	Barium,Dissolved	R1870774	B2
	WG557170	SAMP	Copper,Dissolved	R1870774	B2
L536312-03	WG557170	SAMP	Barium,Dissolved	R1870774	B2
	WG557170	SAMP	Copper,Dissolved	R1870774	B2
	WG555512	SAMP	Nitrate	R1861852	T8

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
B2	(ESC) - The detection limit has been elevated due to blank contamination.
P1	RPD value not applicable for sample concentrations less than 5 times the reporting limit.
T8	(ESC) - Additional method/sample information: Sample(s) received past/too close to holding time expiration.

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
09/27/11 at 17:23:16

TSR Signing Reports: 350
R5 - Desired TAT

Charge $6 for additional metals when metals list is run.

Sample: L536312-01 Account: CEC Received: 09/15/11 15:20 Due Date: 09/27/11 00:00 RPT Date: 09/27/11 17:22
Added M6010AP1-D and ALDICP, BDICP, CADICP, FEDICP, MGDICP, MNDICP, KDICP and NADICP per JH. MS
9/20
Sample: L536312-02 Account: CEC Received: 09/15/11 15:20 Due Date: 09/27/11 00:00 RPT Date: 09/27/11 17:22
Added M6010AP1-D and ALDICP, BDICP, CADICP, FEDICP, MGDICP, MNDICP, KDICP and NADICP per JH. MS
9/20
Sample: L536312-03 Account: CEC Received: 09/15/11 15:20 Due Date: 09/27/11 00:00 RPT Date: 09/27/11 17:22
Added M6010AP1-D and ALDICP, BDICP, CADICP, FEDICP, MGDICP, MNDICP, KDICP and NADICP per JH. MS
9/20
Sample: L536312-04 Account: CEC Received: 09/15/11 15:20 Due Date: 09/27/11 00:00 RPT Date: 09/27/11 17:22

Sample: L536312-05 Account: CEC Received: 09/15/11 15:20 Due Date: 09/27/11 00:00 RPT Date: 09/27/11 17:22

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Quality Assurance Report
Level II

L536312

September 27, 2011

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
Chloride	< 1	mg/l			WG555512	09/16/11 07:55
Nitrate	< .1	mg/l			WG555512	09/16/11 07:55
Sulfate	< 5	mg/l			WG555512	09/16/11 07:55
Antimony	< .001	mg/l			WG555497	09/16/11 19:10
Arsenic	< .001	mg/l			WG555497	09/16/11 19:10
Beryllium	< .001	mg/l			WG555497	09/16/11 19:10
Cadmium	< .0005	mg/l			WG555497	09/16/11 19:10
Copper	< .002	mg/l			WG555497	09/16/11 19:10
Lead	< .001	mg/l			WG555497	09/16/11 19:10
Selenium	< .001	mg/l			WG555497	09/16/11 19:10
Thallium	< .001	mg/l			WG555497	09/16/11 19:10
Zinc	< .01	mg/l			WG555497	09/16/11 19:10
Mercury	< .0002	mg/l			WG555438	09/16/11 15:59
Aluminum	< .1	mg/l			WG555559	09/16/11 19:01
Barium	< .005	mg/l			WG555559	09/16/11 19:01
Boron	< .2	mg/l			WG555559	09/16/11 19:01
Calcium	< .5	mg/l			WG555559	09/16/11 19:01
Chromium	< .01	mg/l			WG555559	09/16/11 19:01
Cobalt	< .01	mg/l			WG555559	09/16/11 19:01
Iron	< .1	mg/l			WG555559	09/16/11 19:01
Magnesium	< .1	mg/l			WG555559	09/16/11 19:01
Manganese	< .01	mg/l			WG555559	09/16/11 19:01
Nickel	< .02	mg/l			WG555559	09/16/11 19:01
Potassium	< .5	mg/l			WG555559	09/16/11 19:01
Silver	< .01	mg/l			WG555559	09/16/11 19:01
Sodium	< .5	mg/l			WG555559	09/16/11 19:01
Vanadium	< .01	mg/l			WG555559	09/16/11 19:01
Aluminum	< .1	mg/l			WG555522	09/17/11 15:04
Barium	< .005	mg/l			WG555522	09/17/11 15:04
Boron	< .2	mg/l			WG555522	09/17/11 15:04
Calcium	< .5	mg/l			WG555522	09/17/11 15:04
Chromium	< .01	mg/l			WG555522	09/17/11 15:04
Cobalt	< .01	mg/l			WG555522	09/17/11 15:04
Iron	< .1	mg/l			WG555522	09/17/11 15:04
Magnesium	< .1	mg/l			WG555522	09/17/11 15:04
Manganese	< .01	mg/l			WG555522	09/17/11 15:04
Nickel	< .02	mg/l			WG555522	09/17/11 15:04
Potassium	< .5	mg/l			WG555522	09/17/11 15:04
Silver	< .01	mg/l			WG555522	09/17/11 15:04
Sodium	< .5	mg/l			WG555522	09/17/11 15:04
Vanadium	< .01	mg/l			WG555522	09/17/11 15:04
Mercury,Dissolved	< .0002	mg/l			WG556582	09/23/11 00:35
Aluminum,Dissolved	< .1	mg/l			WG556625	09/24/11 11:01
Boron,Dissolved	< .2	mg/l			WG556625	09/24/11 11:01
Calcium,Dissolved	< .5	mg/l			WG556625	09/24/11 11:01
Chromium,Dissolved	< .01	mg/l			WG556625	09/24/11 11:01
Cobalt,Dissolved	< .01	mg/l			WG556625	09/24/11 11:01

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Quality Assurance Report
Level II

L536312

September 27, 2011

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
Iron,Dissolved	< .1	mg/l			WG556625	09/24/11 11:01
Magnesium,Dissolved	< .1	mg/l			WG556625	09/24/11 11:01
Manganese,Dissolved	< .01	mg/l			WG556625	09/24/11 11:01
Nickel,Dissolved	< .02	mg/l			WG556625	09/24/11 11:01
Potassium,Dissolved	< .5	mg/l			WG556625	09/24/11 11:01
Silver,Dissolved	< .01	mg/l			WG556625	09/24/11 11:01
Sodium,Dissolved	< .5	mg/l			WG556625	09/24/11 11:01
Vanadium,Dissolved	< .01	mg/l			WG556625	09/24/11 11:01
Antimony,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Arsenic,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Barium,Dissolved	< .005	mg/l			WG557170	09/25/11 15:58
Beryllium,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Cadmium,Dissolved	< .0005	mg/l			WG557170	09/25/11 15:58
Copper,Dissolved	< .02	mg/l			WG557170	09/25/11 15:58
Lead,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Selenium,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Thallium,Dissolved	< .001	mg/l			WG557170	09/25/11 15:58
Zinc,Dissolved	< .01	mg/l			WG557170	09/25/11 15:58
Ammonia Nitrogen	< .1	mg/l			WG556802	09/26/11 12:08
Ammonia Nitrogen	< .1	mg/l			WG556795	09/26/11 13:09
Ammonia Nitrogen	< .1	mg/l			WG557379	09/27/11 15:36

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Chloride	mg/l	3.10	3.10	0.643	20	L536312-01	WG555512
Nitrate	mg/l	0	0	0	20	L536312-01	WG555512
Sulfate	mg/l	6.60	6.60	0.760	20	L536312-01	WG555512
Chloride	mg/l	170.	160.	4.28	20	L535802-01	WG555512
Sulfate	mg/l	260.	240.	7.62	20	L535802-01	WG555512
Antimony	mg/l	0	0	0	20	L536392-05	WG555497
Arsenic	mg/l	0.00240	0.00227	4.31	20	L536392-05	WG555497
Beryllium	mg/l	0	0	0	20	L536392-05	WG555497
Cadmium	mg/l	0	0	0	20	L536392-05	WG555497
Copper	mg/l	0	0	0	20	L536392-05	WG555497
Lead	mg/l	0	0	0	20	L536392-05	WG555497
Selenium	mg/l	0	0	0	20	L536392-05	WG555497
Thallium	mg/l	0	0	0	20	L536392-05	WG555497
Zinc	mg/l	0	0.00189	NA	20	L536392-05	WG555497
Mercury	mg/l	0	0	0	20	L536204-12	WG555438
Aluminum	mg/l	0	0.0546	NA	20	L536374-07	WG555559
Barium	mg/l	0.270	0.280	3.27	20	L536374-07	WG555559
Boron	mg/l	0	0.0694	NA	20	L536374-07	WG555559
Calcium	mg/l	140.	136.	0	20	L536374-07	WG555559
Chromium	mg/l	0	0	0	20	L536374-07	WG555559

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Level II

L536312

September 27, 2011

			Duplicate				
Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Cobalt	mg/l	0	0	0	20	L536374-07	WG555559
Iron	mg/l	5.20	5.20	0.385	20	L536374-07	WG555559
Manganese	mg/l	0.560	0.570	1.59	20	L536374-07	WG555559
Nickel	mg/l	0	0	0	20	L536374-07	WG555559
Potassium	mg/l	2.20	2.39	8.28	20	L536374-07	WG555559
Silver	mg/l	0	0	0	20	L536374-07	WG555559
Sodium	mg/l	21.0	22.1	3.22	20	L536374-07	WG555559
Vanadium	mg/l	0	0	0	20	L536374-07	WG555559
Aluminum	mg/l	0	0	0	20	L536311-02	WG555522
Barium	mg/l	0.0410	0.0399	2.96	20	L536311-02	WG555522
Boron	mg/l	0	0.0506	NA	20	L536311-02	WG555522
Calcium	mg/l	15.0	14.8	2.01	20	L536311-02	WG555522
Chromium	mg/l	0	0.000200	NA	20	L536311-02	WG555522
Cobalt	mg/l	0	0.00100	NA	20	L536311-02	WG555522
Iron	mg/l	0.930	0.911	2.39	20	L536311-02	WG555522
Magnesium	mg/l	8.90	8.67	2.51	20	L536311-02	WG555522
Manganese	mg/l	0.100	0.102	1.94	20	L536311-02	WG555522
Nickel	mg/l	0	0	0	20	L536311-02	WG555522
Potassium	mg/l	1.00	0.935	7.71	20	L536311-02	WG555522
Silver	mg/l	0	0.00130	NA	20	L536311-02	WG555522
Sodium	mg/l	20.0	19.3	2.56	20	L536311-02	WG555522
Vanadium	mg/l	0	0	0	20	L536311-02	WG555522
Mercury,Dissolved	mg/l	0	0	0	20	L537072-01	WG556582
Aluminum,Dissolved	mg/l	0.140	0.154	6.71	20	L537072-01	WG556625
Boron,Dissolved	mg/l	0	0.114	NA	0	L537072-01	WG556625
Calcium,Dissolved	mg/l	7.50	7.47	0.800	20	L537072-01	WG556625
Chromium,Dissolved	mg/l	0	0	0	20	L537072-01	WG556625
Cobalt,Dissolved	mg/l	0	0.000400	NA	20	L537072-01	WG556625
Iron,Dissolved	mg/l	0	0.0732	NA	20	L537072-01	WG556625
Magnesium,Dissolved	mg/l	1.50	1.53	0	20	L537072-01	WG556625
Manganese,Dissolved	mg/l	0	0.00400	NA	20	L537072-01	WG556625
Nickel,Dissolved	mg/l	0	0.00160	NA	20	L537072-01	WG556625
Potassium,Dissolved	mg/l	0.600	0.422	35.3*	20	L537072-01	WG556625
Silver,Dissolved	mg/l	0	0	0	20	L537072-01	WG556625
Sodium,Dissolved	mg/l	3.00	3.00	0.669	20	L537072-01	WG556625
Vanadium,Dissolved	mg/l	0	0.00100	NA	20	L537072-01	WG556625
Antimony,Dissolved	mg/l	0	0.000860	NA	20	L537797-03	WG557170
Arsenic,Dissolved	mg/l	0.00180	0.00170	2.90	20	L537797-03	WG557170
Beryllium,Dissolved	mg/l	0	0.000580	NA	20	L537797-03	WG557170
Cadmium,Dissolved	mg/l	0	0.000320	NA	20	L537797-03	WG557170
Lead,Dissolved	mg/l	0	0.00106	NA	20	L537797-03	WG557170
Selenium,Dissolved	mg/l	0	0	0	20	L537797-03	WG557170
Thallium,Dissolved	mg/l	0	0.000200	NA	20	L537797-03	WG557170
Zinc,Dissolved	mg/l	0	0.00281	NA	20	L537797-03	WG557170
Ammonia Nitrogen	mg/l	0.420	0.480	13.1	20	L537134-01	WG556802
Ammonia Nitrogen	mg/l	0	0	0	20	L536601-02	WG556795
Ammonia Nitrogen	mg/l	0.220	0.170	24.3*	20	L536312-01	WG556795

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Quality Assurance Report
Level II

L536312

September 27, 2011

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Ammonia Nitrogen	mg/l	3.30	3.30	0.303	20	L537255-10	WG557379
Ammonia Nitrogen	mg/l	0	0	0	20	L536312-04	WG557379

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
Chloride	mg/l	40	39.7	99.3	90-110	WG555512
Nitrate	mg/l	8	8.06	101.	90-110	WG555512
Sulfate	mg/l	40	39.6	99.0	90-110	WG555512
Antimony	mg/l	.0567	0.0543	95.8	85-115	WG555497
Arsenic	mg/l	.0567	0.0534	94.2	85-115	WG555497
Beryllium	mg/l	.0567	0.0545	96.1	85-115	WG555497
Cadmium	mg/l	.0567	0.0524	92.4	85-115	WG555497
Copper	mg/l	.0567	0.0543	95.8	85-115	WG555497
Lead	mg/l	.0567	0.0569	100.	85-115	WG555497
Selenium	mg/l	.0567	0.0516	91.0	85-115	WG555497
Thallium	mg/l	.0567	0.0535	94.4	85-115	WG555497
Zinc	mg/l	.0567	0.0590	104.	85-115	WG555497
Mercury	mg/l	.003	0.00302	101.	85-115	WG555438
Aluminum	mg/l	1.13	0.969	85.8	85-115	WG555559
Barium	mg/l	1.13	1.06	93.8	85-115	WG555559
Boron	mg/l	1.13	0.986	87.3	85-115	WG555559
Calcium	mg/l	11.3	10.8	95.6	85-115	WG555559
Chromium	mg/l	1.13	1.09	96.5	85-115	WG555559
Cobalt	mg/l	1.13	1.08	95.6	85-115	WG555559
Iron	mg/l	1.13	1.06	93.8	85-115	WG555559
Magnesium	mg/l	11.3	11.0	97.3	85-115	WG555559
Manganese	mg/l	1.13	1.06	93.8	85-115	WG555559
Nickel	mg/l	1.13	1.02	90.3	85-115	WG555559
Potassium	mg/l	11.3	10.7	94.7	85-115	WG555559
Silver	mg/l	1.13	1.04	92.0	85-115	WG555559
Sodium	mg/l	11.3	10.5	92.9	85-115	WG555559
Vanadium	mg/l	1.13	1.06	93.8	85-115	WG555559
Aluminum	mg/l	1.13	0.999	88.4	85-115	WG555522
Barium	mg/l	1.13	1.10	97.3	85-115	WG555522
Boron	mg/l	1.13	1.02	90.3	85-115	WG555522
Calcium	mg/l	11.3	11.0	97.3	85-115	WG555522
Chromium	mg/l	1.13	1.10	97.3	85-115	WG555522
Cobalt	mg/l	1.13	1.08	95.6	85-115	WG555522
Iron	mg/l	1.13	1.08	95.6	85-115	WG555522
Magnesium	mg/l	11.3	11.4	101.	85-115	WG555522
Manganese	mg/l	1.13	1.11	98.2	85-115	WG555522
Nickel	mg/l	1.13	1.02	90.3	85-115	WG555522
Potassium	mg/l	11.3	11.3	100.	85-115	WG555522
Silver	mg/l	1.13	1.08	95.6	85-115	WG555522
Sodium	mg/l	11.3	11.3	100.	85-115	WG555522
Vanadium	mg/l	1.13	1.10	97.3	85-115	WG555522
Mercury,Dissolved	mg/l	.003	0.00279	93.0	85-115	WG556582

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Level II

L536312

September 27, 2011

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
Aluminum,Dissolved	mg/l	1.13	1.08	95.6	85-115	WG556625
Boron,Dissolved	mg/l	1.13	1.11	98.2	85-115	WG556625
Calcium,Dissolved	mg/l	11.3	11.1	98.2	85-115	WG556625
Chromium,Dissolved	mg/l	1.13	1.14	101.	85-115	WG556625
Cobalt,Dissolved	mg/l	1.13	1.12	99.1	85-115	WG556625
Iron,Dissolved	mg/l	1.13	1.02	90.3	85-115	WG556625
Magnesium,Dissolved	mg/l	11.3	11.5	102.	85-115	WG556625
Manganese,Dissolved	mg/l	1.13	1.12	99.1	85-115	WG556625
Nickel,Dissolved	mg/l	1.13	1.08	95.6	85-115	WG556625
Potassium,Dissolved	mg/l	11.3	11.3	100.	85-115	WG556625
Silver,Dissolved	mg/l	1.13	1.09	96.5	85-115	WG556625
Sodium,Dissolved	mg/l	11.3	11.2	99.1	85-115	WG556625
Vanadium,Dissolved	mg/l	1.13	1.09	96.5	85-115	WG556625
Antimony,Dissolved	mg/l	.0567	0.0513	90.5	85-115	WG557170
Arsenic,Dissolved	mg/l	.0567	0.0512	90.3	85-115	WG557170
Barium,Dissolved	mg/l	.0567	0.0548	96.6	85-115	WG557170
Beryllium,Dissolved	mg/l	.0567	0.0508	89.6	85-115	WG557170
Cadmium,Dissolved	mg/l	.0567	0.0512	90.3	85-115	WG557170
Copper,Dissolved	mg/l	.0567	0.0610	108.	85-115	WG557170
Lead,Dissolved	mg/l	.0567	0.0541	95.4	85-115	WG557170
Selenium,Dissolved	mg/l	.0567	0.0513	90.5	85-115	WG557170
Thallium,Dissolved	mg/l	.0567	0.0525	92.6	85-115	WG557170
Zinc,Dissolved	mg/l	.0567	0.0608	107.	85-115	WG557170
Ammonia Nitrogen	mg/l	7.5	8.22	110.	90-110	WG556802
Ammonia Nitrogen	mg/l	7.5	8.13	108.	90-110	WG556795
Ammonia Nitrogen	mg/l	7.5	7.55	101.	90-110	WG557379

