

November 5, 2014

Mr. Richard Doucette  
Regional Director and Land Protection Manager  
Virginia Department of Environmental Quality  
Northern Virginia Regional Office  
13901 Crown Court  
Woodbridge, Virginia 22193

**Re: 2014 Corrective Action Site Evaluation (CASE) Report  
Laurel Valley Center Sanitary Landfill - Permit No. 251  
JOYCE Project No. 310.1501.03/Task No. 2**

Dear Mr. Doucette:

On behalf of Culpeper County, Joyce Engineering is submitting the second *Corrective Action Site Evaluation* (CASE) for the Laurel Valley Center Sanitary Landfill as required by Module XIV.M.2 of Solid Waste Permit No. 251. A copy of this CASE will be placed in the public repository, located at the County's Office of Environmental Services. If you have any questions or concerns regarding this report, please contact me by phone at (804) 355-4520 or by e-mail at [iwhitlock@joyceengineering.com](mailto:iwhitlock@joyceengineering.com).

Respectfully,  
**JOYCE ENGINEERING**



Ian A. Whitlock, C.E.S.  
Technical Consultant

Attachment

c: Paul E. Howard, Jr., Culpeper County  
Larry W. Syverson, C.P.G., DEQ-CO  
Geoff Christe, DEQ-CO

***PREPARED FOR:***

CULPEPER COUNTY  
118 WEST DAVIS STREET, SUITE 101  
CULPEPER, VIRGINIA 22701



**LAUREL VALLEY CENTER SANITARY LANDFILL  
PERMIT NUMBER 251**

**2014 CORRECTIVE ACTION  
SITE EVALUATION**

**NOVEMBER 2014**

***PREPARED BY:***

**JOYCE**  
ENGINEERING

1604OWNBY LANE  
RICHMOND, VIRGINIA 23220  
PHONE: 804.355.4520  
FAX: 804.355.4282  
JE PROJECT No. 310.1501.03.2

**2014 CORRECTIVE ACTION SITE EVALUATION  
LAUREL VALLEY CENTER SANITARY LANDFILL  
Permit No. 251**

**JOYCE ENGINEERING  
Project No. 310.1501.03.04**

This Corrective Action Site Evaluation was prepared in accordance with the requirements of Module XIV.M.2 of Solid Waste Permit No. 251 and generally accepted standards of environmental practice for the exclusive use of and reliance upon by the referenced client, for specific application to the referenced site. No other warranty is either expressed or implied.

Reuse and reliance of this document by other parties, or for purposes other than those specified, without written authorization, will be at the sole risk of the party or parties utilizing this document. Joyce Engineering shall incur no liability resulting from claims, damages, losses, and expenses that might arise from unauthorized use and reliance of this document.

Conclusions presented in this report are based upon a review of available information, results of our field studies, results of chemical analyses, and professional judgment. Our conclusions do not reflect variations in subsurface groundwater quality that might exist between or beyond sampling points or between specific sampling events.

To the best of our knowledge, information provided by others is true and accurate, unless otherwise noted.



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Ian A. Whitlock, C.E.S.  
Technical Consultant

## 2014 Corrective Action Site Evaluation (CASE) Report Summary



1] DEQ Region: Northern

2] Date:  
11-05-2014

3] Solid Waste Permit Number: 251

4] Facility Name: Laurel Valley Center Sanitary Landfill

5] Landfill Type: Sanitary

6] Date of Groundwater Remedy Implementation (Permit Amendment Issuance): November 5, 2008

7] Case Report Due Date: November 05, 2014

8] CASE Report Period: October 2011 – April 2014

9] Was Public Repository copied on CASE submittal: Yes

10] Name and location (City/Town) of Public Repository: Culpeper County Office of Environmental Services, Culpeper, Virginia.

11] Which groundwater CASE report submittal (circle one) is this? 1<sup>st</sup>  2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> 6<sup>th</sup> 7<sup>th</sup> Other

**Section A - Remedy/Plume behavior: Please use 'Y', 'N', 'NA' – not applicable, or 'P' – possibly, where needed. Any response of Y or P should be fully explained in the associated Appendix.**

12] List the anticipated MNA completion date presented in the original CAP submission?

2014  
(for PPR)

13] Based on CASE period data, what is the current anticipated MNA completion date?

2026

14] Were there any performance problems or Operations and Maintenance issues associated with MNA components during CASE period?

N

15] (if yes to 14) Were these problems rectified during CASE period?

NA

16] Were GPS achieved in all portions of the plume during CASE period?

N

17] (if no to 16) List any MNA wells that did achieve the GPS during CASE period?

CLF-S1,  
CLF-S3,  
MW-X2,  
and  
MW-X2D

18] How many compliance wells continue to exceed GPS during CASE period?

4

19] Did any formally 'clean' Compliance wells exceed GPS during this CASE period?

N

20] Compared to previous data, did GW quality improve in at least some of the Performance wells during CASE Period?

Y

21] Compared to previous data, did the GW quality improve in at least some of the Sentinel wells during CASE Period?

P

22] Was there any evidence of lateral or vertical plume expansion during CASE Period?

Y

23] (if yes to 22) Were any new wells to address expansion installed during CASE Period?

Y

24] Are there any MNA wells screened below the base of the GPS exceeding areas of the plume?

Y

25] Are there clean sentinel wells (i.e., no GPS exceedances) located at the edge of the plume?

Y

26] Was remedy protective of human health and environment during the entire CASE Period?

Y

27] Was there a remedy component in place to control source of the release during CASE Period?

P

28] Did any MNA wells exceed MCL-based GPS during the CASE period?

Y

29] Did any MNA wells exceed BKG-based GPS during the CASE period?