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
Chloride	mg/l	39.8	39.7	100.	90-110	0.252	20	WG555512
Nitrate	mg/l	8.09	8.06	101.	90-110	0.372	20	WG555512
Sulfate	mg/l	39.7	39.6	99.0	90-110	0.252	20	WG555512
Ammonia Nitrogen	mg/l	7.89	8.22	105.	90-110	4.10	20	WG556802
Ammonia Nitrogen	mg/l	8.03	8.13	107.	90-110	1.24	20	WG556795
Ammonia Nitrogen	mg/l	7.23	7.55	96.0	90-110	4.33	20	WG557379

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Chloride	mg/l	50.3	0	50	101.	80-120	L536312-04	WG555512
Nitrate	mg/l	5.01	0	5	100.	80-120	L536312-04	WG555512
Sulfate	mg/l	50.2	0	50	100.	80-120	L536312-04	WG555512
Sulfate	mg/l	478.	250.	50	91.2	80-120	L535835-03	WG555512

* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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		Matrix Spike						
Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Antimony	mg/l	0.0571	0	.0567	101.	75-125	L536392-05	WG555497
Arsenic	mg/l	0.0579	0.00227	.0567	98.1	75-125	L536392-05	WG555497
Beryllium	mg/l	0.0527	0	.0567	92.9	75-125	L536392-05	WG555497
Cadmium	mg/l	0.0535	0	.0567	94.4	75-125	L536392-05	WG555497
Copper	mg/l	0.0564	0	.0567	99.5	75-125	L536392-05	WG555497
Lead	mg/l	0.0565	0	.0567	99.6	75-125	L536392-05	WG555497
Selenium	mg/l	0.0543	0	.0567	95.8	75-125	L536392-05	WG555497
Thallium	mg/l	0.0542	0	.0567	95.6	75-125	L536392-05	WG555497
Zinc	mg/l	0.0612	0.00189	.0567	105.	75-125	L536392-05	WG555497
Mercury	mg/l	0.00314	0	.003	105.	70-130	L536204-12	WG555438
Aluminum	mg/l	1.07	0.0546	1.13	89.8	75-125	L536374-07	WG555559
Barium	mg/l	1.34	0.280	1.13	93.8	75-125	L536374-07	WG555559
Boron	mg/l	1.11	0.0694	1.13	92.1	75-125	L536374-07	WG555559
Calcium	mg/l	146.	136.	11.3	88.5	75-125	L536374-07	WG555559
Chromium	mg/l	1.11	0	1.13	98.2	75-125	L536374-07	WG555559
Cobalt	mg/l	1.06	0	1.13	93.8	75-125	L536374-07	WG555559
Iron	mg/l	6.28	5.20	1.13	95.6	75-125	L536374-07	WG555559
Magnesium	mg/l	48.1	37.9	11.3	90.3	75-125	L536374-07	WG555559
Manganese	mg/l	1.65	0.570	1.13	95.6	75-125	L536374-07	WG555559
Nickel	mg/l	1.03	0	1.13	91.2	75-125	L536374-07	WG555559
Potassium	mg/l	13.4	2.39	11.3	97.4	75-125	L536374-07	WG555559
Silver	mg/l	0.423	0	1.13	37.4*	75-125	L536374-07	WG555559
Sodium	mg/l	33.0	22.1	11.3	96.5	75-125	L536374-07	WG555559
Vanadium	mg/l	1.10	0	1.13	97.3	75-125	L536374-07	WG555559
Aluminum	mg/l	1.00	0	1.13	88.5	75-125	L536311-02	WG555522
Barium	mg/l	1.12	0.0399	1.13	95.6	75-125	L536311-02	WG555522
Boron	mg/l	1.03	0.0506	1.13	86.7	75-125	L536311-02	WG555522
Calcium	mg/l	25.8	14.8	11.3	97.3	75-125	L536311-02	WG555522
Chromium	mg/l	1.08	0.000200	1.13	95.6	75-125	L536311-02	WG555522
Cobalt	mg/l	1.06	0.00100	1.13	93.7	75-125	L536311-02	WG555522
Iron	mg/l	1.94	0.911	1.13	91.1	75-125	L536311-02	WG555522
Magnesium	mg/l	19.5	8.67	11.3	95.8	75-125	L536311-02	WG555522
Manganese	mg/l	1.18	0.102	1.13	95.4	75-125	L536311-02	WG555522
Nickel	mg/l	1.05	0	1.13	92.9	75-125	L536311-02	WG555522
Potassium	mg/l	11.9	0.935	11.3	97.0	75-125	L536311-02	WG555522
Silver	mg/l	0.430	0.00130	1.13	37.9*	75-125	L536311-02	WG555522
Sodium	mg/l	31.0	19.3	11.3	104.	75-125	L536311-02	WG555522
Vanadium	mg/l	1.08	0	1.13	95.6	75-125	L536311-02	WG555522
Mercury,Dissolved	mg/l	0.00297	0	.003	99.0	70-130	L537072-01	WG556582
Aluminum,Dissolved	mg/l	1.20	0.154	1.13	92.6	75-125	L537072-01	WG556625
Boron,Dissolved	mg/l	1.10	0.114	1.13	87.2	75-125	L537072-01	WG556625
Calcium,Dissolved	mg/l	18.6	7.47	11.3	98.5	75-125	L537072-01	WG556625
Chromium,Dissolved	mg/l	1.13	0	1.13	100.	75-125	L537072-01	WG556625
Cobalt,Dissolved	mg/l	1.13	0.000400	1.13	100.	75-125	L537072-01	WG556625
Iron,Dissolved	mg/l	1.10	0.0732	1.13	90.9	75-125	L537072-01	WG556625
Magnesium,Dissolved	mg/l	13.0	1.53	11.3	102.	75-125	L537072-01	WG556625
Manganese,Dissolved	mg/l	1.14	0.00400	1.13	100.	75-125	L537072-01	WG556625
Nickel,Dissolved	mg/l	1.10	0.00160	1.13	97.2	75-125	L537072-01	WG556625
Potassium,Dissolved	mg/l	11.7	0.422	11.3	99.8	75-125	L537072-01	WG556625

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Franklin, TN 37067

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Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Silver,Dissolved	mg/l	0.448	0	1.13	39.6*	75-125	L537072-01	WG556625
Sodium,Dissolved	mg/l	14.3	3.00	11.3	100.	75-125	L537072-01	WG556625
Vanadium,Dissolved	mg/l	1.10	0.00100	1.13	97.2	75-125	L537072-01	WG556625
Antimony,Dissolved	mg/l	0.0535	0.000860	.0567	92.8	75-125	L537797-03	WG557170
Arsenic,Dissolved	mg/l	0.0542	0.00170	.0567	92.6	75-125	L537797-03	WG557170
Beryllium,Dissolved	mg/l	0.0499	0.000580	.0567	87.0	75-125	L537797-03	WG557170
Cadmium,Dissolved	mg/l	0.0522	0.000320	.0567	91.5	75-125	L537797-03	WG557170
Lead,Dissolved	mg/l	0.0519	0.00106	.0567	89.7	75-125	L537797-03	WG557170
Selenium,Dissolved	mg/l	0.0512	0	.0567	90.3	75-125	L537797-03	WG557170
Thallium,Dissolved	mg/l	0.0518	0.000200	.0567	91.0	75-125	L537797-03	WG557170
Zinc,Dissolved	mg/l	0.0584	0.00281	.0567	98.0	75-125	L537797-03	WG557170
Ammonia Nitrogen	mg/l	5.03	0	5	101.	90-110	L536989-01	WG556802
Ammonia Nitrogen	mg/l	5.42	0	5	108.	90-110	L536312-02	WG556795
Ammonia Nitrogen	mg/l	5.87	0.810	5	101.	90-110	L537255-01	WG557379

Matrix Spike Duplicate

Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Chloride	mg/l	50.9	50.3	102.	80-120	1.19	20	L536312-04	WG555512
Nitrate	mg/l	5.08	5.01	102.	80-120	1.39	20	L536312-04	WG555512
Sulfate	mg/l	50.9	50.2	102.	80-120	1.38	20	L536312-04	WG555512
Sulfate	mg/l	476.	478.	90.4	80-120	0.419	20	L535835-03	WG555512
Antimony	mg/l	0.0563	0.0571	99.3	75-125	1.41	20	L536392-05	WG555497
Arsenic	mg/l	0.0584	0.0579	99.0	75-125	0.860	20	L536392-05	WG555497
Beryllium	mg/l	0.0529	0.0527	93.3	75-125	0.379	20	L536392-05	WG555497
Cadmium	mg/l	0.0537	0.0535	94.7	75-125	0.373	20	L536392-05	WG555497
Copper	mg/l	0.0550	0.0564	97.0	75-125	2.51	20	L536392-05	WG555497
Lead	mg/l	0.0581	0.0565	102.	75-125	2.79	20	L536392-05	WG555497
Selenium	mg/l	0.0554	0.0543	97.7	75-125	2.01	20	L536392-05	WG555497
Thallium	mg/l	0.0551	0.0542	97.2	75-125	1.65	20	L536392-05	WG555497
Zinc	mg/l	0.0614	0.0612	105.	75-125	0.326	20	L536392-05	WG555497
Mercury	mg/l	0.00312	0.00314	104.	70-130	0.639	20	L536204-12	WG555438
Aluminum	mg/l	1.05	1.07	88.1	75-125	1.89	20	L536374-07	WG555559
Barium	mg/l	1.33	1.34	92.9	75-125	0.749	20	L536374-07	WG555559
Boron	mg/l	1.11	1.11	92.1	75-125	0	20	L536374-07	WG555559
Calcium	mg/l	147.	146.	97.3	75-125	0.683	20	L536374-07	WG555559
Chromium	mg/l	1.10	1.11	97.3	75-125	0.905	20	L536374-07	WG555559
Cobalt	mg/l	1.06	1.06	93.8	75-125	0	20	L536374-07	WG555559
Iron	mg/l	6.29	6.28	96.5	75-125	0.159	20	L536374-07	WG555559
Magnesium	mg/l	48.0	48.1	89.4	75-125	0.208	20	L536374-07	WG555559
Manganese	mg/l	1.65	1.65	95.6	75-125	0	20	L536374-07	WG555559
Nickel	mg/l	1.03	1.03	91.2	75-125	0	20	L536374-07	WG555559
Potassium	mg/l	12.9	13.4	93.0	75-125	3.80	20	L536374-07	WG555559
Silver	mg/l	0.398	0.423	35.2*	75-125	6.09	20	L536374-07	WG555559
Sodium	mg/l	32.0	33.0	87.6	75-125	3.08	20	L536374-07	WG555559

* Performance of this Analyte is outside of established criteria.
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Mr. Michael Johnson
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Franklin, TN 37067

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		Matrix Spike Duplicate							
Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Vanadium	mg/l	1.10	1.10	97.3	75-125	0	20	L536374-07	WG555559
Aluminum	mg/l	1.02	1.00	90.3	75-125	1.98	20	L536311-02	WG555522
Barium	mg/l	1.14	1.12	97.4	75-125	1.77	20	L536311-02	WG555522
Boron	mg/l	1.07	1.03	90.2	75-125	3.81	20	L536311-02	WG555522
Calcium	mg/l	25.6	25.8	95.6	75-125	0.778	20	L536311-02	WG555522
Chromium	mg/l	1.10	1.08	97.3	75-125	1.83	20	L536311-02	WG555522
Cobalt	mg/l	1.08	1.06	95.5	75-125	1.87	20	L536311-02	WG555522
Iron	mg/l	1.99	1.94	95.5	75-125	2.54	20	L536311-02	WG555522
Magnesium	mg/l	19.8	19.5	98.5	75-125	1.53	20	L536311-02	WG555522
Manganese	mg/l	1.21	1.18	98.0	75-125	2.51	20	L536311-02	WG555522
Nickel	mg/l	1.06	1.05	93.8	75-125	0.948	20	L536311-02	WG555522
Potassium	mg/l	12.2	11.9	99.7	75-125	2.49	20	L536311-02	WG555522
Silver	mg/l	0.540	0.430	47.7*	75-125	22.7*	20	L536311-02	WG555522
Sodium	mg/l	31.5	31.0	108.	75-125	1.60	20	L536311-02	WG555522
Vanadium	mg/l	1.10	1.08	97.3	75-125	1.83	20	L536311-02	WG555522
Mercury,Dissolved	mg/l	0.00293	0.00297	97.7	70-130	1.36	20	L537072-01	WG556582
Aluminum,Dissolved	mg/l	1.23	1.20	95.2	75-125	2.47	20	L537072-01	WG556625
Boron,Dissolved	mg/l	1.11	1.10	88.1	75-125	0.905	20	L537072-01	WG556625
Calcium,Dissolved	mg/l	18.7	18.6	99.4	75-125	0.536	20	L537072-01	WG556625
Chromium,Dissolved	mg/l	1.15	1.13	102.	75-125	1.75	20	L537072-01	WG556625
Cobalt,Dissolved	mg/l	1.14	1.13	101.	75-125	0.881	20	L537072-01	WG556625
Iron,Dissolved	mg/l	1.12	1.10	92.6	75-125	1.80	20	L537072-01	WG556625
Magnesium,Dissolved	mg/l	13.0	13.0	102.	75-125	0	20	L537072-01	WG556625
Manganese,Dissolved	mg/l	1.14	1.14	100.	75-125	0	20	L537072-01	WG556625
Nickel,Dissolved	mg/l	1.11	1.10	98.1	75-125	0.905	20	L537072-01	WG556625
Potassium,Dissolved	mg/l	11.6	11.7	98.9	75-125	0.858	20	L537072-01	WG556625
Silver,Dissolved	mg/l	0.596	0.448	52.7*	75-125	28.4*	20	L537072-01	WG556625
Sodium,Dissolved	mg/l	14.3	14.3	100.	75-125	0	20	L537072-01	WG556625
Vanadium,Dissolved	mg/l	1.10	1.10	97.2	75-125	0	20	L537072-01	WG556625
Antimony,Dissolved	mg/l	0.0534	0.0535	92.7	75-125	0.187	20	L537797-03	WG557170
Arsenic,Dissolved	mg/l	0.0540	0.0542	92.2	75-125	0.370	20	L537797-03	WG557170
Beryllium,Dissolved	mg/l	0.0513	0.0499	89.4	75-125	2.77	20	L537797-03	WG557170
Cadmium,Dissolved	mg/l	0.0520	0.0522	91.1	75-125	0.384	20	L537797-03	WG557170
Lead,Dissolved	mg/l	0.0519	0.0519	89.7	75-125	0	20	L537797-03	WG557170
Selenium,Dissolved	mg/l	0.0503	0.0512	88.7	75-125	1.77	20	L537797-03	WG557170
Thallium,Dissolved	mg/l	0.0515	0.0518	90.5	75-125	0.581	20	L537797-03	WG557170
Zinc,Dissolved	mg/l	0.0581	0.0584	97.5	75-125	0.515	20	L537797-03	WG557170
Ammonia Nitrogen	mg/l	5.36	5.03	107.	90-110	6.35	20	L536989-01	WG556802
Ammonia Nitrogen	mg/l	5.33	5.42	107.	90-110	1.67	20	L536312-02	WG556795
Ammonia Nitrogen	mg/l	5.73	5.87	98.4	90-110	2.41	20	L537255-01	WG557379

Batch number /Run number / Sample number cross reference

WG555512: R1861852: L536312-01 02 03 04 05
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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WG555497: R1862033: L536312-01 02 03 04 05
WG555438: R1862156: L536312-01 02 03 04 05
WG555559: R1862633: L536312-04 05
WG555522: R1862836: L536312-01 02 03
WG556582: R1869486: L536312-01 02 03
WG556625: R1870474: L536312-01 02 03
WG557170: R1870774: L536312-01 02 03
WG556802: R1871275: L536312-03 05
WG556795: R1871537: L536312-01 02
WG557379: R1872998: L536312-04

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Quality Assurance Report
Level II

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The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

A115

Chain of Custody
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ESC
L-A-B S-C-I-E-N-C-E-S
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Company Name/Address:
Civil & Environmental Consultants - TN
405 Duke Drive. Suite 270
Franklin.TN 37067

Billing Information:
Mr. Kevin Wolfe
405 Duke Drive, Suite 270

Franklin,TN 37067

Report to: Mike Johnson

Email to: mjohnson@cecinc.com

Project Description: EWS - CAMDEN

City/Sate Collected:

Phone: (615) 333-7797
FAX: (615) 333-7751

Client Project #: 101-301

ESC Key: CEC-CUSTOM TIRE

Collected by (print): M Johnson

Site/Facility ID#:

P.O.#:

Collected by (signature):

Immediately Packed on Ice N ___ [✓ Y X]

Rush? (Lab MUST Be Notified)
- _____ Same Day...... 200%
- _____ Next Day........ 100%
- _____ Two Day........ 50%
- _____ Three Day....... 25%

Date Results Needed:

Email? __No__Yes

FAX? __No__Yes

CoCode CEC (lab use only)
Template/Prelogin
Shipped Via

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	Cl, NO3, SO4 / 250ml HDPE - NP	METALS - 500ml HDPE HNO3 <2	NH3 - 250 HDPE H2SO4 <2	Remarks/Contaminant	Sample # (lab only)
MW-1	G	GW	—	9/14/11	1230	3	X	X	X		L536312-01
MW-3	G	GW	—	9/14/11	1200	3	X	X	X		-02
DUPLICATE	G	GW	—	9/14/11	—	3	X	X	X		-03
FIELD BLANK	G	GW	—	9/14/11	1240	3	X	X	X		-04
EQUIPMENT BLANK	G	GW	—	9/14/11	1255	3	X	X	X		-05

*Matrix: SS - Soil/Solid GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other___________

pH ____________ Temp ____________

Flow ____________ Other ____________

* Remarks: METALS = API + Al, B, Ca, Fe, Mg, Mn, K, Na

Relinquished by: (Signature)	Date: 9/15/11	Time: 1040	Received by: (Signature) Dennis Word	Samples returned via: ☐ UPS ☐ FedEx ☒ Courier ☐ _______	Condition: (lab use only) OK
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 4.1° / Bottles Received: 15	CoC Seals Intact ___Y ___N ___NA
Relinquished by: (Signature) Dennis Word	Date: 9/15/11	Time: 1515	Received for lab by: (Signature) Matthew [illegible]	Date: 9/15/11 / Time: 15:20	pH Checked: <2 / NCF:

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Est. 1970

Mr. Michael Johnson
Civil & Environmental Consultants - TN
405 Duke Drive, Suite 270
Franklin, TN 37067

Report Summary

Wednesday November 16, 2011

Report Number: L546215
Samples Received: 11/10/11
Client Project: 101-301

Description: EWS - Camden

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By: Jimmy Hunt

Jimmy Hunt , ESC Representative

Laboratory Certification Numbers

A2LA - 1461-01, AIHA - 100789, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375/DW21704, ND - R-140
NJ - TN002,NJ NELAP - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910, NV - TN000032008A,
TX - T104704245, OK-9915, PA - 68-02979

Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.
Note: The use of the preparatory EPA Method 3511 is not approved or endorsed by the CA ELAP.