Y

30] Did any MNA exceed ACL-based GPS during the CASE period?	Y
31] Are there performance wells located downgradient from each exceeding Compliance well?	Y
32] Was surface water sampling part of the MNA remedy?	N
33] Did surface water sampling results show concentrations in excess of GPS in surface water?	NA
<b>Section B - Groundwater Sampling: Please use 'Y', 'N', 'NA' – not applicable, or 'P' – possibly, where needed. Any response of Y or P should be fully explained in the associated Appendix.</b>	
34] Were all Permit-listed MNA network wells sampled during CASE period?	Y
35] If not, list the wells which could not be sampled:	NA
36] List the reason for the non-sampling during CASE period:	NA
37] Other than issues noted above, were all Corrective Action related wells sampled at the required quarterly or semi-annual frequency outlined in Module XIV during CASE period?	Y
38] (if no to 37) List the reason for the non-frequency sampling.	NA
39] Were all MNA related wells sampled for the required constituents of Module XIV during CASE period?	Y
40] (if no to 39) List the reason for the non-sampling of Permit required constituents.	NA
41] Were all analysis during CASE period conducted by VELAP certified facilities?	Y
42] Did analytical results support biological destruction of the waste mass during the CASE period based on changes in downgradient parent/daughter ratios?	Y
43] Did results of MNA performance parameter sampling support biologic destruction of water mass based on changes in electron receptors/donors within the plume of contamination?	Y
44] Are copies of all sampling event analytical results obtained during the CASE Period attached as an Appendix in CDROM format?	Y
<b>Section C - Risk Exposure Factors: Please use 'Y', 'N', 'NA' – not applicable, or 'P' – possibly, where needed. Any response of Y or P should be fully explained in the associated Appendix.</b>	
45] Does owner/operator legally own/control all areas currently underlain by landfill contaminated groundwater (i.e., those portions of the plume that exceed GPS)?	Y
46] (if no to 45) Provide the name of current ownership:	NA
47] Was there any potential for exposure of humans or environmental receptors to contaminated groundwater during the CASE Period?	N
48] Was there any change in adjacent property land-use during the CASE Period which could change the potential exposure risks previously defined during remedy selection?	N
49] Are source area containment components in place to prevent exposure and minimize future releases?	Y
50] Was there any remedy related site activity which created a short term exposure risk to workers or the environment during the CASE period?	N
51] Is there any potential for vapor intrusion issues above the landfill contaminant plume?	Y (See Appendix C)
52] Is groundwater currently used (or potentially used) on site for any reason?	Y (See Appendix C)
53] Is groundwater currently or potentially used as a potable water source in the landfill area?	N
54] (if needed) Is there an alternate drinking water supply in the vicinity of the landfill?	Y
55] Is there evidence of (or potential for) groundwater plume discharge to surface waters on site or adjacent properties?	P
<b>Section D - Interpretation of Analytical Results: Please use 'Y', 'N', 'NA' – not applicable, or 'P' – possibly, where needed. Any response of Y or P should be fully explained in the associated Appendix.</b>	

56] What statistical method was used to assess groundwater trends during CASE Period?	Mann-Kendall, Spearman, Sen's Slope Analysis
57] Was prior CASE period data pooled with current CASE data to develop the time series plots?	Y
58] Were any unusual statistical problems noted (i.e. outliers)?	N
59] Were time series plots provided individually for all GPS exceeding constituents in each MW they were identified in during the CASE period?	Y
60] When looking solely at Sentinel well data during the CASE period, did any constituents show upward trending concentration behavior (if so, list constituent(s) on the line below)?	N
61] When looking solely at Performance well data during the CASE period, did any constituents show upward trending concentration behavior (if so, list constituent(s) on the line below)?	N
62] When looking solely at Compliance well data during the CASE period, did any constituents show upward trending concentration behavior (if so, list constituent(s) on the line below)?	N
63] Do the down plume changes in stoichiometric Parent/Daughter ratios confirm breakdown of contaminant mass?	Y
64] Do the results of EPA MNA performance parameter sampling (i.e., redox potential, DO, manganese (II), iron (II), sulfate, methane, etc.) and electron donors vs acceptors document biological breakdown of contaminant mass?	Y
<b>Section E – Future Actions: Please use 'Y', 'N', 'NA' – not applicable, or 'P' – possibly, where needed. Any response of Y or P should be fully explained in the associated Appendix.</b>	
65] Based on the data acquired during this CASE period, and reviewed in context of data collected during previous CASE periods, does the implemented remedy have the ability to achieve all GPS within a reasonable timeframe?	Y
66] (if no to 65) Is Interim Measure use justifiable on site?	NA
67] (if no to 65 and 66) Is Alternate Remedy application justified on site (if yes, list remedy type on line below)?	NA
68] Is the Alternate Remedy discussed in detail in the current CAP?	Y
69] (if no to 65-67) Will owner/operator be submitting a technically infeasible demonstration (as defined in the VSWMR) to the Director?	NA
70] Are there any other actions planned for the site during the upcoming CASE period not currently covered by the existing CAP?	N
<b>Attachments. The following attachments must be included in the CASE in the order prescribed</b>	
<b>Attachment I:</b> Site Identified on a USGS 7 1/2-minute Topographic Map: Drawing 1	
<b>Attachment II:</b> Property Map(s): Drawing 2	
<b>Attachment III:</b> Aerial Photograph(s): Drawing 2	
<b>Attachment IV:</b> GW flow rate calculations (based on most recent CASE period sampling event)	
<b>Attachment V:</b> Potentiometric Surface Map, scaled to fit a size no larger than 11" x 17", based on the most recent CASE period sampling event: Drawing 3	

<b>Attachment VI:</b> Table of constituents exceeding GPS, listed for each well, based on all available sampling data obtained post remedy implementation	
<b>Attachment VII:</b> Vertical and Horizontal Plume maps provided for each GPS exceeding constituent on site (wherever possible – sized to fit on an 11” x 17” sheet)	
<b>Attachment VIII:</b> Statistical Analysis and Time Series Data Plots for each GPS exceeding constituent identified within individual wells sampled during the CASE period	
<b>Attachment IX:</b> Complete Laboratory Analytical Reports (including Verification events) for each sampling event during the CASE period	
<b>Attachment X:</b> Chain of Custody and Field book documentation (including Verification events) for each sampling event during the CASE period	
<i>Note: Attachments VII, VIII, and IX may be submitted in electronic format on CD.</i>	
<b>Appendices. The following should be included as needed following the instructions in the SI</b>	
<b>Appendix A</b> - Remedy/Plume behavior, Detailed Discussion	
<b>Appendix B</b> - Groundwater Sampling, Detailed Discussion	
<b>Appendix C</b> - Risk Exposure Factors	
<b>Appendix D</b> - Interpretation of Analytical Results, Detailed Discussion	
<b>Appendix E</b> - Future Actions	
<b>Responsible Official Signature:</b>	
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.	
Name: Ian A. Whitlock	Title: Technical Consultant
Signature: 	Date: 11/05/14