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REPORT OF ANALYSIS

Mr. Michael Johnson
Civil & Environmental Consultants -
405 Duke Drive, Suite 270
Franklin, TN 37067

November 16, 2011

ESC Sample # : L546215-01

Site ID :

Project # : 101-301

Date Received : November 10, 2011
Description : EWS - Camden

Sample ID : MW-2

Collected By :
Collection Date : 11/10/11 13:50

Parameter	Result	Det. Limit	Units	Method	Date	Dil.
Chloride	67.	1.0	mg/l	9056	11/11/11	1
Nitrate	2.6	0.10	mg/l	9056	11/11/11	1
Sulfate	74.	5.0	mg/l	9056	11/11/11	1
Coliform,fecal	99.		col/100ml	9222D	11/10/11	10000

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.
This report shall not be reproduced, except in full, without the written approval from ESC.
.
Reported: 11/16/11 10:38 Printed: 11/16/11 10:39

Attachment A
List of Analytes with QC Qualifiers

Sample Number	Work Group	Sample Type	Analyte	Run ID	Qualifier
L546215-01	WG565130	SAMP	Sulfate	R1933073	J3

Attachment B
Explanation of QC Qualifier Codes

Qualifier	Meaning
J3	The associated batch QC was outside the established quality control range for precision.

Qualifier Report Information

ESC utilizes sample and result qualifiers as set forth by the EPA Contract Laboratory Program and as required by most certifying bodies including NELAC. In addition to the EPA qualifiers adopted by ESC, we have implemented ESC qualifiers to provide more information pertaining to our analytical results. Each qualifier is designated in the qualifier explanation as either EPA or ESC. Data qualifiers are intended to provide the ESC client with more detailed information concerning the potential bias of reported data. Because of the wide range of constituents and variety of matrices incorporated by most EPA methods,it is common for some compounds to fall outside of established ranges. These exceptions are evaluated and all reported data is valid and useable "unless qualified as 'R' (Rejected)."

Definitions

Accuracy - The relationship of the observed value of a known sample to the true value of a known sample. Represented by percent recovery and relevant to samples such as: control samples, matrix spike recoveries, surrogate recoveries, etc.

Precision - The agreement between a set of samples or between duplicate samples. Relates to how close together the results are and is represented by Relative Percent Differrence.

Surrogate - Organic compounds that are similar in chemical composition, extraction, and chromotography to analytes of interest. The surrogates are used to determine the probable response of the group of analytes that are chemically related to the surrogate compound. Surrogates are added to the sample and carried through all stages of preparation and analyses.

TIC - Tentatively Identified Compound: Compounds detected in samples that are not target compounds, internal standards, system monitoring compounds, or surrogates.

Summary of Remarks For Samples Printed
11/16/11 at 10:39:11

TSR Signing Reports: 350
R5 - Desired TAT

Charge $6 for additional metals when metals list is run.

Sample: L546215-01 Account: CEC Received: 11/10/11 16:05 Due Date: 11/17/11 00:00 RPT Date: 11/16/11 10:38

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Franklin, TN 37067

Quality Assurance Report
Level II

L546215

November 16, 2011

Laboratory Blank

Analyte	Result	Units	% Rec	Limit	Batch	Date Analyzed
Chloride	< 1	mg/l			WG565130	11/11/11 07:17
Nitrate	< .1	mg/l			WG565130	11/11/11 07:17
Sulfate	< 5	mg/l			WG565130	11/11/11 07:17

Duplicate

Analyte	Units	Result	Duplicate	RPD	Limit	Ref Samp	Batch
Chloride	mg/l	66.0	67.0	1.66	20	L546215-01	WG565130
Nitrate	mg/l	2.60	2.60	1.90	20	L546215-01	WG565130
Sulfate	mg/l	58.0	74.0	24.9*	20	L546215-01	WG565130
Nitrate	mg/l	0.400	0.460	14.7	20	L546292-06	WG565130

Laboratory Control Sample

Analyte	Units	Known Val	Result	% Rec	Limit	Batch
Chloride	mg/l	40	39.9	99.8	90-110	WG565130
Nitrate	mg/l	8	8.18	102.	90-110	WG565130
Sulfate	mg/l	40	39.9	99.8	90-110	WG565130

Laboratory Control Sample Duplicate

Analyte	Units	Result	Ref	%Rec	Limit	RPD	Limit	Batch
Chloride	mg/l	39.9	39.9	100.	90-110	0	20	WG565130
Nitrate	mg/l	8.18	8.18	102.	90-110	0	20	WG565130
Sulfate	mg/l	40.1	39.9	100.	90-110	0.500	20	WG565130

Matrix Spike

Analyte	Units	MS Res	Ref Res	TV	% Rec	Limit	Ref Samp	Batch
Nitrate	mg/l	6.07	1.30	5	95.4	80-120	L546286-01	WG565130
Sulfate	mg/l	110.	67.0	50	86.0	80-120	L546286-01	WG565130

Matrix Spike Duplicate

Analyte	Units	MSD	Ref	%Rec	Limit	RPD	Limit	Ref Samp	Batch
Nitrate	mg/l	6.21	6.07	98.2	80-120	2.28	20	L546286-01	WG565130
Sulfate	mg/l	111.	110.	88.0	80-120	0.905	20	L546286-01	WG565130

Batch number /Run number / Sample number cross reference

WG565130: R1933073: L546215-01
WG565842: R1933112: L546215-01

* * Calculations are performed prior to rounding of reported values.
* Performance of this Analyte is outside of established criteria.
For additional information, please see Attachment A 'List of Analytes with QC Qualifiers.'

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Quality Assurance Report
Level II

L546215

November 16, 2011

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Civil & Environmental Consultants - TN
405 Duke Drive. Suite 270
Franklin,TN 37067

Billing information:

Mr. Kevin Wolfe
405 Duke Drive, Suite 270

Franklin,TN 37067

Chain of Custody
Page ___ of ___
D039

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Phone: (615) 758-5858
Fax: (615) 758-5859

Report to: **Mr. Michael Johnson**

Email: **mjohnson@cecinc.com**

Project Description: **EWS - Camden**

City/State Collected

Phone: **(615) 333-7797**
FAX: **(615) 333-7751**

Client Project #: **101-301**

Lab Project #: **CEC-CUSTOM TIRE**

Collected by (print):

Site/Facility ID#:

P.O.#:

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
- ___ Same Day 200%
- ___ Next Day........................100%
- ___ Two Day..........................50%
- ___ Three Day........................25%

Date Results Needed

Email? __No X Yes
FAX? __No __Yes

Acctnum: **CEC** (lab use only)
Template/Prelogin: **T75244/ P374271**
Cooler #: 11/9/11 AR
Shipped Via: **Client**

Analysis/Container/Preservative

Sample ID	Comp/Grab	Matrix*	Depth	Date	Time	No. of Cntrs	Cl, NO3, SO4 125mlHDPE-NoPres	Fecal Coliform Microbiological	~~Metals 500mlHDPE-HNO3~~	~~NH3 250mlHDPE-H2SO4~~				Remarks/Contaminant	Sample # (lab only)
MW-2	G	GW	–	11/10/11	13:50	4	X	X	~~X~~	~~X~~					L546215-01

*Matrix: SS - Soil GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other_________

pH ____________ Temp ____________

Flow ____________ Other ____________

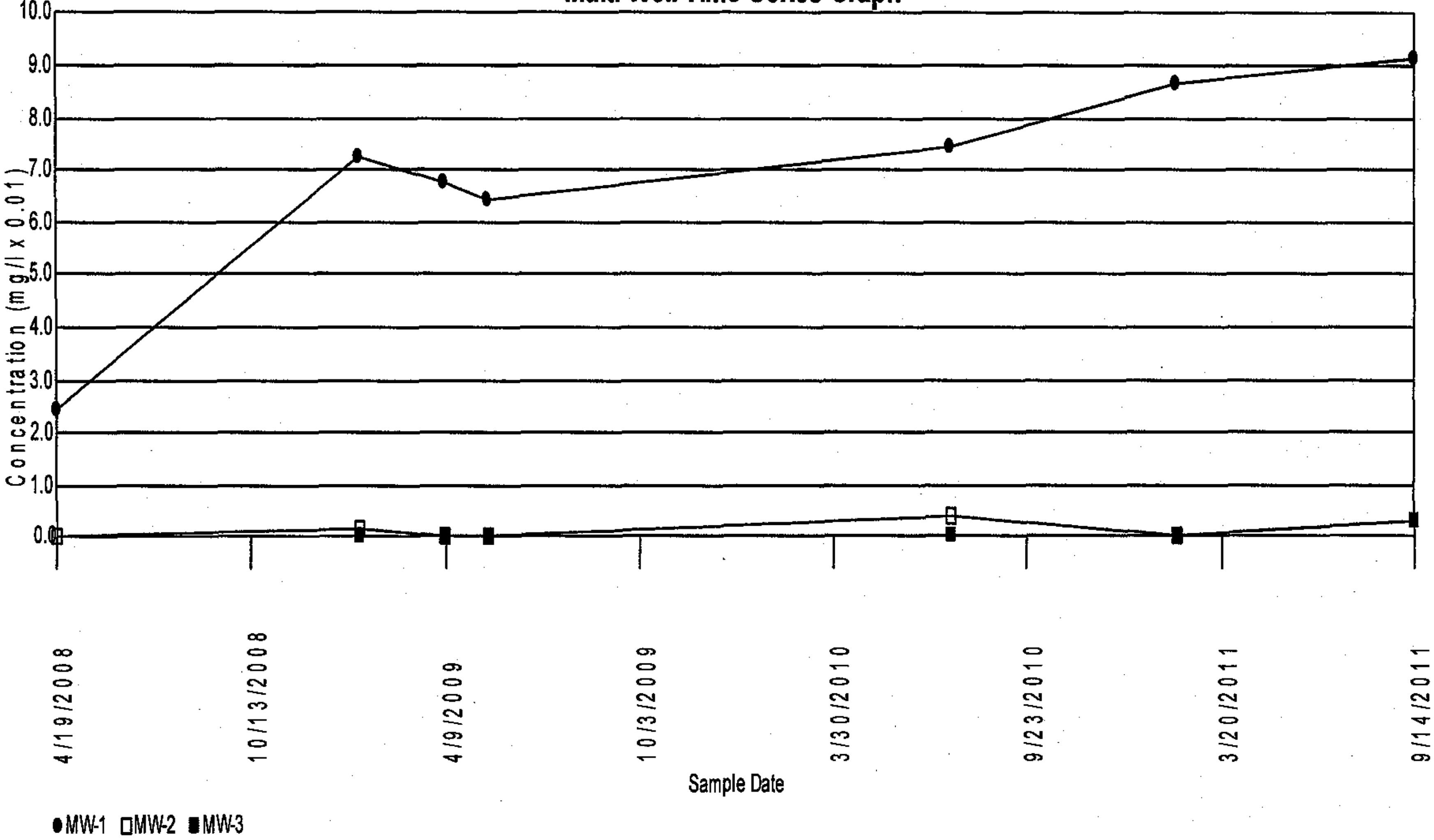
Remarks: Metals = AP1 + Al, B, Ca, Fe, K, Mg, Mn, Na

Relinquished by: (Signature)	Date: 11/10/11	Time: 4:05	Received by: (Signature)	Samples returned via: ☐ UPS ☐ FedEx ☐ Courier ☐ CLS	Condition: (lab use only) on ice ok
Relinquished by: (Signature)	Date:	Time:	Received by: (Signature)	Temp: 2.1 Bottles Received: 2	COC Seal Intact: ___ Y ___ N ___ NA
Relinquished by: (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 11/10/11 Time: 4:05	pH Checked: NCF:

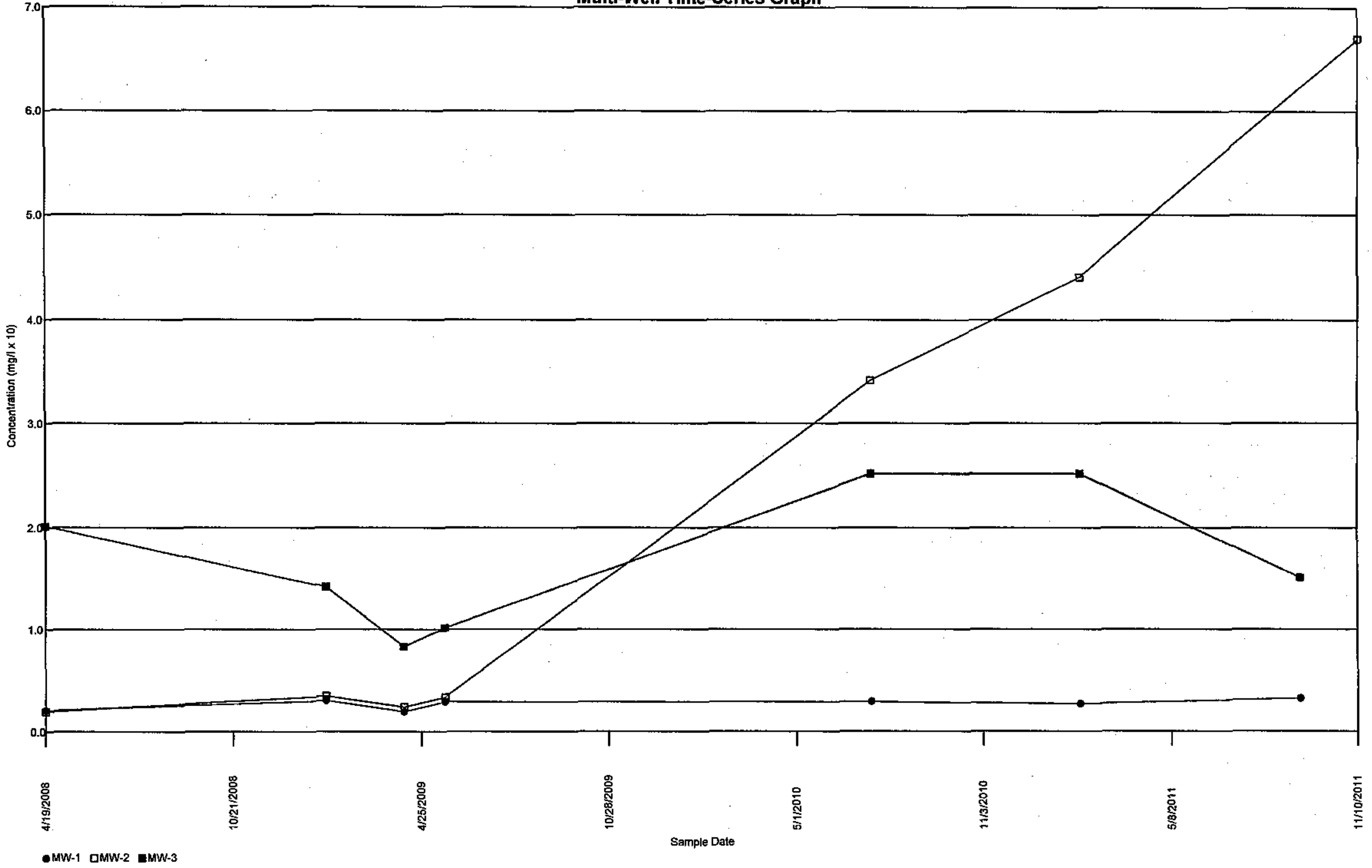
Appendix D
Statistical & Trend Analysis

Arsenic

Multi-Well Time-Series Graph

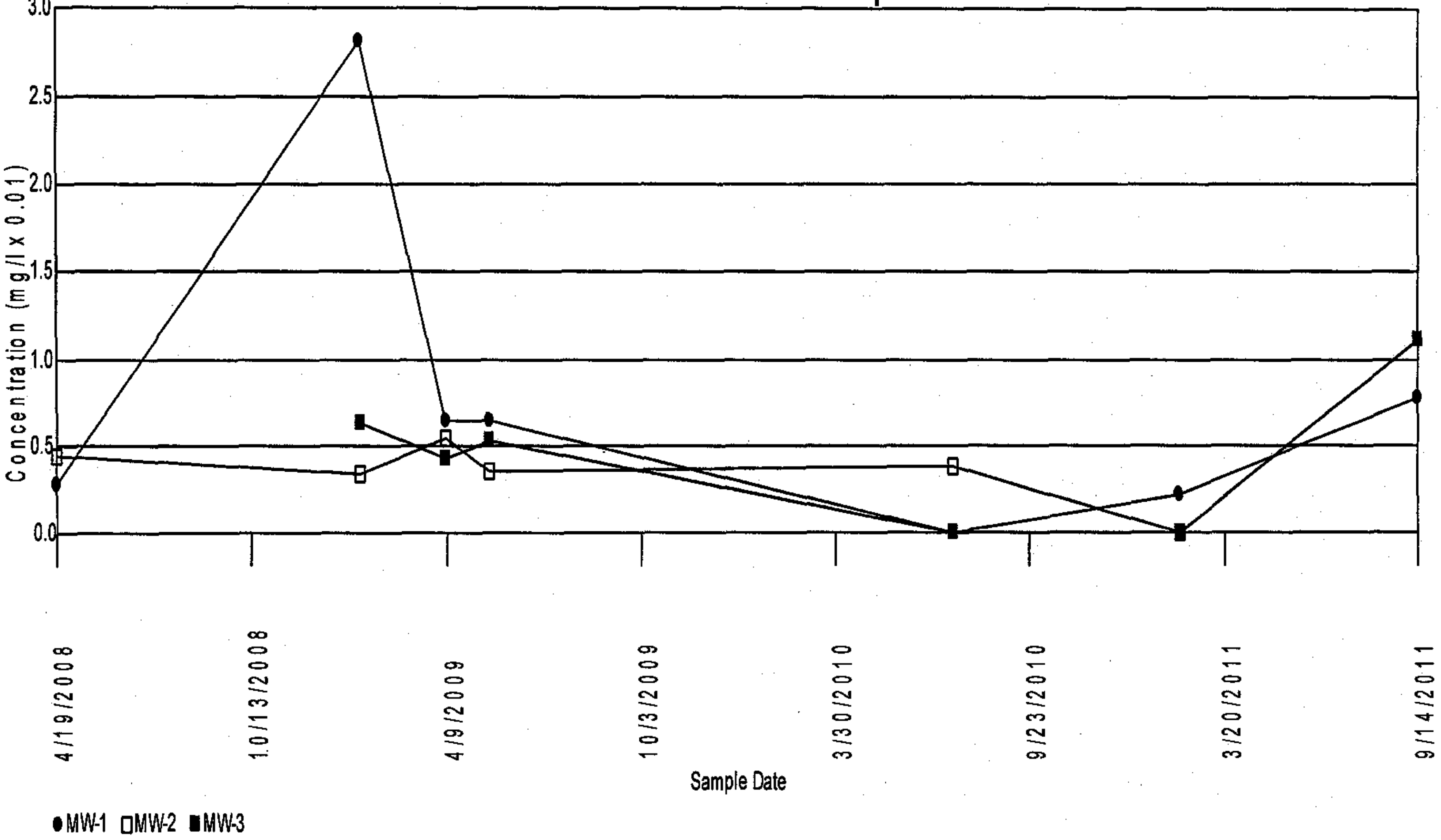


Chloride
Multi-Well Time-Series Graph



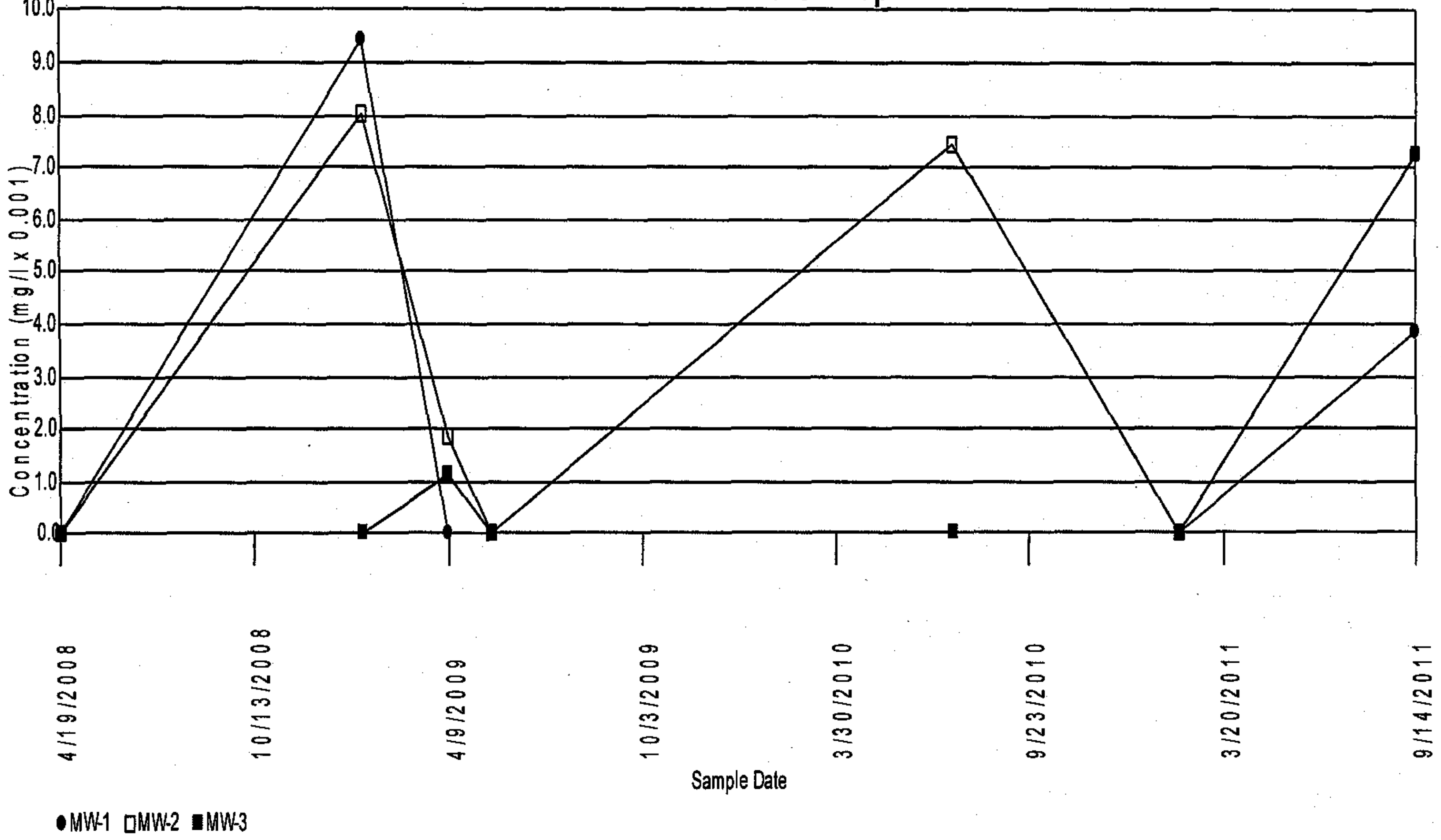
Copper

Multi-Well Time-Series Graph



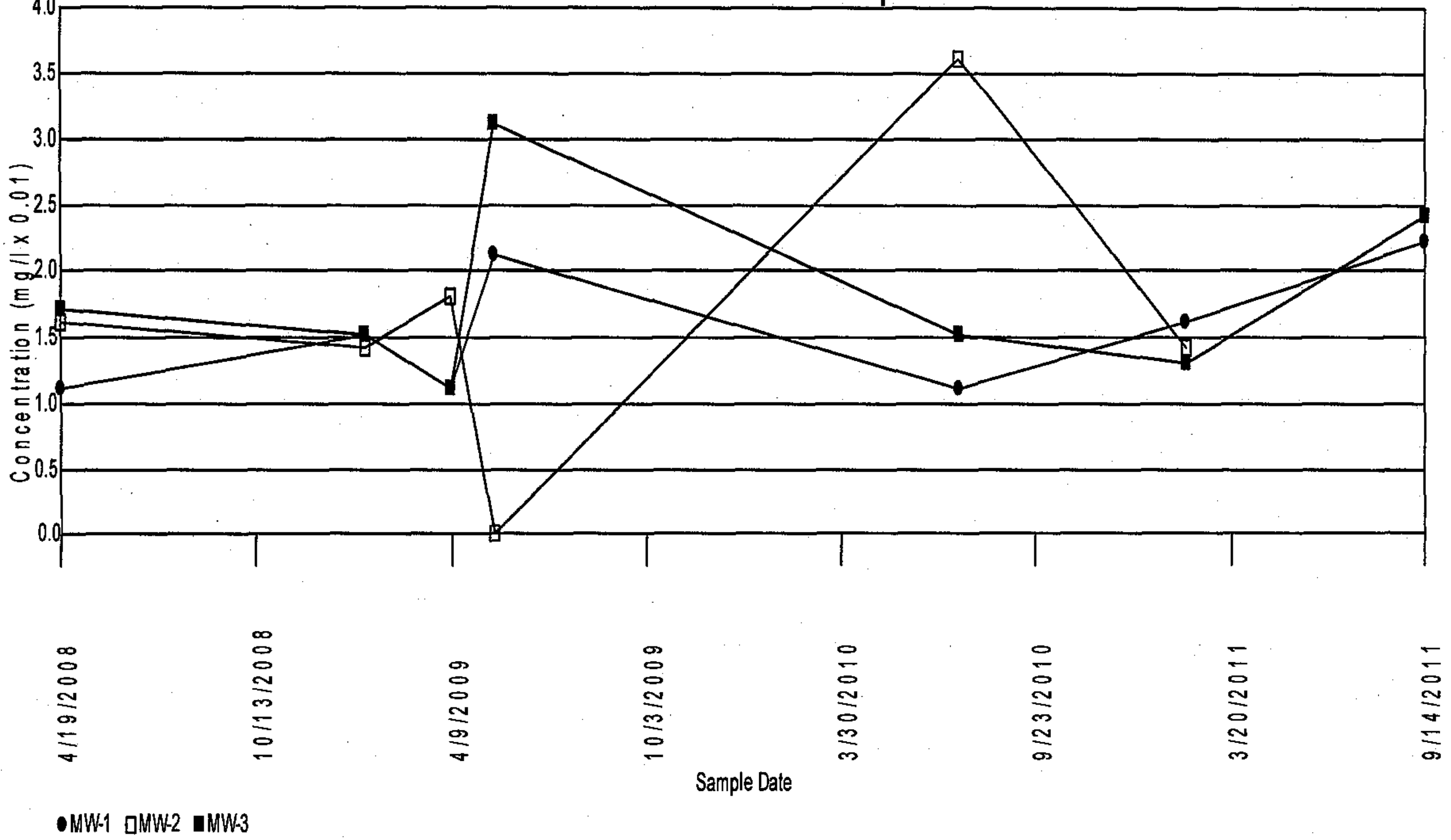
Lead

Multi-Well Time-Series Graph



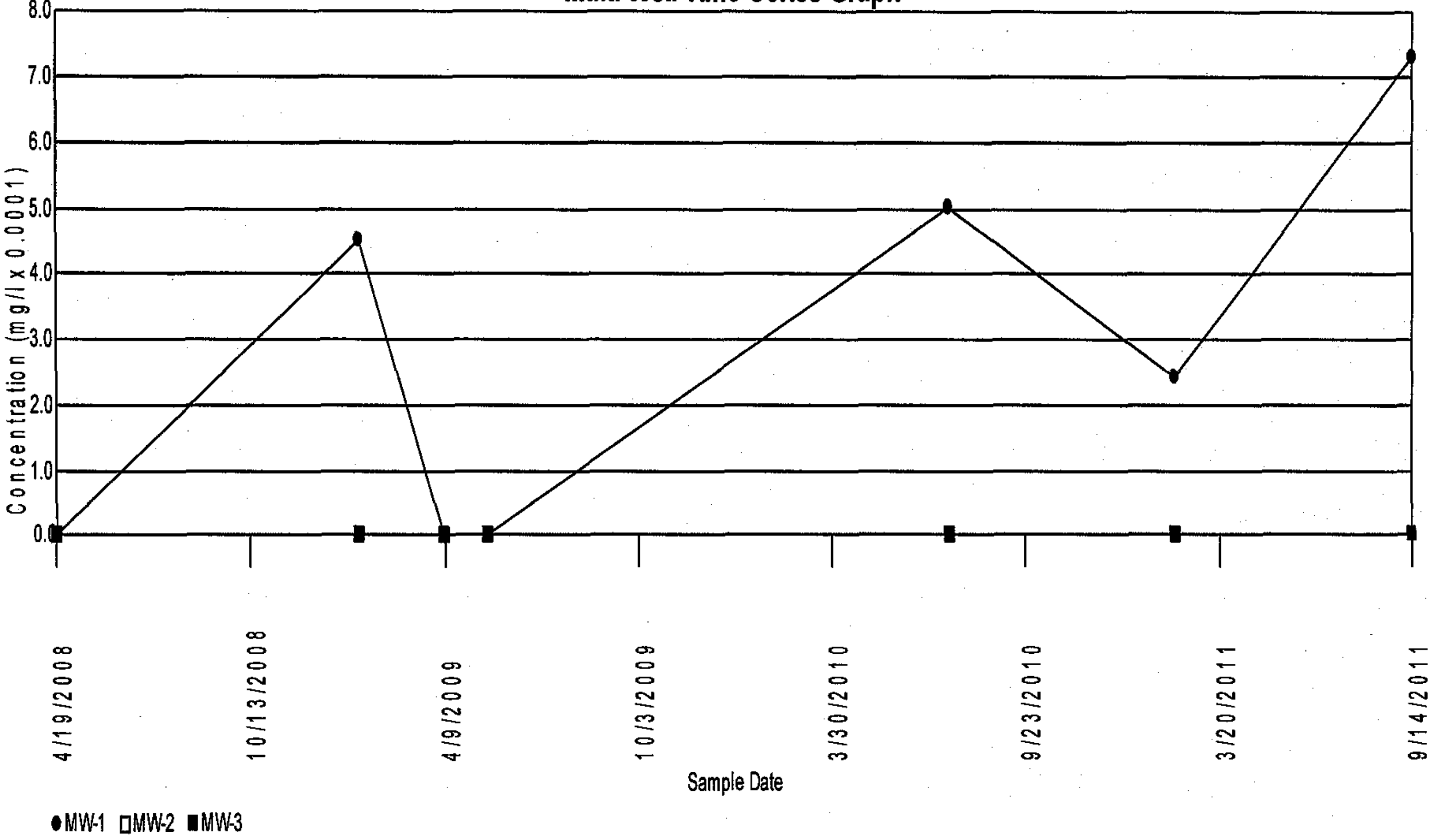
Zinc

Multi-Well Time-Series Graph



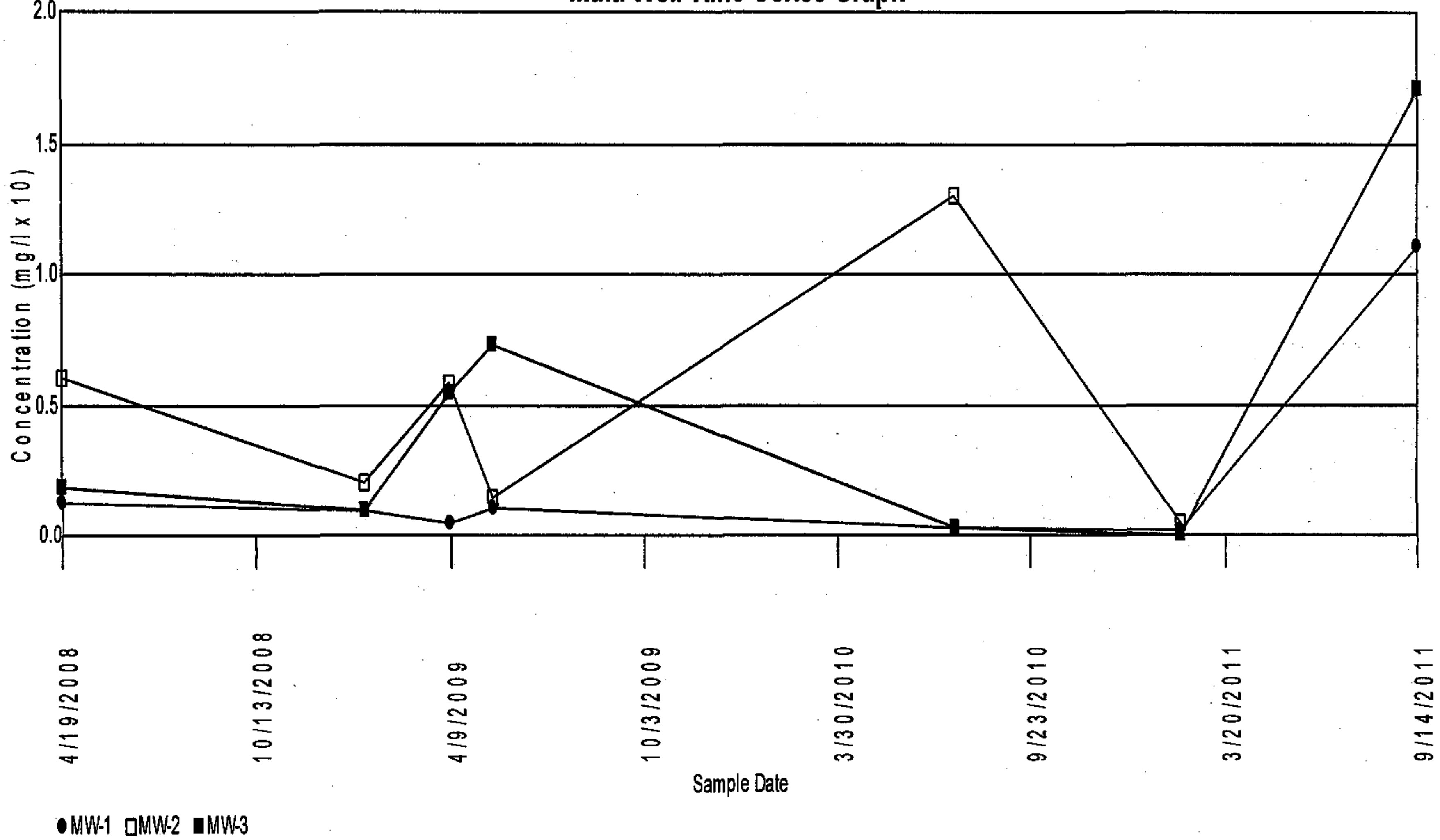
Mercury

Multi-Well Time-Series Graph



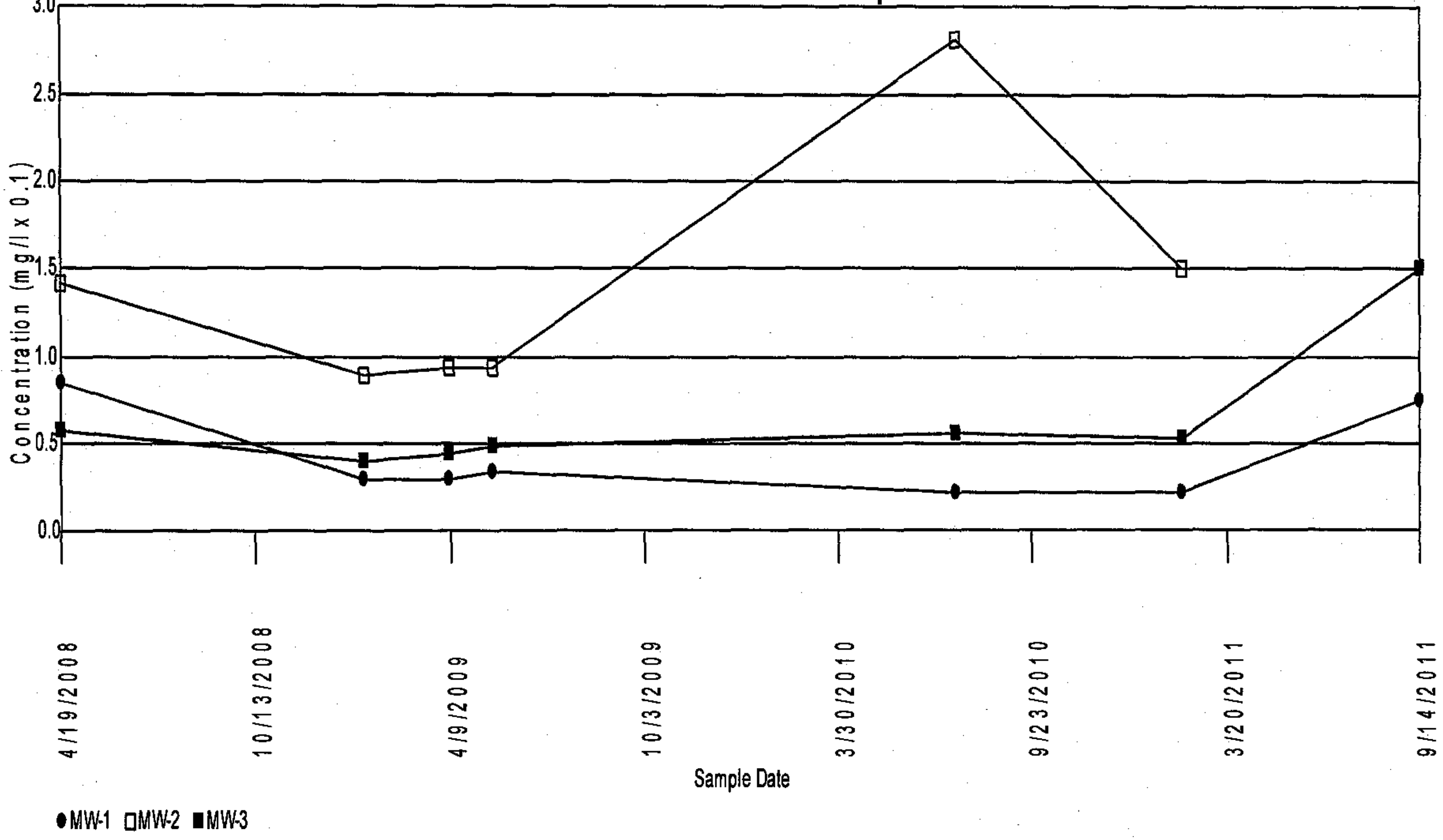