**Attachment I:**

Site Identified on a USGS 7 1/2-minute Topographic Map:

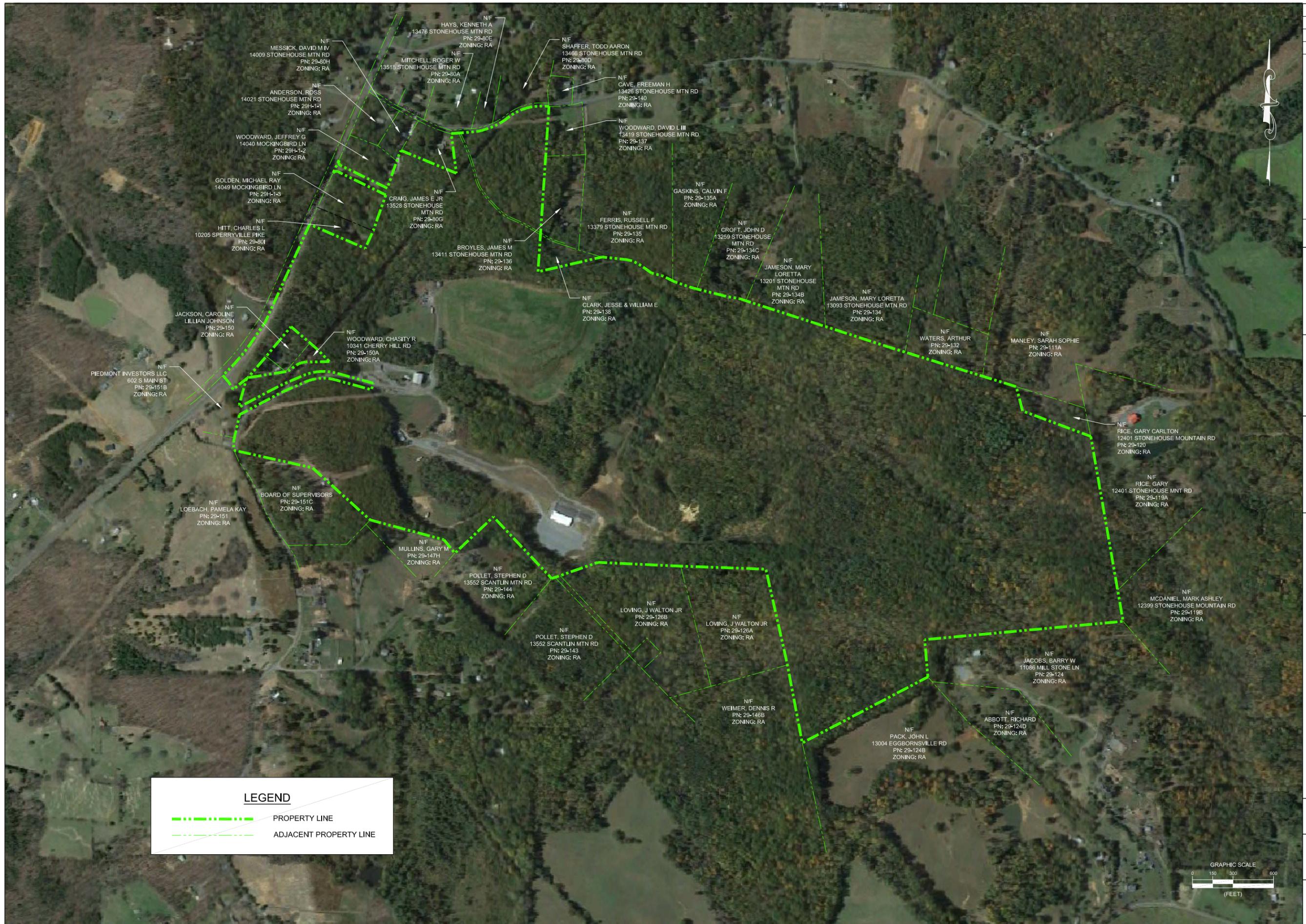
**Drawing 1: Site Location Map**



**Attachment II:**

Property Map(s):

**Drawing 2: Property Map on Aerial Photograph**



**LEGEND**

 PROPERTY LINE  
 ADJACENT PROPERTY LINE



DESIGNED	JCW	NO	BY	CK	APP
DRAWN	DAS				
CHECKED	JAW				
APPROVED	JCW				
DATE	10/17/14				
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LAUREL VALLEY CENTER SANITARY LANDFILL CULPEPER COUNTY, VIRGINIA					
PROPERTY MAP					
PROJECT NO. 310.1501.03					
SCALE AS SHOWN					
DRAWING NO. 2					
REVISIONS AND RECORD OF ISSUE DATE NO					

**Attachment III:**

Aerial Photograph(s):

**See Attachment II**

**Attachment IV:**

GW flow rate calculations (based on most recent CASE period sampling event)

**GW Flow Rate Calculations Table – April 2014**

**Attachment IV**  
**Groundwater Flow Rate Calculations**  
**First Semi-Annual 2014 Monitoring Event**  
**Laurel Valley Center Sanitary Landfill**  
**Permit No. 251**

Hydraulic Conductivity (k, cm/s)	Hydraulic Conductivity (k, ft/day)	Countour Lines (feet amsl)	Flow Length (feet)	Gradient (i) (foot/foot)	Effective Porosity (unitless)	Estimated Groundwater Velocity	
						(cm/s)	(feet/year)
3.93E-04	1.11E+00	600 - 490	1981	5.6E-02	0.35	6.23E-05	65

Notes:                      amsl = Above mean sea level  
                                    cm/s = Centimeter per second

**Attachment V:**

Potentiometric Surface Map, scaled to fit a size no larger than 11" x 17", based on the most recent CASE period sampling event:

**Drawing 3: Groundwater Surface Contour Map – April 7, 2014**



**Attachment VI:**

Table of constituents exceeding GPS, listed for each well, based on all available sampling data obtained post remedy implementation

**Constituents Exceeding GPS**



Attachment VI  
 Summary of Historical Groundwater Protection Standard Exceedances  
 Laurel Valley Center Sanitary Landfill  
 VSWMR Permit No. 251