Aluminum

Multi-Well Time-Series Graph



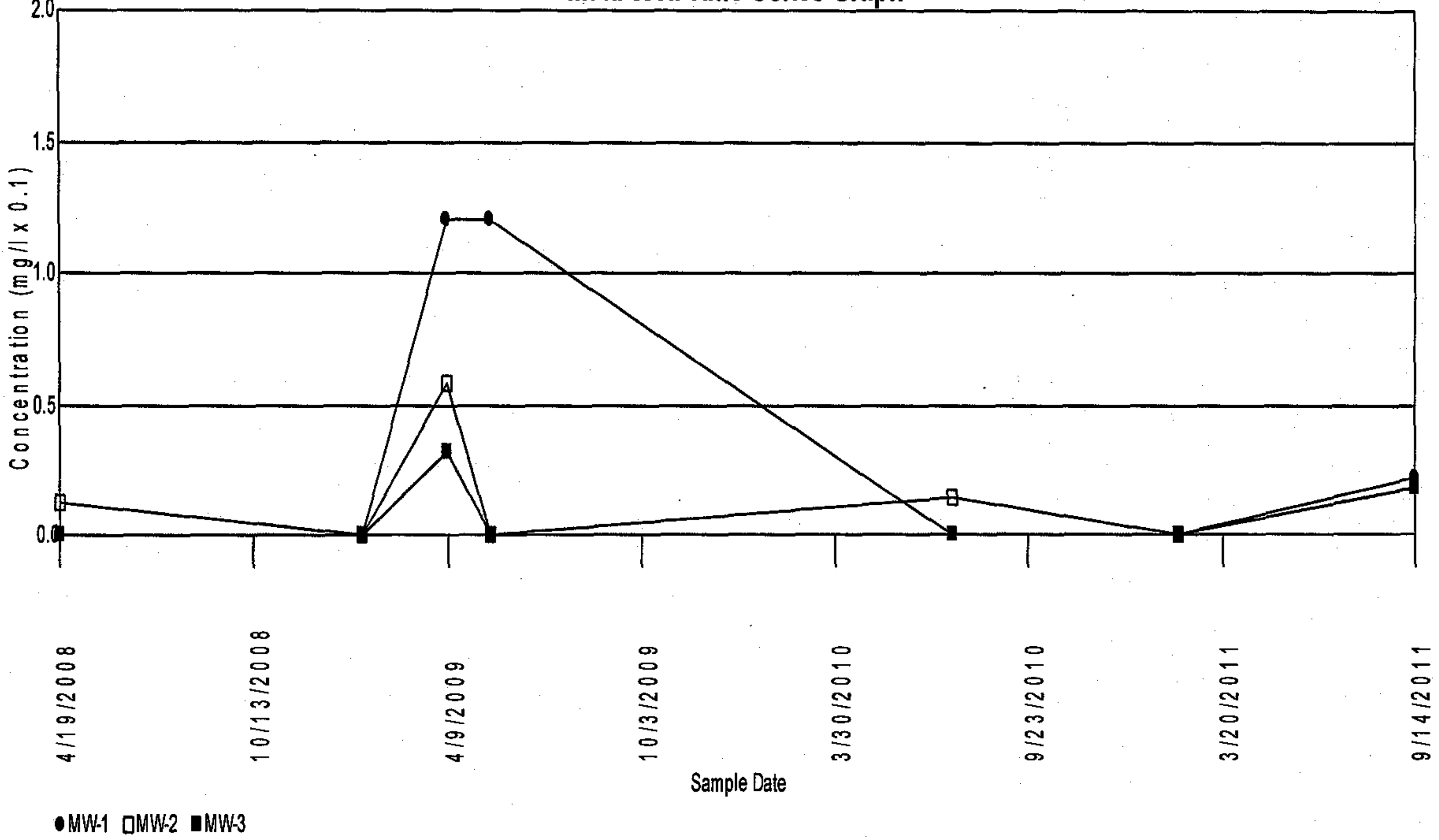
Barium

Multi-Well Time-Series Graph



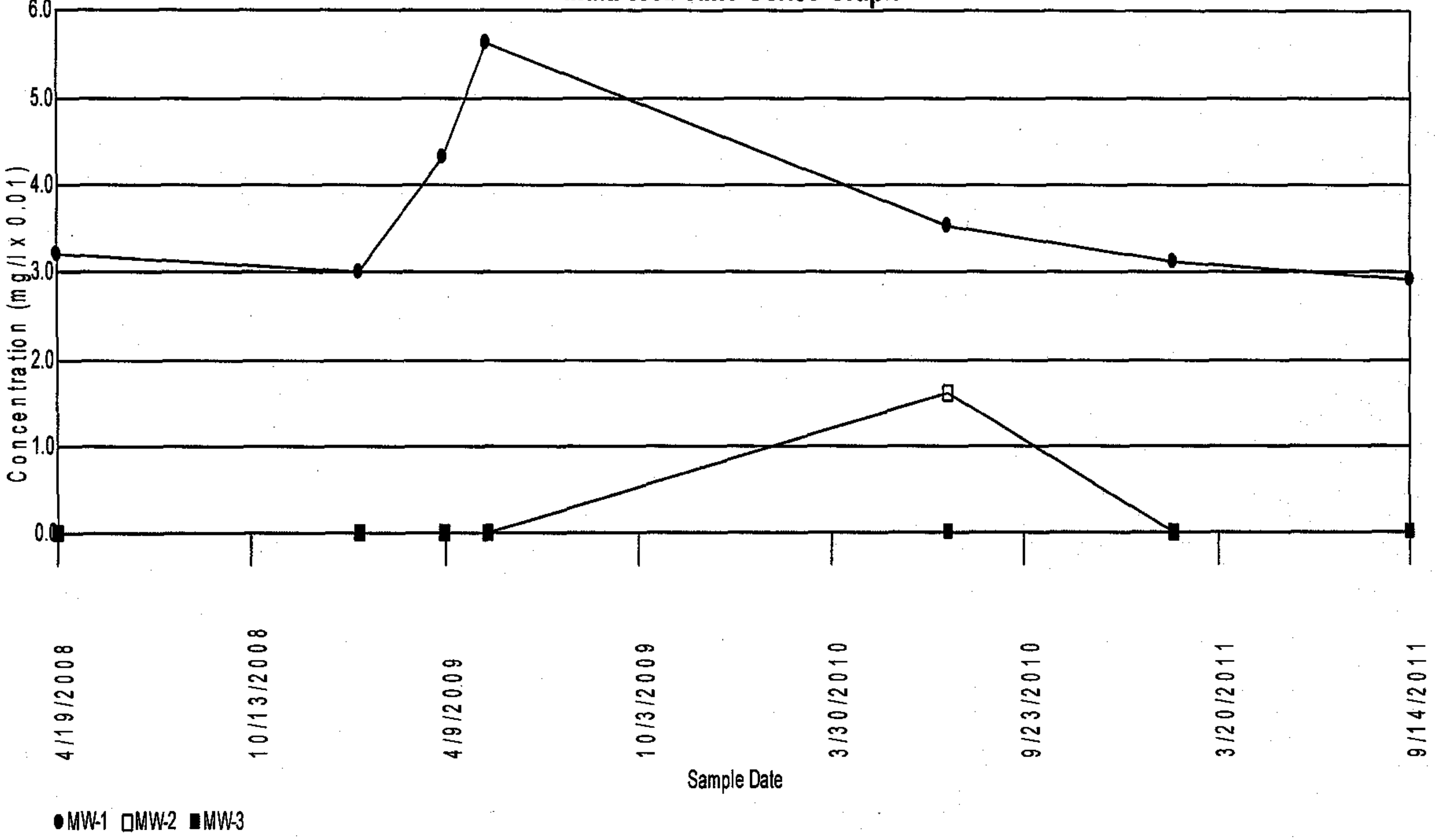
Chromium

Multi-Well Time-Series Graph



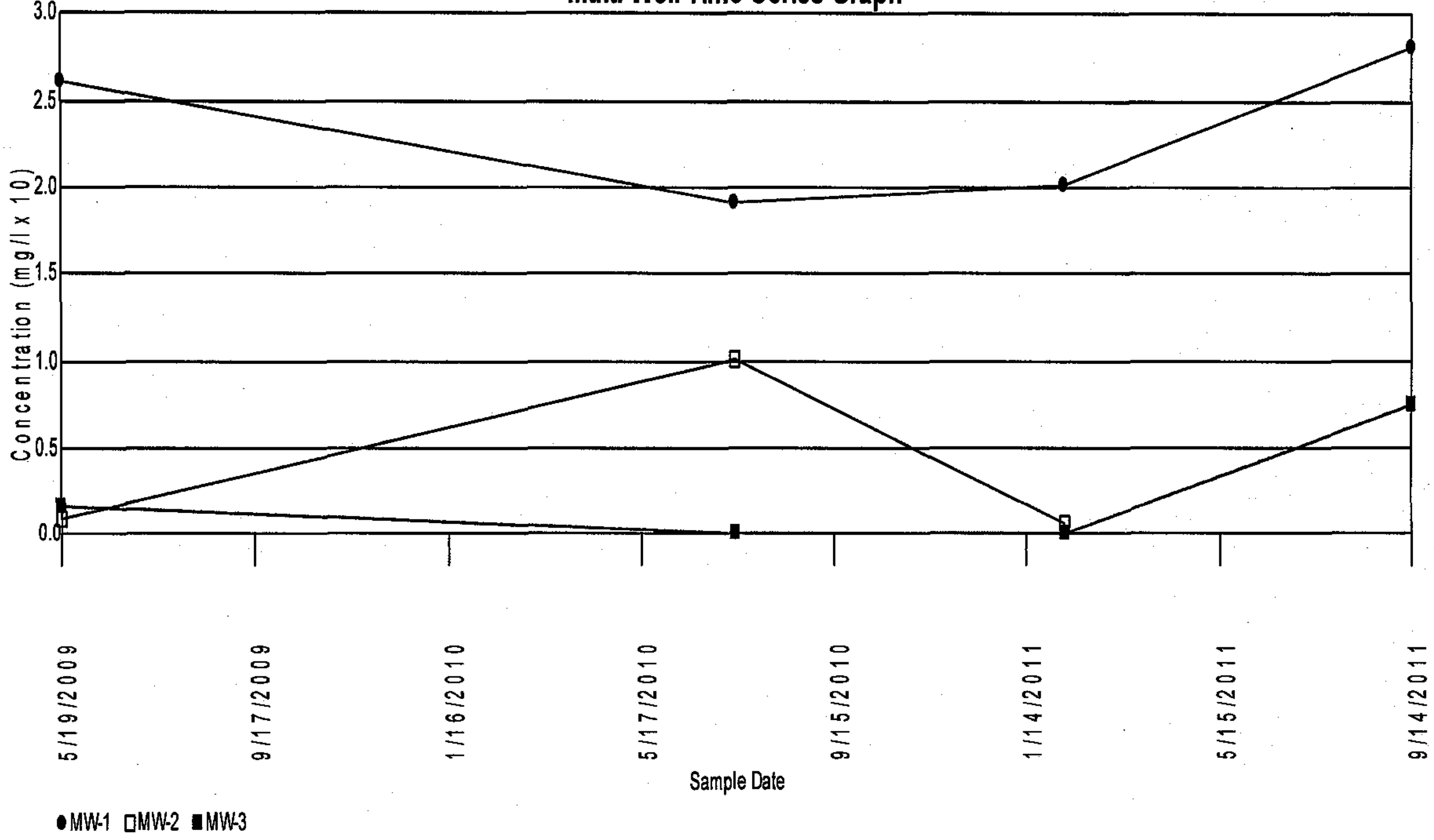
Cobalt

Multi-Well Time-Series Graph



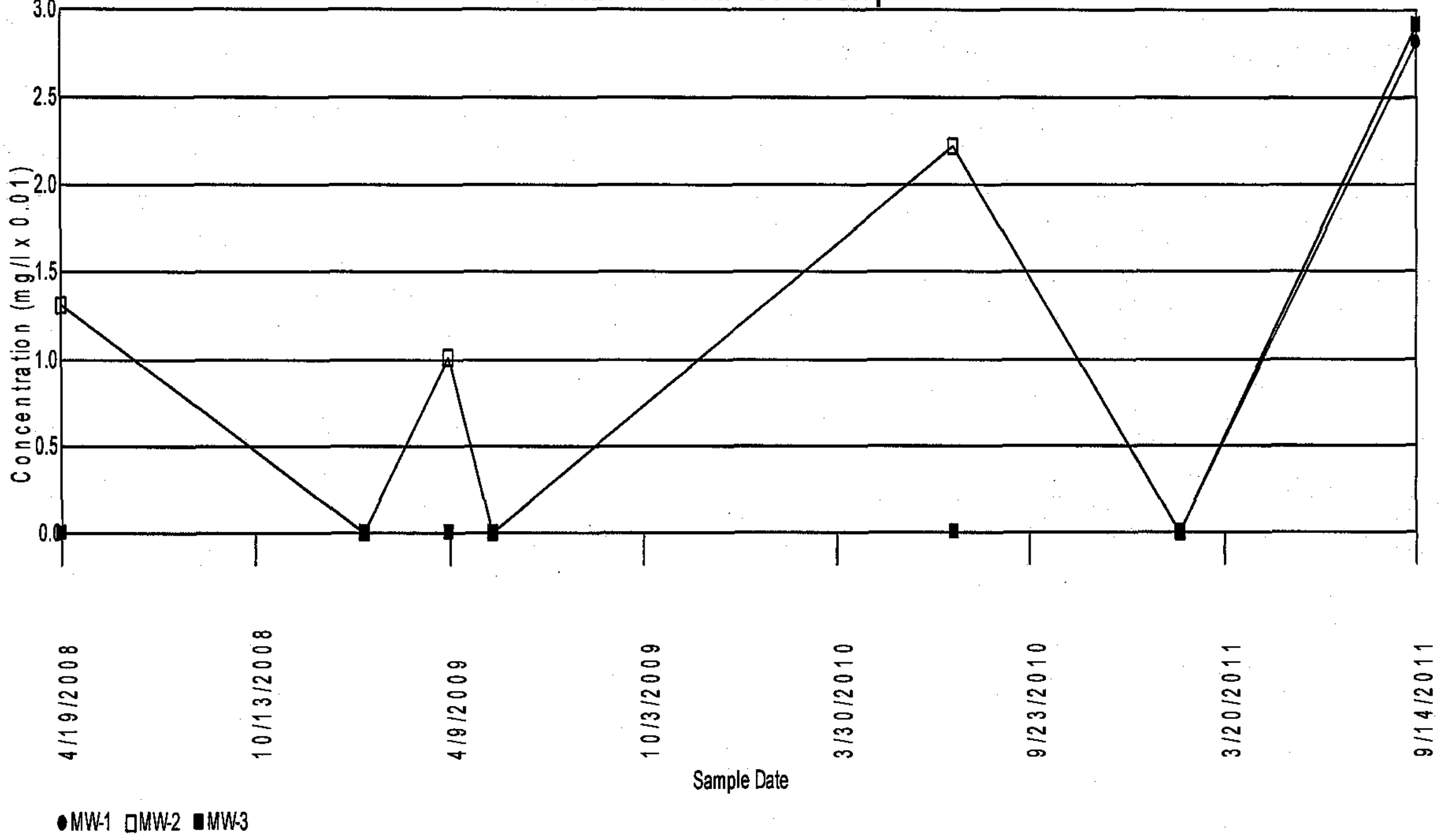
Iron

Multi-Well Time-Series Graph



Vanadium

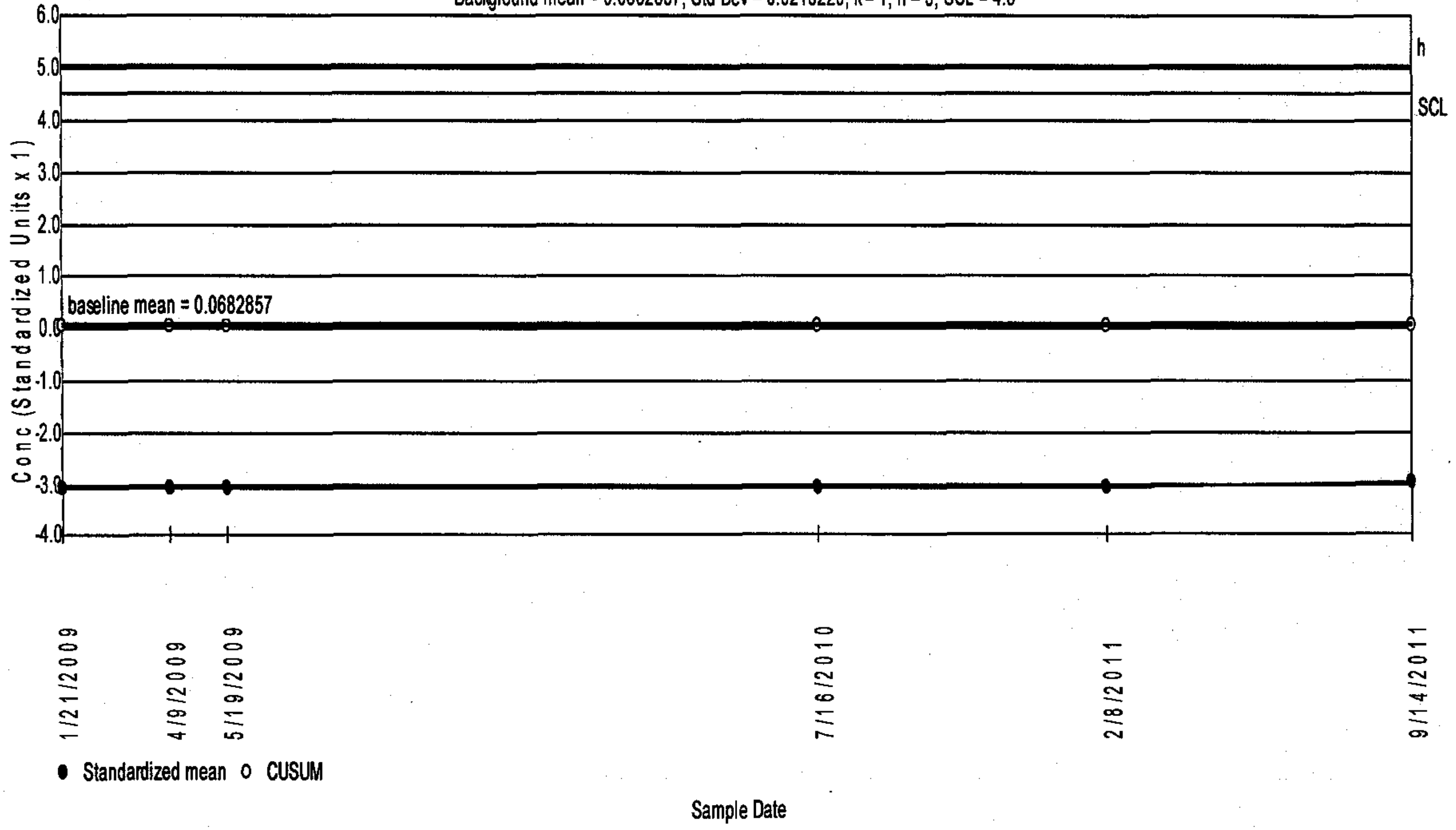
Multi-Well Time-Series Graph



Arsenic

Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-3

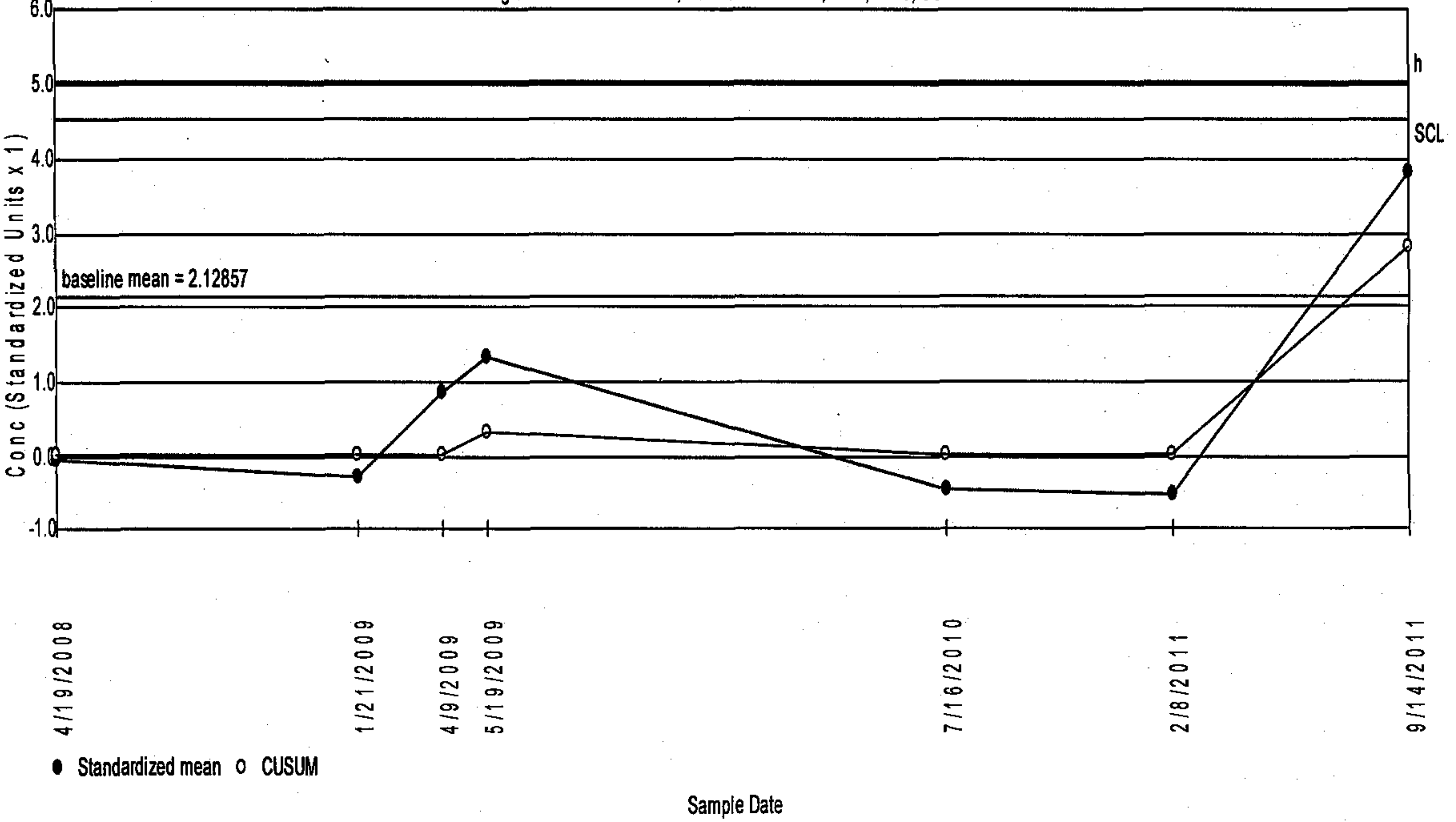