Sample	EPA	Method	DL	QL	MW-1A	MW-1B	MW-1C	MW-1D	MW-1E	MW-1F	MW-1G	MW-1H	MW-1I	MW-1J	MW-1K	MW-1L	MW-1M	MW-1N	MW-1O	MW-1P	MW-1Q	MW-1R	MW-1S	MW-1T	MW-1U	MW-1V	MW-1W	MW-1X	MW-1Y	MW-1Z	MW-2A	MW-2B	MW-2C	MW-2D	MW-2E	MW-2F	MW-2G	MW-2H	MW-2I	MW-2J	MW-2K	MW-2L	MW-2M	MW-2N	MW-2O	MW-2P	MW-2Q	MW-2R	MW-2S	MW-2T	MW-2U	MW-2V	MW-2W	MW-2X	MW-2Y	MW-2Z	MW-3A	MW-3B	MW-3C	MW-3D	MW-3E	MW-3F	MW-3G	MW-3H	MW-3I	MW-3J	MW-3K	MW-3L	MW-3M	MW-3N	MW-3O	MW-3P	MW-3Q	MW-3R	MW-3S	MW-3T	MW-3U	MW-3V	MW-3W	MW-3X	MW-3Y	MW-3Z	MW-4A	MW-4B	MW-4C	MW-4D	MW-4E	MW-4F	MW-4G	MW-4H	MW-4I	MW-4J	MW-4K	MW-4L	MW-4M	MW-4N	MW-4O	MW-4P	MW-4Q	MW-4R	MW-4S	MW-4T	MW-4U	MW-4V	MW-4W	MW-4X	MW-4Y	MW-4Z	MW-5A	MW-5B	MW-5C	MW-5D	MW-5E	MW-5F	MW-5G	MW-5H	MW-5I	MW-5J	MW-5K	MW-5L	MW-5M	MW-5N	MW-5O	MW-5P	MW-5Q	MW-5R	MW-5S	MW-5T	MW-5U	MW-5V	MW-5W	MW-5X	MW-5Y	MW-5Z	MW-6A	MW-6B	MW-6C	MW-6D	MW-6E	MW-6F	MW-6G	MW-6H	MW-6I	MW-6J	MW-6K	MW-6L	MW-6M	MW-6N	MW-6O	MW-6P	MW-6Q	MW-6R	MW-6S	MW-6T	MW-6U	MW-6V	MW-6W	MW-6X	MW-6Y	MW-6Z	MW-7A	MW-7B	MW-7C	MW-7D	MW-7E	MW-7F	MW-7G	MW-7H	MW-7I	MW-7J	MW-7K	MW-7L	MW-7M	MW-7N	MW-7O	MW-7P	MW-7Q	MW-7R	MW-7S	MW-7T	MW-7U	MW-7V	MW-7W	MW-7X	MW-7Y	MW-7Z	MW-8A	MW-8B	MW-8C	MW-8D	MW-8E	MW-8F	MW-8G	MW-8H	MW-8I	MW-8J	MW-8K	MW-8L	MW-8M	MW-8N	MW-8O	MW-8P	MW-8Q	MW-8R	MW-8S	MW-8T	MW-8U	MW-8V	MW-8W	MW-8X	MW-8Y	MW-8Z	MW-9A	MW-9B	MW-9C	MW-9D	MW-9E	MW-9F	MW-9G	MW-9H	MW-9I	MW-9J	MW-9K	MW-9L	MW-9M	MW-9N	MW-9O	MW-9P	MW-9Q	MW-9R	MW-9S	MW-9T	MW-9U	MW-9V	MW-9W	MW-9X	MW-9Y	MW-9Z	MW-10A	MW-10B	MW-10C	MW-10D	MW-10E	MW-10F	MW-10G	MW-10H	MW-10I	MW-10J	MW-10K	MW-10L	MW-10M	MW-10N	MW-10O	MW-10P	MW-10Q	MW-10R	MW-10S	MW-10T	MW-10U	MW-10V	MW-10W	MW-10X	MW-10Y	MW-10Z	MW-11A	MW-11B	MW-11C	MW-11D	MW-11E	MW-11F	MW-11G	MW-11H	MW-11I	MW-11J	MW-11K	MW-11L	MW-11M	MW-11N	MW-11O	MW-11P	MW-11Q	MW-11R	MW-11S	MW-11T	MW-11U	MW-11V	MW-11W	MW-11X	MW-11Y	MW-11Z	MW-12A	MW-12B	MW-12C	MW-12D	MW-12E	MW-12F	MW-12G	MW-12H	MW-12I	MW-12J	MW-12K	MW-12L	MW-12M	MW-12N	MW-12O	MW-12P	MW-12Q	MW-12R	MW-12S	MW-12T	MW-12U	MW-12V	MW-12W	MW-12X	MW-12Y	MW-12Z	MW-13A	MW-13B	MW-13C	MW-13D	MW-13E	MW-13F	MW-13G	MW-13H	MW-13I	MW-13J	MW-13K	MW-13L	MW-13M	MW-13N	MW-13O	MW-13P	MW-13Q	MW-13R	MW-13S	MW-13T	MW-13U	MW-13V	MW-13W	MW-13X	MW-13Y	MW-13Z	MW-14A	MW-14B	MW-14C	MW-14D	MW-14E	MW-14F	MW-14G	MW-14H	MW-14I	MW-14J	MW-14K	MW-14L	MW-14M	MW-14N	MW-14O	MW-14P	MW-14Q	MW-14R	MW-14S	MW-14T	MW-14U	MW-14V	MW-14W	MW-14X	MW-14Y	MW-14Z	MW-15A	MW-15B	MW-15C	MW-15D	MW-15E	MW-15F	MW-15G	MW-15H	MW-15I	MW-15J	MW-15K	MW-15L	MW-15M	MW-15N	MW-15O	MW-15P	MW-15Q	MW-15R	MW-15S	MW-15T	MW-15U	MW-15V	MW-15W	MW-15X	MW-15Y	MW-15Z	MW-16A	MW-16B	MW-16C	MW-16D	MW-16E	MW-16F	MW-16G	MW-16H	MW-16I	MW-16J	MW-16K	MW-16L	MW-16M	MW-16N	MW-16O	MW-16P	MW-16Q	MW-16R	MW-16S	MW-16T	MW-16U	MW-16V	MW-16W	MW-16X	MW-16Y	MW-16Z	MW-17A	MW-17B	MW-17C	MW-17D	MW-17E	MW-17F	MW-17G	MW-17H	MW-17I	MW-17J	MW-17K	MW-17L	MW-17M	MW-17N	MW-17O	MW-17P	MW-17Q	MW-17R	MW-17S	MW-17T	MW-17U	MW-17V	MW-17W	MW-17X	MW-17Y	MW-17Z	MW-18A	MW-18B	MW-18C	MW-18D	MW-18E	MW-18F	MW-18G	MW-18H	MW-18I	MW-18J	MW-18K	MW-18L	MW-18M	MW-18N	MW-18O	MW-18P	MW-18Q	MW-18R	MW-18S	MW-18T	MW-18U	MW-18V	MW-18W	MW-18X	MW-18Y	MW-18Z	MW-19A	MW-19B	MW-19C	MW-19D	MW-19E	MW-19F	MW-19G	MW-19H	MW-19I	MW-19J	MW-19K	MW-19L	MW-19M	MW-19N	MW-19O	MW-19P	MW-19Q	MW-19R	MW-19S	MW-19T	MW-19U	MW-19V	MW-19W	MW-19X	MW-19Y	MW-19Z	MW-20A	MW-20B	MW-20C	MW-20D	MW-20E	MW-20F	MW-20G	MW-20H	MW-20I	MW-20J	MW-20K	MW-20L	MW-20M	MW-20N	MW-20O	MW-20P	MW-20Q	MW-20R	MW-20S	MW-20T	MW-20U	MW-20V	MW-20W	MW-20X	MW-20Y	MW-20Z	MW-21A	MW-21B	MW-21C	MW-21D	MW-21E	MW-21F	MW-21G	MW-21H	MW-21I	MW-21J	MW-21K	MW-21L	MW-21M	MW-21N	MW-21O	MW-21P	MW-21Q	MW-21R	MW-21S	MW-21T	MW-21U	MW-21V	MW-21W	MW-21X	MW-21Y	MW-21Z	MW-22A	MW-22B	MW-22C	MW-22D	MW-22E	MW-22F	MW-22G	MW-22H	MW-22I	MW-22J	MW-22K	MW-22L	MW-22M	MW-22N	MW-22O	MW-22P	MW-22Q	MW-22R	MW-22S	MW-22T	MW-22U	MW-22V	MW-22W	MW-22X	MW-22Y	MW-22Z	MW-23A	MW-23B	MW-23C	MW-23D	MW-23E	MW-23F	MW-23G	MW-23H	MW-23I	MW-23J	MW-23K	MW-23L	MW-23M	MW-23N	MW-23O	MW-23P	MW-23Q	MW-23R	MW-23S	MW-23T	MW-23U	MW-23V	MW-23W	MW-23X	MW-23Y	MW-23Z	MW-24A	MW-24B	MW-24C	MW-24D	MW-24E	MW-24F	MW-24G	MW-24H	MW-24I	MW-24J	MW-24K	MW-24L	MW-24M	MW-24N	MW-24O	MW-24P	MW-24Q	MW-24R	MW-24S	MW-24T	MW-24U	MW-24V	MW-24W	MW-24X	MW-24Y	MW-24Z	MW-25A	MW-25B	MW-25C	MW-25D	MW-25E	MW-25F	MW-25G	MW-25H	MW-25I	MW-25J	MW-25K	MW-25L	MW-25M	MW-25N	MW-25O	MW-25P	MW-25Q	MW-25R	MW-25S	MW-25T	MW-25U	MW-25V	MW-25W	MW-25X	MW-25Y	MW-25Z	MW-26A	MW-26B	MW-26C	MW-26D	MW-26E	MW-26F	MW-26G	MW-26H	MW-26I	MW-26J	MW-26K	MW-26L	MW-26M	MW-26N	MW-26O	MW-26P	MW-26Q	MW-26R	MW-26S	MW-26T	MW-26U	MW-26V	MW-26W	MW-26X	MW-26Y	MW-26Z	MW-27A	MW-27B	MW-27C	MW-27D	MW-27E	MW-27F	MW-27G	MW-27H	MW-27I	MW-27J	MW-27K	MW-27L	MW-27M	MW-27N	MW-27O	MW-27P	MW-27Q	MW-27R	MW-27S	MW-27T	MW-27U	MW-27V	MW-27W	MW-27X	MW-27Y	MW-27Z	MW-28A	MW-28B	MW-28C	MW-28D	MW-28E	MW-28F	MW-28G	MW-28H	MW-28I	MW-28J	MW-28K	MW-28L	MW-28M	MW-28N	MW-28O	MW-28P	MW-28Q	MW-28R	MW-28S	MW-28T	MW-28U	MW-28V	MW-28W	MW-28X	MW-28Y	MW-28Z	MW-29A	MW-29B	MW-29C	MW-29D	MW-29E	MW-29F	MW-29G	MW-29H	MW-29I	MW-29J	MW-29K	MW-29L	MW-29M	MW-29N	MW-29O	MW-29P	MW-29Q	MW-29R	MW-29S	MW-29T	MW-29U	MW-29V	MW-29W	MW-29X	MW-29Y	MW-29Z	MW-30A	MW-30B	MW-30C	MW-30D	MW-30E	MW-30F	MW-30G	MW-30H	MW-30I	MW-30J	MW-30K	MW-30L	MW-30M	MW-30N	MW-30O	MW-30P	MW-30Q	MW-30R	MW-30S	MW-30T	MW-30U	MW-30V	MW-30W	MW-30X	MW-30Y	MW-30Z	MW-31A	MW-31B	MW-31C	MW-31D	MW-31E	MW-31F	MW-31G	MW-31H	MW-31I	MW-31J	MW-31K	MW-31L	MW-31M	MW-31N	MW-31O	MW-31P	MW-31Q	MW-31R	MW-31S	MW-31T	MW-31U	MW-31V	MW-31W	MW-31X	MW-31Y	MW-31Z	MW-32A	MW-32B	MW-32C	MW-32D	MW-32E	MW-32F	MW-32G	MW-32H	MW-32I	MW-32J	MW-32K	MW-32L	MW-32M	MW-32N	MW-32O	MW-32P	MW-32Q	MW-32R	MW-32S	MW-32T	MW-32U	MW-32V	MW-32W	MW-32X	MW-32Y	MW-32Z	MW-33A	MW-33B	MW-33C	MW-33D	MW-33E	MW-33F	MW-33G	MW-33H	MW-33I	MW-33J	MW-33K	MW-33L	MW-33M	MW-33N	MW-33O	MW-33P	MW-33Q	MW-33R	MW-33S	MW-33T	MW-33U	MW-33V	MW-33W	MW-33X	MW-33Y	MW-33Z	MW-34A	MW-34B	MW-34C	MW-34D	MW-34E	MW-34F	MW-34G	MW-34H	MW-34I	MW-34J	MW-34K	MW-34L	MW-34M	MW-34N	MW-34O	MW-34P	MW-34Q	MW-34R	MW-34S	MW-34T	MW-34U	MW-34V	MW-34W	MW-34X	MW-34Y	MW-34Z	MW-35A	MW-35B	MW-35C	MW-35D	MW-35E
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**Attachment VII:**