Background mean = 0.0682857; Std Dev = 0.0218229; k= 1; h = 5; SCL = 4.5



Aluminum

Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-3

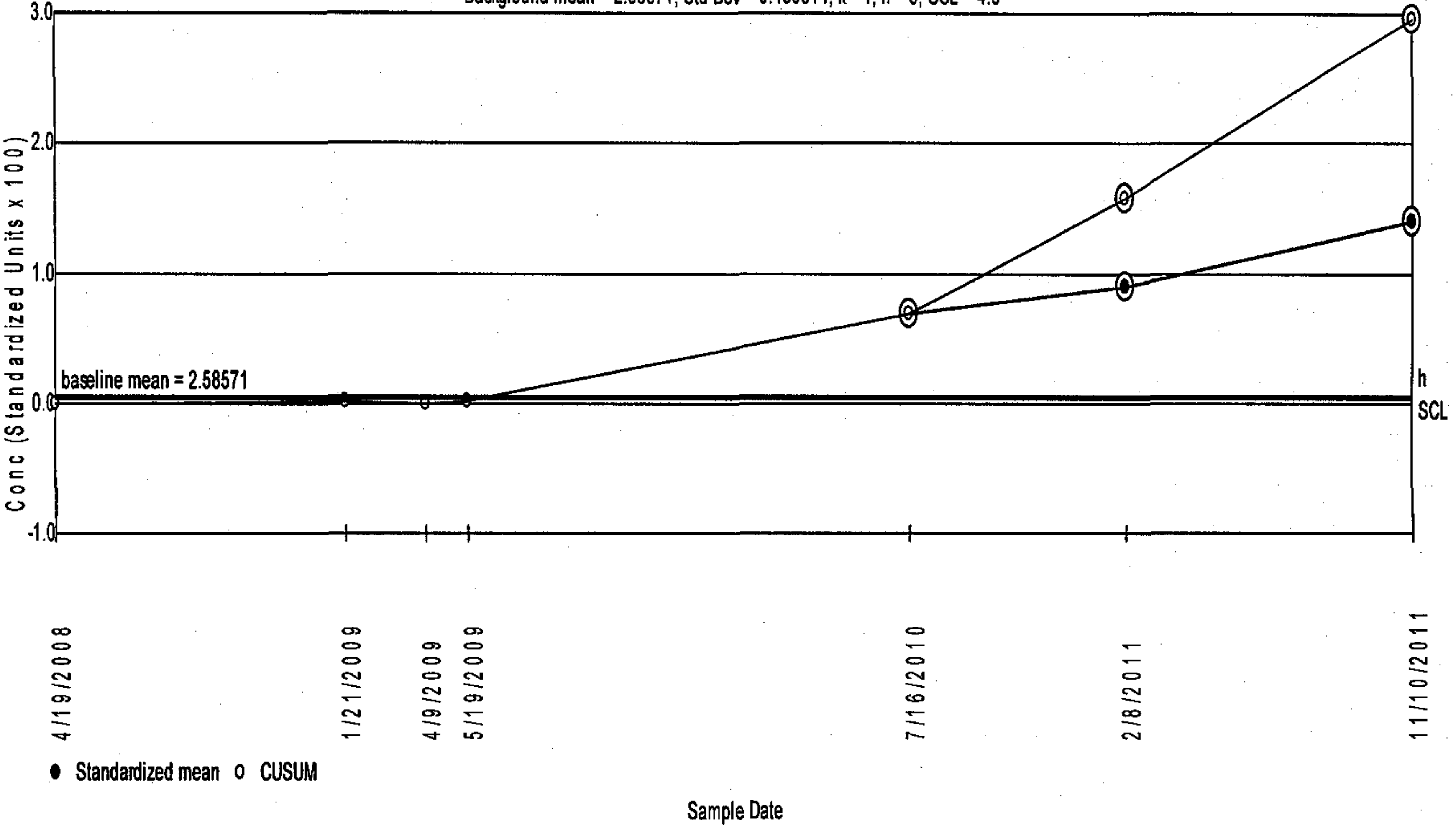
Background mean = 2.12857; Std Dev = 3.93395; k= 1; h = 5; SCL = 4.5

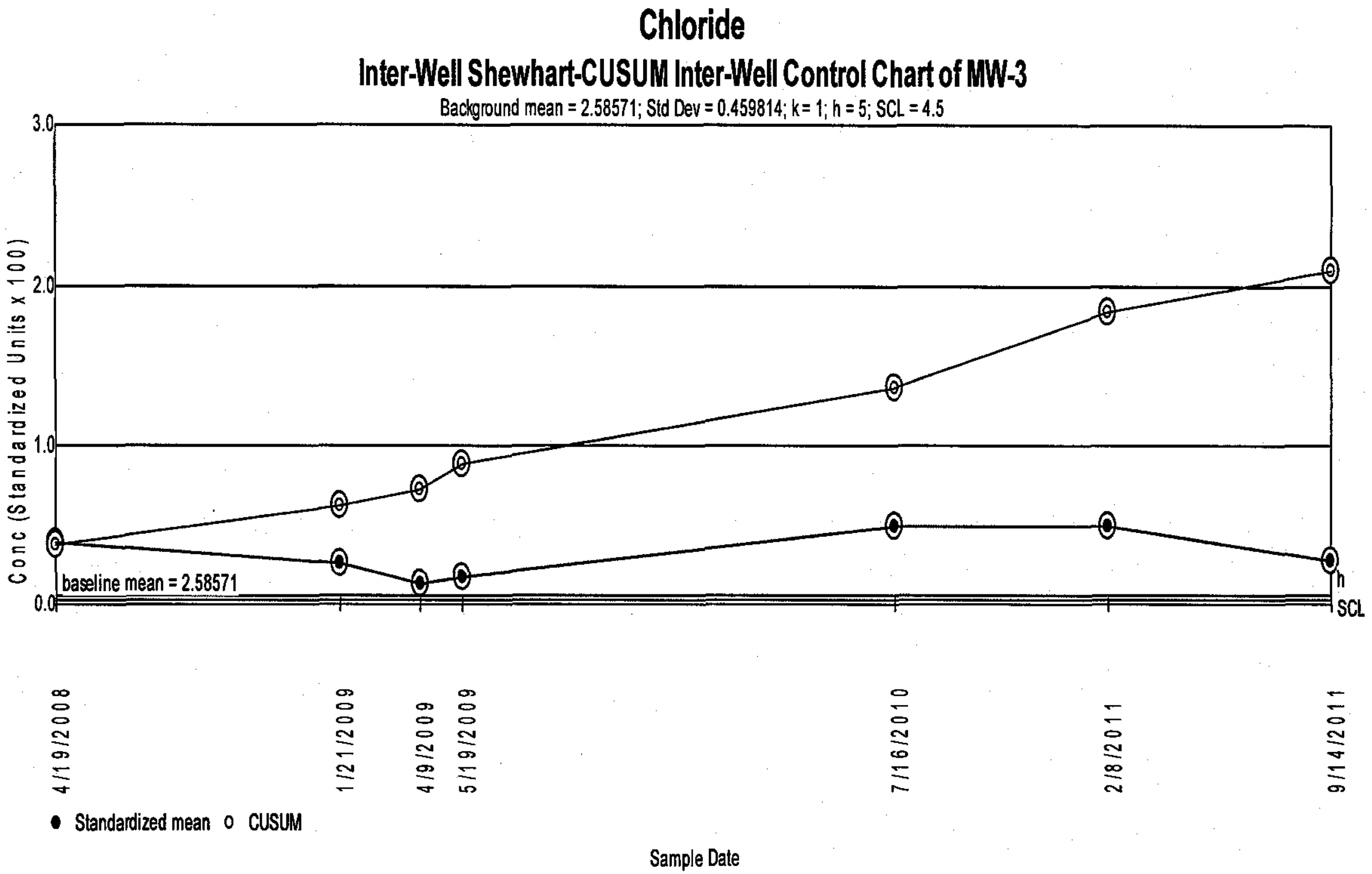


Chloride

Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-2

Background mean = 2.58571; Std Dev = 0.459814; k= 1; h = 5; SCL = 4.5





Chloride

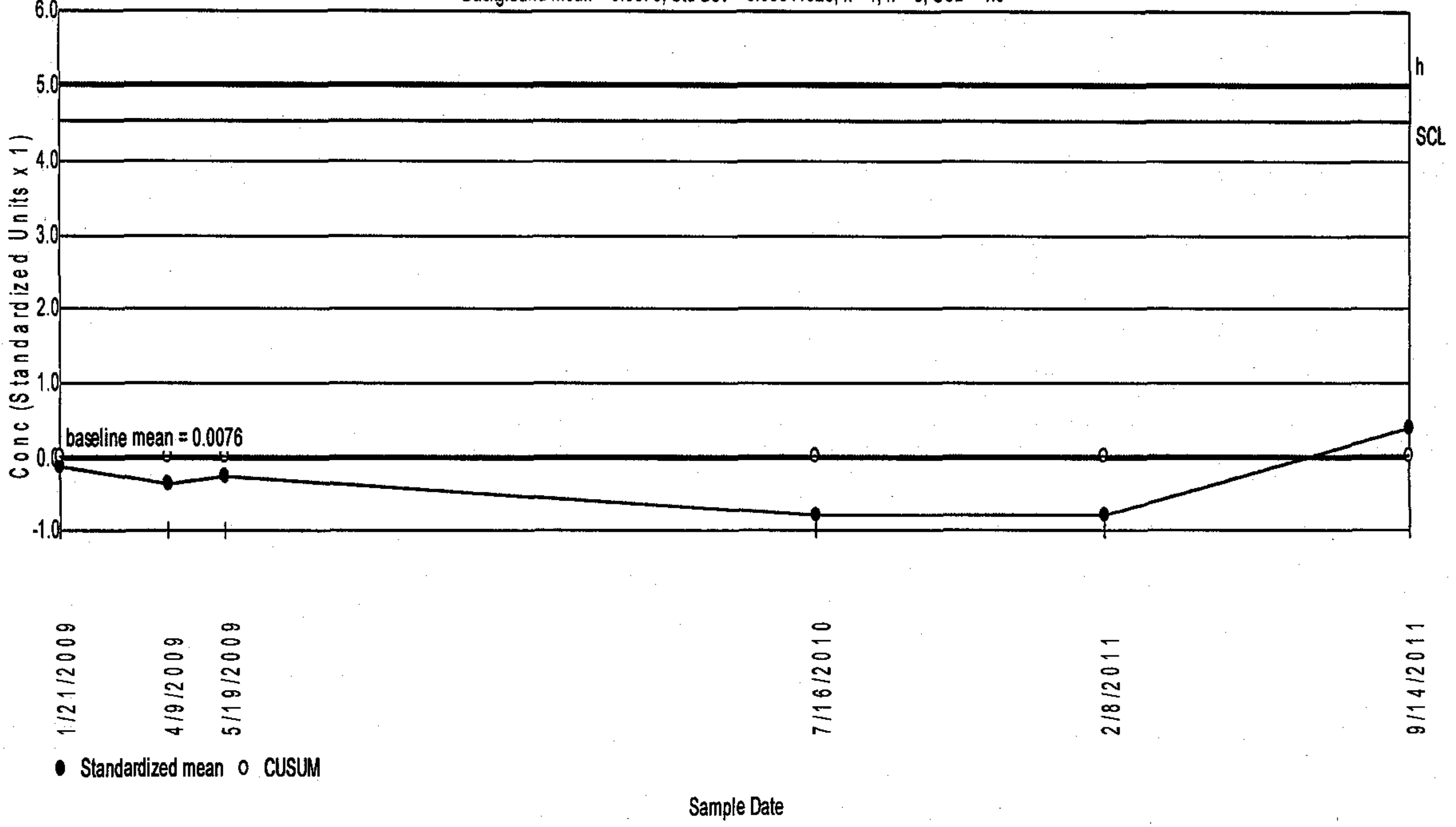
Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-3

Background mean = 2.58571; Std Dev = 0.459814; k = 1; h = 5; SCL = 4.5

Copper

Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-3

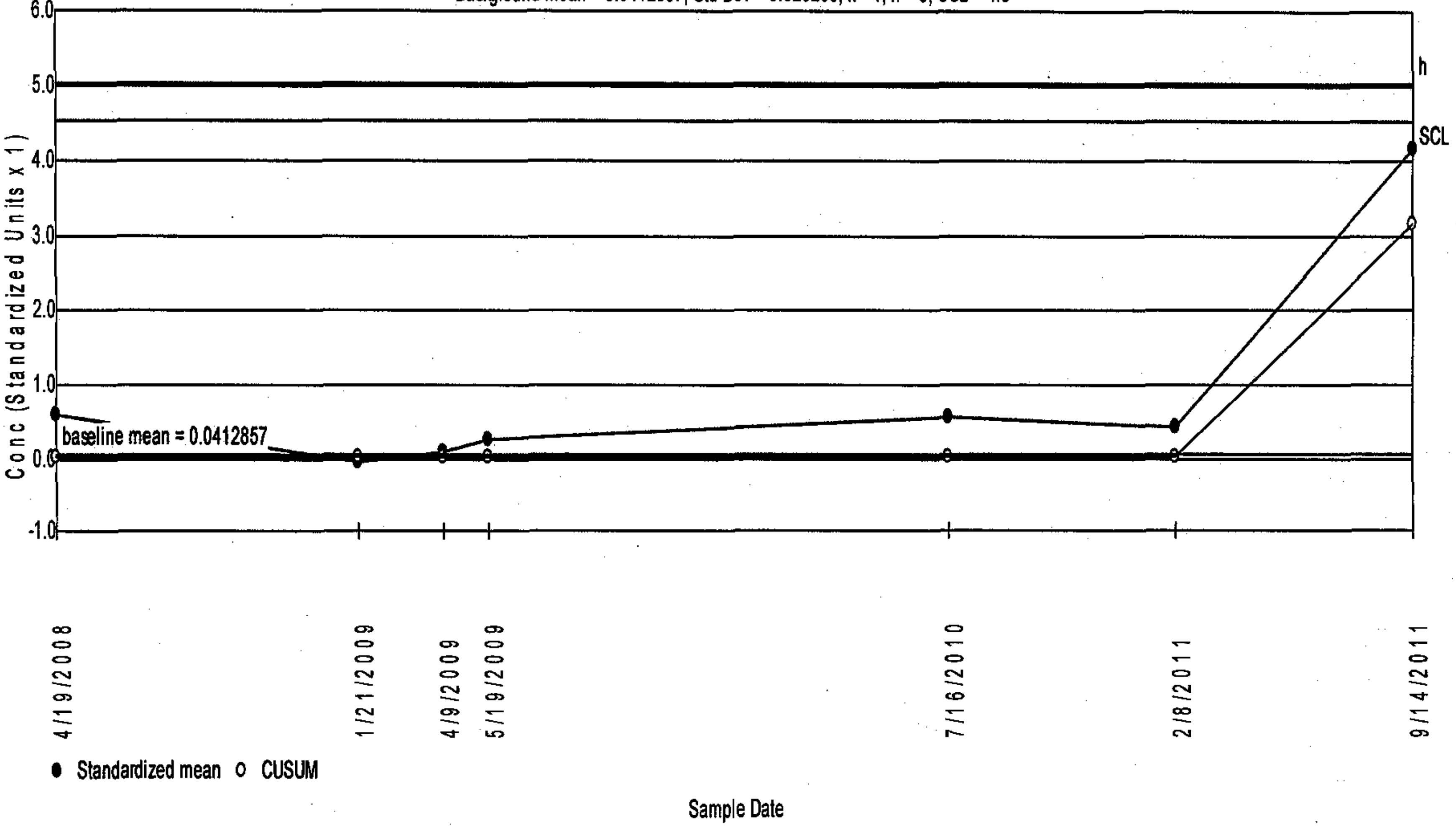
Background mean = 0.0076; Std Dev = 0.00941028; k = 1; h = 5; SCL = 4.5



Barium

Inter-Well Shewhart-CUSUM Inter-Well Control Chart of MW-3

Background mean = 0.0412857; Std Dev = 0.026266; k= 1; h = 5; SCL = 4.5



Non-Parametric Prediction Interval

Intra-Well Comparison for MW-1

Parameter: Arsenic

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.086
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	0.024
	1/21/2009	0.072
	4/9/2009	0.067
	5/19/2009	0.064
	7/16/2010	0.074
	2/8/2011	0.086

Date	Samples	Mean	Impacted
9/14/2011	1	0.091	TRUE

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Aluminum

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 1.2
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	1.2
	1/21/2009	0.94
	4/9/2009	0.44
	5/19/2009	1
	7/16/2010	0.2
	2/8/2011	0.12

Date	Samples	Mean	Impacted
9/14/2011	1	11	TRUE

Parametric Prediction Interval Analysis
Intra-Well Comparison for MW-1
Parameter: Cobalt

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well USEPA Style 95% Comparison
For 1 recent sampling event(s)
Future Samples (k) = 1
From 6 baseline samples
Baseline mean = 0.0378333 Std Dev = 0.0100681
95% confidence t = 2.01505 at 5 degrees of freedom
Actual confidence level is 1.0 - (0.05/1) = 95 %

Baseline Samples	Date	Result
	4/19/2008	0.032
	1/21/2009	0.03
	4/9/2009	0.043
	5/19/2009	0.056
	7/16/2010	0.035
	2/8/2011	0.031

Date	Samples	Mean	Interval	Impacted
9/14/2011	1	0.029	[0, 0.0597466]	FALSE

Non-Parametric Prediction Interval
Inter-Well Comparison
Parameter: Cobalt

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 60%
Number of comparisons = 2
Future Samples (k) = 2
Recent Dates = 1
Background Samples (n) = 7
Maximum Background Concentration = 0.056
Confidence Level = 77.8%
False Positive Rate = 22.2%

Well	Date	Samples	Mean	Impacted
MW-2	2/8/2011	1	0	FALSE
MW-3	9/14/2011	1	0	FALSE

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Copper

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 16.6667%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.028
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	0.0027
	1/21/2009	0.028
	4/9/2009	0.0064
	5/19/2009	0.0063
	7/16/2010	ND<0
	2/8/2011	0.0021

Date	Samples	Mean	Impacted
9/14/2011	1	0.0077	FALSE

Wilcoxon Non-Parametric Analysis (Inter-Well)

Parameter: Chloride

Well: MW-2

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total non detects is 0
Non detect rank is 0

Wilcoxon Ranks

Well	Date	Result	Rank
MW-1	4/19/2008	2	3
	1/21/2009	2.9	8
	4/9/2009	1.9	1
	5/19/2009	2.8	6
	7/16/2010	2.8	7
	2/8/2011	2.6	5
	9/14/2011	3.1	9
MW-2	4/19/2008	1.9	2
	1/21/2009	3.3	11
	4/9/2009	2.3	4
	5/19/2009	3.2	10
	7/16/2010	34	12
	2/8/2011	44	13
	11/10/2011	67	14

The Wilcoxon Statistic is 38
The Expected value is is 24.5
The Standard Deviation is 7.82624
The Z Score is 1.66108
The Standard Deviation adjusted for ties is 7.82624
The Z Score adjusted for ties is 7.82624
1.66108 < 2.326 indicating no contamination at 1% significance level
1.66108 < 2.326 indicating no contamination at 1% significance level when adjusted for ties

Wilcoxon Non-Parametric Analysis (Inter-Well)

Parameter: Chloride

Well: MW-3

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total non detects is 0
Non detect rank is 0

Wilcoxon Ranks

Well	Date	Result	Rank
MW-1	4/19/2008	2	2
	1/21/2009	2.9	6
	4/9/2009	1.9	1
	5/19/2009	2.8	4
	7/16/2010	2.8	5
	2/8/2011	2.6	3
	9/14/2011	3.1	7
MW-3	4/19/2008	20	12
	1/21/2009	14	10
	4/9/2009	8.2	8
	5/19/2009	10	9
	7/16/2010	25	13
	2/8/2011	25	14
	9/14/2011	15	11

The Wilcoxon Statistic is 49
The Expected value is is 24.5
The Standard Deviation is 7.82624
The Z Score is 3.06661
The Standard Deviation adjusted for ties is 7.82624
The Z Score adjusted for ties is 7.82624
3.06661 > 2.326 indicating possible contamination at 1% significance level
3.06661 > 2.326 indicating possible contamination at 1% significance level when adjusted for ties

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Chromium

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 66.6667%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.12
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	ND<0
	1/21/2009	ND<0
	4/9/2009	0.12
	5/19/2009	0.12
	7/16/2010	ND<0
	2/8/2011	ND<0

Date	Samples	Mean	Impacted
9/14/2011	1	0.022	FALSE

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Chromium

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 60%
Number of comparisons = 2
Future Samples (k) = 2
Recent Dates = 1
Background Samples (n) = 7
Maximum Background Concentration = 0.12
Confidence Level = 77.8%
False Positive Rate = 22.2%

Well	Date	Samples	Mean	Impacted
MW-2	2/8/2011	1	0	FALSE
MW-3	9/14/2011	1	0.018	FALSE

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Barium

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.084
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	0.084
	1/21/2009	0.028
	4/9/2009	0.028
	5/19/2009	0.033
	7/16/2010	0.021
	2/8/2011	0.021

Date	Samples	Mean	Impacted
9/14/2011	1	0.074	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-1

Parameter: Lead

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 83.3333%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.0094
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	ND<0
	1/21/2009	0.0094
	4/9/2009	ND<0
	5/19/2009	ND<0
	7/16/2010	ND<0
	2/8/2011	ND<0

Date	Samples	Mean	Impacted
9/14/2011	1	0.0038	FALSE

Non-Parametric Prediction Interval
Inter-Well Comparison
Parameter: Lead

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 65%
Number of comparisons = 2
Future Samples (k) = 2
Recent Dates = 1
Background Samples (n) = 7
Maximum Background Concentration = 0.0094
Confidence Level = 77.8%
False Positive Rate = 22.2%

Well	Date	Samples	Mean	Impacted
MW-2	2/8/2011	1	0	FALSE
MW-3	9/14/2011	1	0.0072	FALSE

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Mercury

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 50%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0.0005
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	ND<0
	1/21/2009	0.00045
	4/9/2009	ND<0
	5/19/2009	ND<0
	7/16/2010	0.0005
	2/8/2011	0.00024

Date	Samples	Mean	Impacted
9/14/2011	1	0.00073	TRUE

Non-Parametric Prediction Interval

Inter-Well Comparison

Parameter: Mercury

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 80%
Number of comparisons = 2
Future Samples (k) = 2
Recent Dates = 1
Background Samples (n) = 7
Maximum Background Concentration = 0.00073
Confidence Level = 77.8%
False Positive Rate = 22.2%

Well	Date	Samples	Mean	Impacted
MW-2	2/8/2011	1	0	FALSE
MW-3	9/14/2011	1	0	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-1

Parameter: Vanadium

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 100%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 0
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	ND<0
	1/21/2009	ND<0
	4/9/2009	ND<0
	5/19/2009	ND<0
	7/16/2010	ND<0
	2/8/2011	ND<0

Date	Samples	Mean	Impacted
9/14/2011	1	0.028	TRUE

Non-Parametric Prediction Interval
Inter-Well Comparison
Parameter: Vanadium

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 75%
Number of comparisons = 2
Future Samples (k) = 2
Recent Dates = 1
Background Samples (n) = 7
Maximum Background Concentration = 0.028
Confidence Level = 77.8%
False Positive Rate = 22.2%

Well	Date	Samples	Mean	Impacted
MW-2	2/8/2011	1	0	FALSE
MW-3	9/14/2011	1	0.029	TRUE

Wilcoxon Non-Parametric Analysis (Inter-Well)

Parameter: Vanadium

Well: MW-3

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total non detects is 12
Non detect rank is 6.5

Wilcoxon Ranks

Well	Date	Result	Rank
MW-1	4/19/2008	ND<0	6.5
	1/21/2009	ND<0	6.5
	4/9/2009	ND<0	6.5
	5/19/2009	ND<0	6.5
	7/16/2010	ND<0	6.5
	2/8/2011	ND<0	6.5
	9/14/2011	0.028	13
MW-3	4/19/2008	ND<0	6.5
	1/21/2009	ND<0	6.5
	4/9/2009	ND<0	6.5
	5/19/2009	ND<0	6.5
	7/16/2010	ND<0	6.5
	2/8/2011	ND<0	6.5
	9/14/2011	0.029	14

The Wilcoxon Statistic is 25
The Expected value is is 24.5
The Standard Deviation is 7.82624
The Z Score is 0
The Standard Deviation adjusted for ties is 4.7697
The Z Score adjusted for ties is 4.7697
0 < 2.326 indicating no contamination at 1% significance level
0 < 2.326 indicating no contamination at 1% significance level when adjusted for ties

Non-Parametric Prediction Interval
Intra-Well Comparison for MW-1
Parameter: Chloride

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Samples (n) = 6
Maximum Baseline Concentration = 2.9
Confidence Level = 85.7%
False Positive Rate = 14.3%

Baseline Samples	Date	Result
	4/19/2008	2
	1/21/2009	2.9
	4/9/2009	1.9
	5/19/2009	2.8
	7/16/2010	2.8
	2/8/2011	2.6

Date	Samples	Mean	Impacted
9/14/2011	1	3.1	TRUE

Wilcoxon Non-Parametric Analysis (Inter-Well)

Parameter: Chloride

Well: MW-2

Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total non detects is 0
Non detect rank is 0

Wilcoxon Ranks

Well	Date	Result	Rank
MW-1	4/19/2008	2	3
	1/21/2009	2.9	8
	4/9/2009	1.9	1
	5/19/2009	2.8	6
	7/16/2010	2.8	7
	2/8/2011	2.6	5
	9/14/2011	3.1	9
MW-2	4/19/2008	1.9	2
	1/21/2009	3.3	11
	4/9/2009	2.3	4
	5/19/2009	3.2	10
	7/16/2010	34	12
	2/8/2011	44	13
	11/10/2011	67	14

The Wilcoxon Statistic is 38
The Expected value is is 24.5
The Standard Deviation is 7.82624
The Z Score is 1.66108
The Standard Deviation adjusted for ties is 7.82624
The Z Score adjusted for ties is 7.82624
1.66108 < 2.326 indicating no contamination at 1% significance level
1.66108 < 2.326 indicating no contamination at 1% significance level when adjusted for ties

03-02-01 MONITORING WELLS USING CONVENTIONAL PURGING

I. **SCOPE AND APPLICABILITY:** This procedure is applicable to the sampling of monitoring wells which do not contain free product using conventional purge methodology.

II. PROJECT-SPECIFIC REQUIREMENTS

A. SAMPLE LOCATIONS AND NUMBERING SYSTEM:

B. ANALYTICAL PARAMETERS AND SAMPLE FREQUENCY:

C. FIELD SCREENING AND ANALYSES: *Reference appropriate SOPs.*

D. QUALITY ASSURANCE SAMPLES: *Number and type of blanks and duplicates. Reference SOPs 04-01-01, 04-01-02, and 04-02-01 as appropriate.*

E. FILTRATION:

F. PURGE CRITERION AND DISPOSAL OF PURGE WATER:

G. WELL KEYS: *Indicate whether wells use CEC's standard key*

H. DEDICATED EQUIPMENT: *Indicate whether dedicated pumps or bailers have been installed.*

I. OTHER REQUIREMENTS:

III. **METHODOLOGY:** Monitoring wells should be sampled progressing from least contaminated to most contaminated to reduce the chances of cross contamination between samples. If a bailer is employed, use new rope for each well.

A. PURGING: Purging is performed to remove static water standing in the well bore, thereby allowing collection of a sample representative of water in the aquifer. Unless otherwise specified in Section II.F., well development may suffice for the purge, so long as the sample is collected immediately following development.

1. Measure the water level from the top of the riser pipe at the pre-marked reference point (SOP 06-01-01).

2. Calculate the purge volume using the data presented in Exhibit 03-02-01 and the criterion presented in Section II.F.

3. Remove the required volume of water using one of the following methods. If the well goes dry, the purge can be considered complete unless otherwise specified in Section II.F. However, attempts should be made to prevent the well from going dry during purging, drying the well disrupts the flow regime and can result in the loss of volatile compounds. Therefore:

≅ If a well is known to have a low yield, it should be purged by bailing.

≅ If a pump is used for purging, adjust the pumping rate to maintain a water column in the well, if possible.

≅ Do not attempt to purge a well to dryness unless it is infeasible to maintain water in the well at a reasonable purge rate.

METHOD A: If the purge criterion is specified on volume of water to be removed:

a. Remove the required volume of water using a submersible pump or bailer. If a pump is used, a check valve must be installed on the pump to prevent pumped water from returning to the well. Begin purging at the top of the water column. Minimize aeration of the water during purging by pumping at a low rate or lowering the bailer gently into the water.

b. Lower the pump or bailer as necessary to continue purging until the well volume criterion is met.

METHOD B: If the purge criteria are specified on stabilization of field analyses:

a. Measure initial water quality by retrieving a sample from the top of the water column using a bailer. Conduct the field analyses specified in Section II.F. Record these results on the Groundwater Monitoring Data Sheet (SOP 07-02-01).

b. Remove one well volume of water by submersible pump or bailer. If a pump is used, a check valve must be installed to prevent water from returning to the well. Begin purging at the top of the water column. Minimize aeration of the water during purging by pumping at a low rate or lowering the bailer gently into the water.

c. After one well volume has been removed, conduct field analyses on the groundwater being discharged. Record results on the Monitoring Sampling Data Sheet.

d. Repeat steps b and c until the purge criteria have been met.

B. SAMPLE COLLECTION: Groundwater samples should be collected immediately after purging , if the well will yield sufficiently. Some low-yielding wells may require time to recover prior to sampling. If the well will not yield a sample immediately after purging, a maximum of 24 hours between purging and sampling is permitted.

1. Collect water from the well by slowly lowering a decontaminated bailer into the water column.

2. Transfer the samples which do not require filtering directly into sample bottles in the following order:

Volatile Organic Compounds
Semi-Volatile Organic Compounds
Pesticides and PCBs
Cations and Anions
Radionuclides
Bacteria.

3. If indicated in Section II.E., filter the required aliquots (SOP 05-03-02 or 05-03-03) and fill those sample bottles.

4. Preserve the samples immediately in accordance with SOP 07-01-02.

5. Conduct field analyses: pH (SOP 05-04-01 or 05-04-04), temperature, specific conductance (SOP 05-04-02), dissolved oxygen (SOP 05-04-03), Eh (SOP 05-04-08), and any other parameters listed in Section II.C.

6. If a dedicated sample bailer was used, return it to the well head. Otherwise, decontaminate the bailer as specified in SOP 01-01-00.

7. Replace the well cap and lock the protective casing.

8. Collect quality-assurance samples specified in Section II.D in accordance with SOP 04-01-01, 04-01-02, and 04-02-01.

9. Decontaminate samples in accordance with SOP 01-01-00.

10. Pack and ship the samples in accordance with SOP 07-01-03. Samples should be shipped on a daily basis and such that holding time requirements (SOP 07-01-02) can be met.