Vertical and Horizontal Plume Maps provided for each GPS exceeding constituent on site (wherever possible – sized to fit on an 11” x 17” sheet)

**Drawing 12: Geologic Cross Sections: May 2011 & April 2014**

<b>Constituent of Concern</b>	<b>Isoconcentration Map May 2011 &amp; April 2014</b>	<b>May 2011 Cross-Sections</b>	<b>April 2014 Cross-Sections</b>
Cobalt	Drawing 4	Drawing 13A	Drawing 13B
Mercury	Drawing 5	Drawing 14A	Drawing 14B
Benzene	Drawing 6	Drawing 15A	Drawing 15B
1,1-Dichloroethane	Drawing 7	Drawing 16A	Drawing 16B
Naphthalene	Drawing 8	Drawing 17A	Drawing 17B
Tetrachloroethene	Drawing 9	Drawing 18A	Drawing 18B
Trichloroethene	Drawing 10	Drawing 19A	Drawing 19B
Vinyl Chloride	Drawing 11	Drawing 20A	Drawing 20B









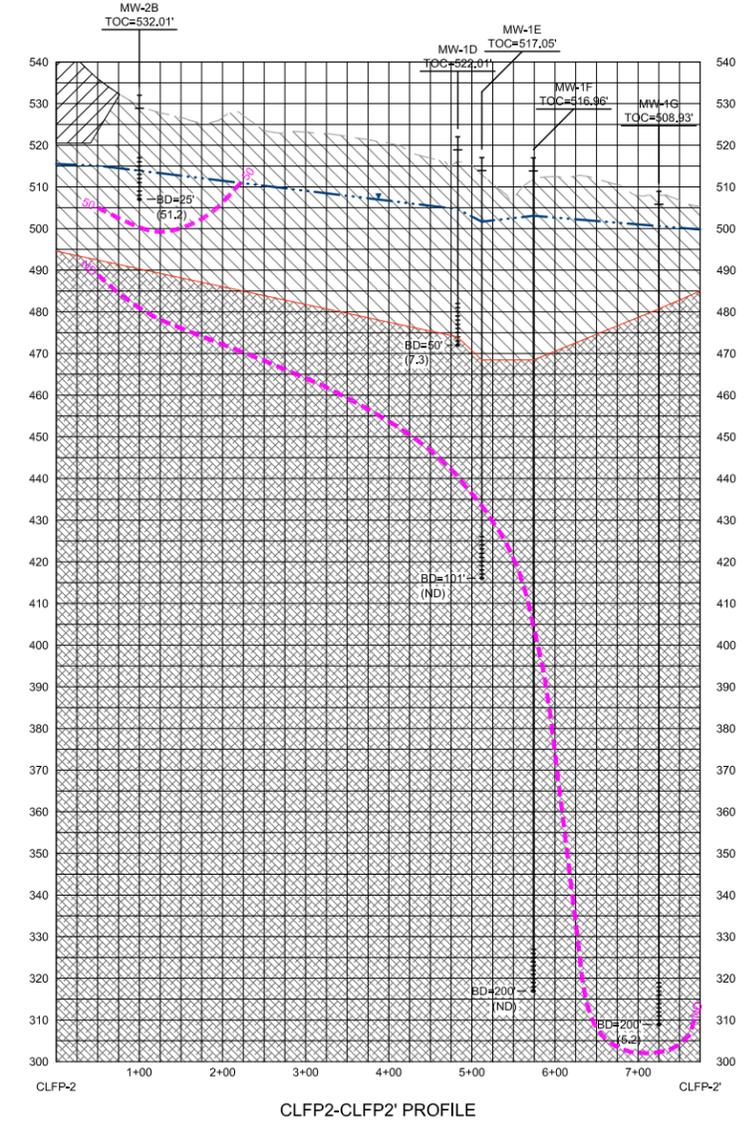
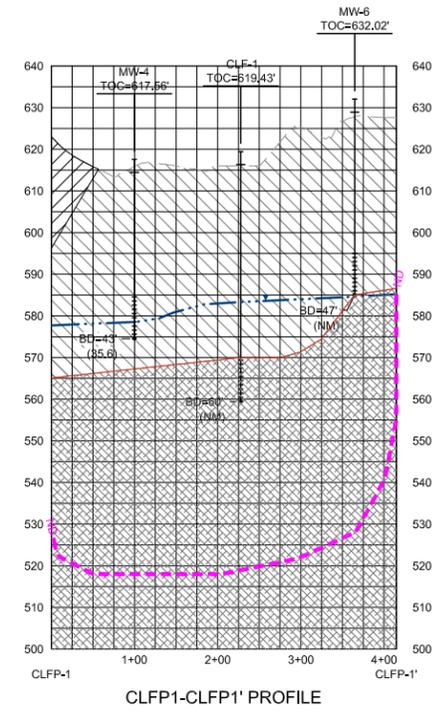