IV. PRECAUTIONS AND COMMON PROBLEMS

A. When using a bailer, do not allow the rope to drag on the ground. If necessary, lay out plastic sheeting to catch the rope.

B. When using a pump, exercise caution to prevent cross-contaminating samples with the hose. Do not sample from the pump discharge for trace organic compounds. Always use a check valve if not using a dedicated hose. Discard hose if there is a question about whether it can be adequately decontaminated.

C. Check the holding times on the analyses to be conducted. The holding time for some parameters is 24 hours. Plan sampling and shipping of these samples accordingly.

D. Preserve samples immediately after collection, including keeping them cool. Do not let samples sit in a hot vehicle until the end of the day.

V. DOCUMENTATION

A. Record information on a Groundwater Monitoring Data Sheet (SOP 07-02-01).

B. Prepare a Trip Report (SOP 07-02-04) and include:

≅ Time, date, and method of sample shipment
≅ Preservation methods and sample handling
≅ Description of purge and sampling methods
≅ The Groundwater Monitoring Data Sheet.

VII. REFERENCES

None

03-02-01 MONITORING WELLS USING CONVENTIONAL PURGING

I. **SCOPE AND APPLICABILITY:** This procedure is applicable to the sampling of monitoring wells which do not contain free product using conventional purge methodology.

II. **PROJECT-SPECIFIC REQUIREMENTS**

A. SAMPLE LOCATIONS AND NUMBERING SYSTEM:

B. ANALYTICAL PARAMETERS AND SAMPLE FREQUENCY:

C. FIELD SCREENING AND ANALYSES: *Reference appropriate SOPs.*

D. QUALITY ASSURANCE SAMPLES: *Number and type of blanks and duplicates. Reference SOPs 04-01-01, 04-01-02, and 04-02-01 as appropriate.*

E. FILTRATION:

F. PURGE CRITERION AND DISPOSAL OF PURGE WATER:

G. WELL KEYS: *Indicate whether wells use CEC's standard key*

H. DEDICATED EQUIPMENT: *Indicate whether dedicated pumps or bailers have been installed.*

I. OTHER REQUIREMENTS:

III. **METHODOLOGY:** Monitoring wells should be sampled progressing from least contaminated to most contaminated to reduce the chances of cross contamination between samples. If a bailer is employed, use new rope for each well.

A. PURGING: Purging is performed to remove static water standing in the well bore, thereby allowing collection of a sample representative of water in the aquifer. Unless otherwise specified in Section II.F., well development may suffice for the purge, so long as the sample is collected immediately following development.

1. Measure the water level from the top of the riser pipe at the pre-marked reference point (SOP 06-01-01).

2. Calculate the purge volume using the data presented in Exhibit 03-02-01 and the criterion presented in Section II.F.

3. Remove the required volume of water using one of the following methods. If the well goes dry, the purge can be considered complete unless otherwise specified in Section II.F. However, attempts should be made to prevent the well from going dry during purging, drying the well disrupts the flow regime and can result in the loss of volatile compounds. Therefore:

≅ If a well is known to have a low yield, it should be purged by bailing.

≅ If a pump is used for purging, adjust the pumping rate to maintain a water column in the well, if possible.

≅ Do not attempt to purge a well to dryness unless it is infeasible to maintain water in the well at a reasonable purge rate.

METHOD A: If the purge criterion is specified on volume of water to be removed:

a. Remove the required volume of water using a submersible pump or bailer. If a pump is used, a check valve must be installed on the pump to prevent pumped water from returning to the well. Begin purging at the top of the water column. Minimize aeration of the water during purging by pumping at a low rate or lowering the bailer gently into the water.

b. Lower the pump or bailer as necessary to continue purging until the well volume criterion is met.

METHOD B: If the purge criteria are specified on stabilization of field analyses:

a. Measure initial water quality by retrieving a sample from the top of the water column using a bailer. Conduct the field analyses specified in Section II.F. Record these results on the Groundwater Monitoring Data Sheet (SOP 07-02-01).

b. Remove one well volume of water by submersible pump or bailer. If a pump is used, a check valve must be installed to prevent water from returning to the well. Begin purging at the top of the water column. Minimize aeration of the water during purging by pumping at a low rate or lowering the bailer gently into the water.

c. After one well volume has been removed, conduct field analyses on the groundwater being discharged. Record results on the Monitoring Sampling Data Sheet.

d. Repeat steps b and c until the purge criteria have been met.

B. SAMPLE COLLECTION: Groundwater samples should be collected immediately after purging , if the well will yield sufficiently. Some low-yielding wells may require time to recover prior to sampling. If the well will not yield a sample immediately after purging, a maximum of 24 hours between purging and sampling is permitted.

1. Collect water from the well by slowly lowering a decontaminated bailer into the water column.

2. Transfer the samples which do not require filtering directly into sample bottles in the following order:

   Volatile Organic Compounds
   Semi-Volatile Organic Compounds
   Pesticides and PCBs
   Cations and Anions
   Radionuclides
   Bacteria.

3. If indicated in Section II.E., filter the required aliquots (SOP 05-03-02 or 05-03-03) and fill those sample bottles.

4. Preserve the samples immediately in accordance with SOP 07-01-02.

5. Conduct field analyses: pH (SOP 05-04-01 or 05-04-04), temperature, specific conductance (SOP 05-04-02), dissolved oxygen (SOP 05-04-03), Eh (SOP 05-04-08), and any other parameters listed in Section II.C.

6. If a dedicated sample bailer was used, return it to the well head. Otherwise, decontaminate the bailer as specified in SOP 01-01-00.

7. Replace the well cap and lock the protective casing.

8. Collect quality-assurance samples specified in Section II.D in accordance with SOP 04-01-01, 04-01-02, and 04-02-01.

9. Decontaminate samples in accordance with SOP 01-01-00.

10. Pack and ship the samples in accordance with SOP 07-01-03. Samples should be shipped on a daily basis and such that holding time requirements (SOP 07-01-02) can be met.

IV. PRECAUTIONS AND COMMON PROBLEMS

A. When using a bailer, do not allow the rope to drag on the ground. If necessary, lay out plastic sheeting to catch the rope.

B. When using a pump, exercise caution to prevent cross-contaminating samples with the hose. Do not sample from the pump discharge for trace organic compounds. Always use a check valve if not using a dedicated hose. Discard hose if there is a question about whether it can be adequately decontaminated.

C. Check the holding times on the analyses to be conducted. The holding time for some parameters is 24 hours. Plan sampling and shipping of these samples accordingly.

D. Preserve samples immediately after collection, including keeping them cool. Do not let samples sit in a hot vehicle until the end of the day.

V. DOCUMENTATION

A. Record information on a Groundwater Monitoring Data Sheet (SOP 07-02-01).

B. Prepare a Trip Report (SOP 07-02-04) and include:

≅ Time, date, and method of sample shipment
≅ Preservation methods and sample handling
≅ Description of purge and sampling methods
≅ The Groundwater Monitoring Data Sheet.

VII. REFERENCES

None

04-01-01 EQUIPMENT BLANKS

I. **SCOPE AND APPLICABILITY:** Equipment blanks are collected to assess the adequacy of decontamination procedures and to determine whether sampling equipment and methods are contributing contaminants to samples.

II. PROJECT-SPECIFIC REQUIREMENTS:

WATER TYPES TO BE USED FOR BLANKS: *[distilled water, deionized water, HPLC-grade water, etc.]*

III. METHODOLOGY

A. Review the SOP for the medium sampled to establish the frequency for collection of blanks.

B. Assemble a complete set of decontaminated sampling equipment for the subject sampling effort.

C. Rinse the blank water across the sampling equipment, catching it in a decontaminated stainless-steel bucket. Handle the water in the same manner as the samples. For example, if samples for metals analysis are to be filtered with a disposable filter, the blank aliquot for metals analysis should be processed through a new disposable filter. Blanks for soil sampling may be run across the split-spoon sampler, trowel, and bucket.

D. Fill a complete set of sample bottles.

E. Assign the blank a sample number of the same format as the other samples in the series.

F. Store, handle, and ship the blanks in the same manner as the samples.

IV. PRECAUTIONS AND COMMON PROBLEMS

A. The selection of stock solution depends upon the requirements of the project. Analyses for trace contaminants will require a purer blank solution than analyses for major constituents. Stringent analytical requirements will necessitate the use of laboratory-supplied blank water.

B. Include ALL sampling equipment in the rinsing procedure.

V. **DOCUMENTATION:** Record the following information in the field logbook:

- ≅ Source of blank water
- ≅ Time and sequence within the sampling event when the blanks were prepared
- ≅ Description of the procedure for preparing the blanks
- ≅ Sample numbers assigned to blanks.

Incorporate this information into the Trip Report (SOP 07-02-04).

VI. REFERENCES

EPA, 1986. Test Methods for Evaluating Solid Waste: SW-846; Volume II. Washington, DC.

04-01-02 TRIP BLANKS

I. **SCOPE AND APPLICABILITY:** Trip blanks are prepared to evaluate whether volatile constituents have migrated into samples from the air on-site, during shipping, or at the laboratory.

II. PROJECT-SPECIFIC REQUIREMENTS:

A. Frequency:

B. Other Criteria:

III. METHODOLOGY

A. When ordering bottles from the laboratory for the sampling event, request that trip blanks be sent also.

B. Keep the supplied blanks with the samples being collected throughout the sampling event. Handle the blanks in the same manner as the filled sample vials.

C. Assign the trip blank a sample number of the format used for the sampling event.

D. Return the trip blanks to the laboratory with the samples. Include the samples on the Chain-of-Custody form (SOP 07-02-02). Analysis is typically performed for volatile organic compounds only.

IV. **PRECAUTIONS AND COMMON PROBLEMS:** None.

V. **DOCUMENTATION:** Describe handling on the trip blanks in the Trip Report (SOP 07-02-04). Include the sample numbers assigned.

VI. REFERENCES

EPA, 1986. Test Methods for Evaluating Solid Waste: SW-846; Volume II. Washington, DC.

04-02-01 LIQUID DUPLICATES

I. **SCOPE AND APPLICABILITY:** Duplicate samples are collected to evaluate the precision involved in the sampling effort. Duplicate samples must be collected to be as similar as possible to the original sample. This procedure is applicable of collection of duplicate samples of all liquids and flowable sludges.

II. PROJECT-SPECIFIC REQUIREMENTS:

NUMBER/FREQUENCY OF DUPLICATE SAMPLING:

DUPLICATE NUMBERING SYSTEM: *[Indicate how sample numbers are to be assigned to duplicates, and whether "blind" numbers should be assigned.]*

III. METHODOLOGY

A. Prepare sample bottles for the target sample and its duplicate.

B. Collect the liquid sample in accordance with the appropriate SOP.

C. When filling sample bottles, fill each type of bottle for the sample and duplicate in sequence. Fill both VOA vials, then both metals bottles, etc. This will assure that the duplicate is as similar to the original sample as possible.

D. Preserve the sample and duplicate identically.

IV. PRECAUTIONS AND COMMON PROBLEMS

A. Failure to fill bottles alternately between the sample and duplicate may result in poor reproducibility between analyses.

B. Samples with free product or multiple phases present special problems. The phase distribution must be the same in both aliquots.

V. **DOCUMENTATION:** List the sample and duplicate on the Groundwater Monitoring Data Sheet as separate samples, describing the duplicate in the "Comments" column. If a Groundwater Monitoring Data Sheet is not appropriate, incorporate this information into the Trip Report (SOP 07-02-04).

VI. **REFERENCES:** None.

05-03-05 BAILER

I. **EQUIPMENT SPECIFICATION:** This procedure is applicable to the use of all bottom-fill bailers.

II. INSPECTION AND CALIBRATION

A. DAILY INSPECTION AND CHECKS: Make sure fittings at both ends of the bailer are secure. Assure that the check valve opens and closes freely.

B. CALIBRATION: There is no calibration applicable to this equipment.

C. ROUTINE MAINTENANCE: There is no maintenance applicable to this equipment. Bailers are typically replaced if damaged.

III. USE

A. Select a rope or cable for suspension of the bailer which is appropriate to project requirements. Typically, small gauge nylon rope is used, although stainless-steel cable may be used when samples will be analyzed to very low detection limits. The rope or cable should be new and clean. Do not use materials which have been used on another project, as this may result in cross contamination.

B. Consult the Project Manager to select a bailer composition which is compatible with the anticipated groundwater quality. For most applications, PVC bailers are adequate. Stainless-steel may be used where very low levels of organic compounds are of interest. Teflon bailers are available and may be requested on some projects.

C. Using a strong, non-slipping knot, such as a bowline, tie the rope or cable to the top of the bailer.

D. Lower the bailer into the well. Do not let the bailer free-fall down the well, as the device may shatter or the ball valve may become dislodged upon striking the water or the bottom of the well.

E. Raise the bailer by pulling the rope with a smooth, uniform motion. A jerky motion may open the check valve, resulting in water loss. Check the knot periodically.

Do not allow the bailer rope to drag on the ground. Place plastic sheeting on the ground to keep the rope clean if conditions are muddy, the ground surface is contaminated, or very low levels of contaminants are of interest.

IV. DECONTAMINATION:

The equipment should be decontaminated in accordance with SOP 01-01-00.

Typically, the bailer is washed with a potable water and non-phosphate soap solution. The bailer is then rinsed with distilled water and wrapped in plastic or foil until used.

V. TROUBLESHOOTING

A. If the knot should come undone or the rope breaks, the bailer typically can be recovered using a weighted fishing hook tied to monofilament line.

B. When bailing turbid water, it may be necessary to rinse the ball-valve at the bottom of the bailer with distilled water if it clogs.

06-01-01 WATER-LEVEL MEASUREMENT IN MONITORING WELLS

I. **SCOPE AND APPLICABILITY:** This procedure is applicable to the measurement of water levels in monitoring wells and open boreholes.

II. PROJECT-SPECIFIC REQUIREMENTS

A. REQUIRED READINGS:

B. APPLICABLE METHODS:

III. **METHODOLOGY:** Water levels should always be recorded to ±0.01 foot. Measurements should be made from a marked point on the inner casing for monitoring wells, and from the ground surface for open boreholes. Equipment should be decontaminated in accordance with SOP 01-01-00 after each measurement. The following methods may be used:

A. CHALKED-TAPE METHOD

1. Check records for historic water levels in the well, if available.

2. Rub the first five feet of a steel surveyor's chain or fiberglass tape with carpenter's chalk.

3. Lower the tape into the well until the end of the tape enters the water.

4. Record the tape footing at the wellhead to within 0.01 feet.

5. Pull the tape out of the well and read the tape footage of the water mark to within 0.01 feet. The difference between the readings is the water level.

B. SOUNDING

1. Attach a small float or hollow-bottom weight or sounder to the end of a tape measure.

2. Lower the sounder into the well and listen for the sound of the weight hitting the water surface.

3. When this is heard, pull the sounder back a few inches and redrop it by 1/4-inch increments until the sound is heard again.

4. Subsequent smaller increments of lowering the sounder will allow water-level measurements to within 0.01 feet.

5. Measure the length from the zero mark on the tape measure to the bottom of the weight. Add this value to all field measurements made with the sounder.

C. ELECTRIC-WATER LEVEL METER (Solinst)

1. Turn the Solinst on by turning the knob clockwise. This knob is also the volume control. Test the Solinst to see if the battery is dead by pushing the button next to the volume knob.If the battery is charged the Solinst will emit an audible tone and the red indicator light will illuminate.
2. Lower the end of the probe into the well or borehole. The probe will cause the unit to emit the tone and illuminate the light when it contacts water.

3. Pull the probe back a few inches and lower the probe in smaller increments until the water level is measured to within 0.01 feet.

4. The water level is read directly from the Solinst tape, and already includes a correction for the length of the probe on the bottom of the tape.

D. INTERFACE PROBE: This is the only reliable method for wells with floating free product.

1. Push the On/Off button to turn unit on. Lower the probe into the liquid. The horn will sound a steady tone and the yellow light will illuminate when the probe contacts an oil product. Slowly raise probe until sound stops, lower until sound is heard again to refine the oil level.

2. Read the tape marking and note as the surface level of product.

3. Slowly lower the probe through the oil product, searching for the oil-water interface. When the probe reaches water the tone will switch from steady to a beeping tone and the red light will illuminate. Slowly move probe up and down to refine the oil/water interface to within 0.01 feet. Read the water level directly from the tape. The length of the probe is already considered.

NOTE: Auto Shutoff Feature: After approximately five minutes of power on, the unit will auto-shut off. A chirping sound will be heard, warning impending shut off. Press

07-01-01 MAINTAINING SAMPLE CHAIN OF CUSTODY

I. **SCOPE AND APPLICABILITY:** This procedure is to be employed whenever samples are collected for laboratory analysis, and is designed to ensure that sample integrity is maintained. These procedures are necessary to assure that samples are defensible.

II. **PROJECT-SPECIFIC REQUIREMENTS:** None.

III. METHODOLOGY

A. SAMPLE CUSTODY: The sampling personnel must maintain custody of the samples until they are delivered to the laboratory, at which time the laboratory takes over the custody record. A sample is considered to be in custody if:

- it is in the investigator's actual possession
- it is in view of the investigator
- it has been placed in a secure area
- a signed custody seal has been placed on the sample container such that the seal would be destroyed if the container was opened.

B. CUSTODY RECORD

1. Complete a Chain-of-Custody Form for each shipping container of samples as described in SOP 07-02-02. Place the white copy of the completed form in the shipping container with the samples, as discussed in SOP 07-01-03.

2. Affix a signed custody seal to secure all samples. Seals may be placed across the lids of individual sample bottles, or on each shipping container of samples. If seals are placed on shipping containers, at least two seals must be used, and they must be placed such that the container cannot be opened without breaking the seals.

IV. PRECAUTIONS AND COMMON PROBLEMS

A. It may be necessary to cover custody seals with clear postal tape to prevent them from falling off.

B. Deliver or fax a copy of the custody form to the Project Manager within 24 hours of shipping the samples so that any errors can be corrected before the laboratory begins processing the samples.

V. DOCUMENTATION

A. The pink copy of the Chain-of-Custody Form should be submitted to the Project Manager as soon as possible after the samples are shipped.

B. The Project Manager or a designee must review the form for completeness and correctness. Any errors should be flagged, and the laboratory should be contacted if errors could affect analysis. The reviewer should initial and date the form, then place it in the Project File.

C. Compliance or problems with custody procedures should be documented in the Trip Report (SOP 07-02-04).

VI. REFERENCES

EPA Region IV; 1991. Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual. Athens, Georgia.