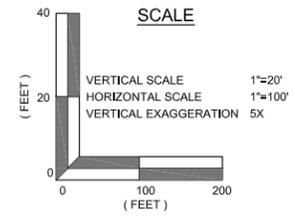








- NOTES:**
- GROUNDWATER LEVEL ELEVATIONS WERE INFERRED BASED ON MONITORING WELL DATA AND TOPOGRAPHY.
  - STATIC WATER LEVELS WERE MEASURED ON MAY 2, 2011.
  - WELLS WERE SAMPLED ON MAY 3 - 5, AND JUNE 22, 2011. MW-1G WAS SAMPLED ON OCTOBER 6, 2011.
  - ND = NOT DETECTED
  - J = ESTIMATED
  - µg/L = MICROGRAMS PER LITER
  - NM = NOT MEASURED



**LEGEND**

MW-1G TOC=508.93'

BORING IDENTIFICATION AND SURVEYED TOP OF CASING ELEVATION IN FEET ABOVE MEAN SEA LEVEL (AMSL)

MW = MONITORING WELL

TOP OF CASING

GROUND SURFACE

SCREENED INTERVAL

BD=200' (5.2)

BORING DEPTH IN FEET

COBALT CONCENTRATION (µg/L)

ESTIMATED TOP OF BEDROCK

POTENTIOMETRIC SURFACE

SURFACE TOPOGRAPHY

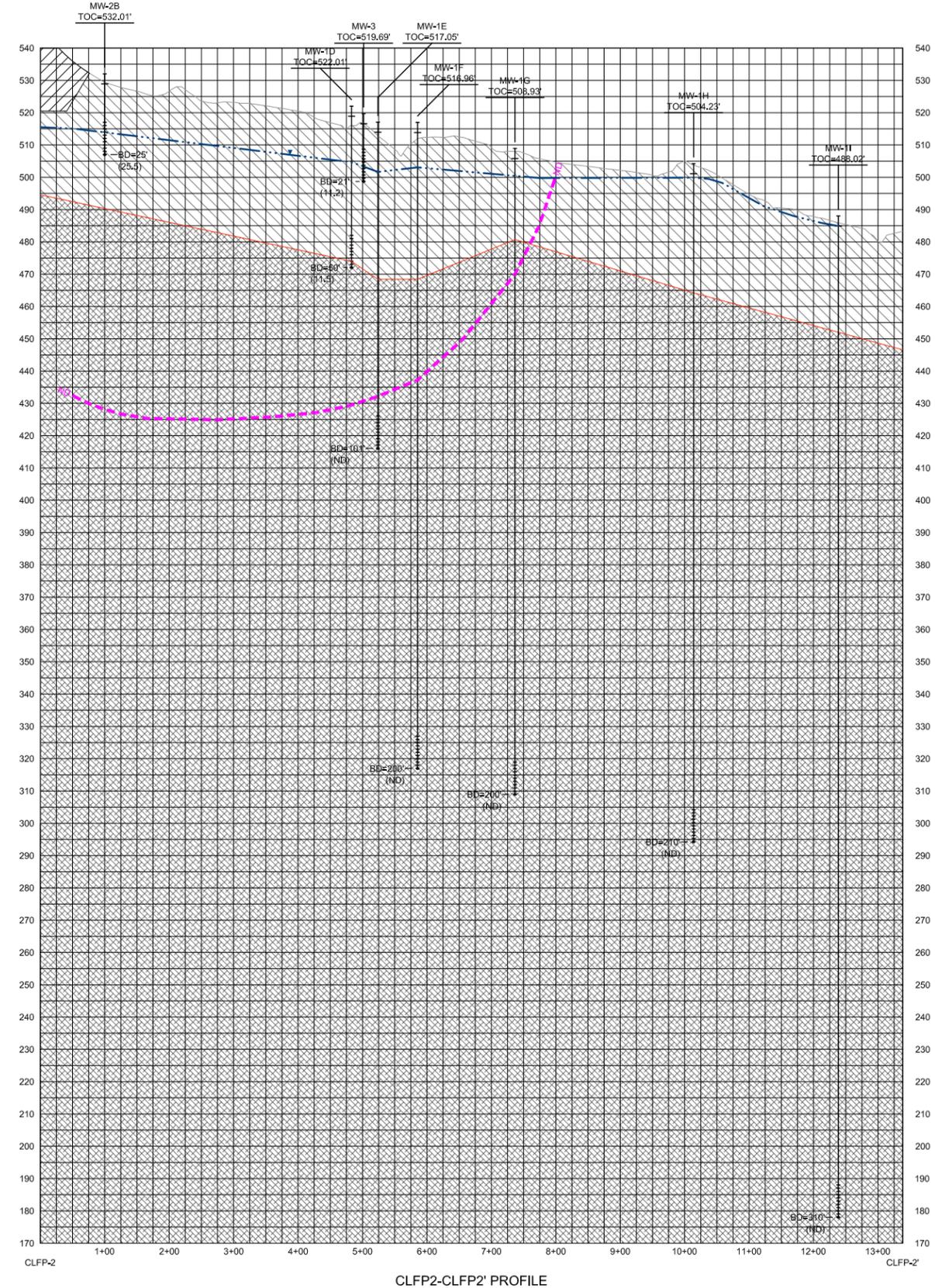
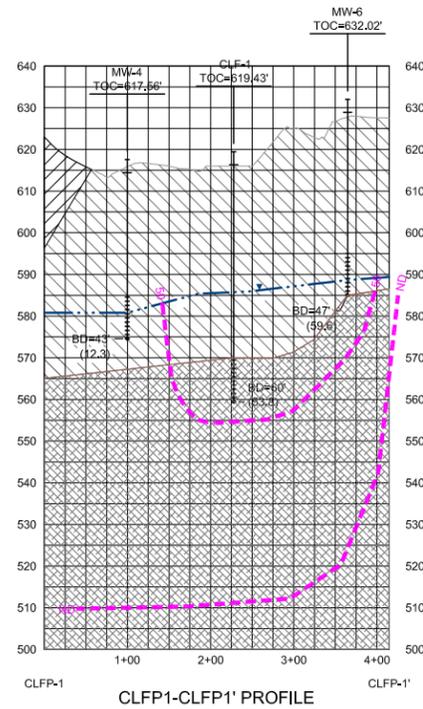
INFERRED COBALT ISOCONCENTRATION CONTOUR (µg/L)

SAPROLITE

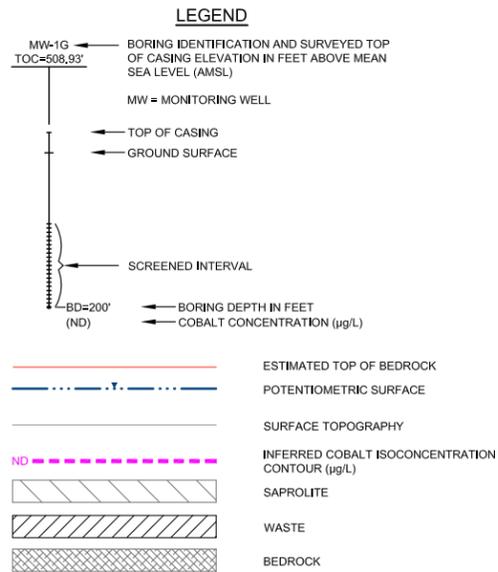
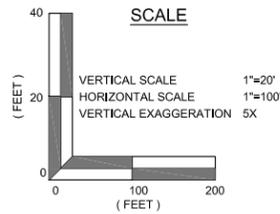
WASTE

BEDROCK

DESIGNED	JCW	NO.	BY	CK	APP
DRAWN	DAS				
CHECKED	JAW				
APPROVED	JGW				
DATE	10/17/14				
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 1604 OWENBY LANE RICHMOND, VA 23220 PHONE: (804) 355-4520					
<b>LAUREL VALLEY CENTER SANITARY LANDFILL</b> <b>CULPEPER COUNTY, VIRGINIA</b> <b>CROSS SECTIONS - MAY 2011</b> <b>COBALT</b> <b>PERMIT NO. 251</b>					
PROJECT NO. 310.1501.03					
SCALE AS SHOWN					
DRAWING NO. 13A					
REVISIONS AND RECORD OF ISSUE					
DATE					



- NOTES:**
- GROUNDWATER LEVEL ELEVATIONS WERE INFERRED BASED ON MONITORING WELL DATA AND TOPOGRAPHY.
  - STATIC WATER LEVELS WERE MEASURED ON APRIL 7, 2014.
  - WELLS WERE SAMPLED ON APRIL 8 & 9, 2014.
  - ND = NOT DETECTED
  - J = ESTIMATED
  - µg/L = MICROGRAMS PER LITER
  - NM = NOT MEASURED



DESIGNED	JCW
DRAWN	DAS
CHECKED	JAW
APPROVED	JGW
DATE	10/17/14

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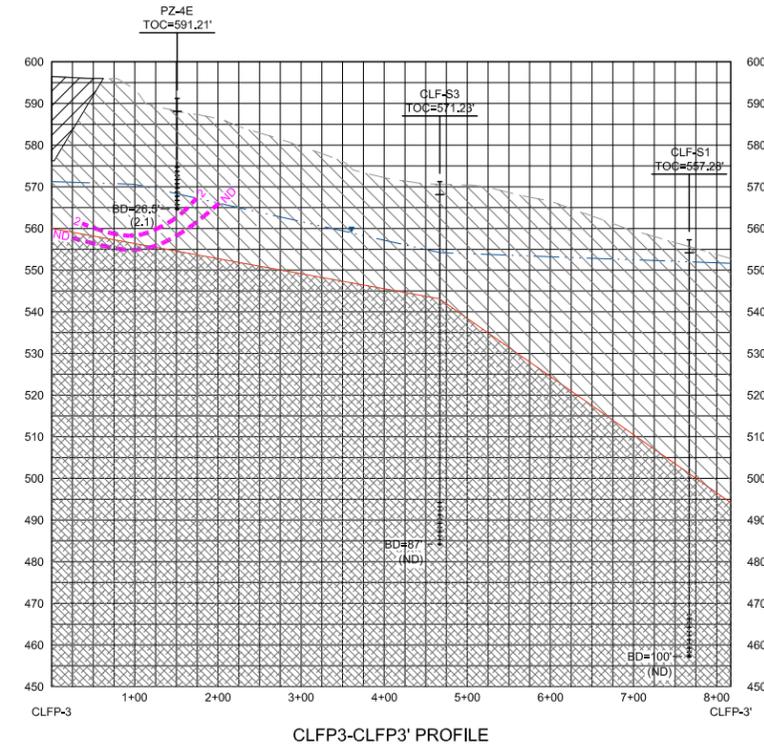
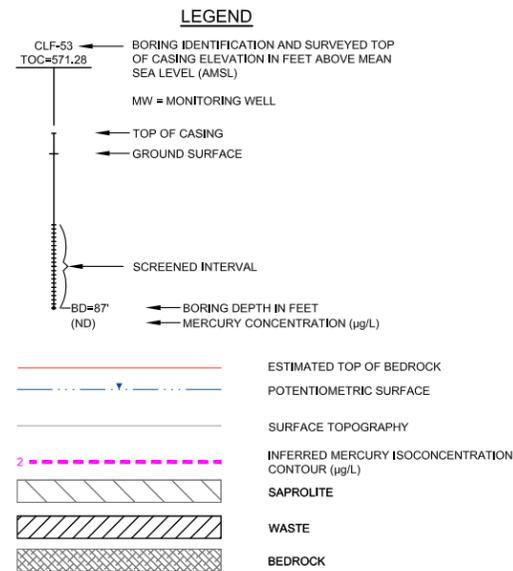
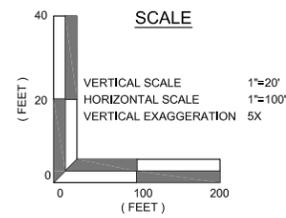
LAUREL VALLEY CENTER SANITARY LANDFILL  
CULPEPER COUNTY, VIRGINIA  
CROSS SECTIONS - APRIL 2014  
COBALT  
PERMIT NO. 251

PROJECT NO.	310.1501.03
SCALE	AS SHOWN
DRAWING NO.	13B

NO. BY CK APP  
REVISIONS AND RECORD OF ISSUE  
DATE

**NOTES:**

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LAUREL VALLEY CENTER SANITARY LANDFILL  
CULPEPER COUNTY, VIRGINIA

CROSS SECTION - MAY 2011  
MERCURY  
PERMIT NO. 251

PROJECT NO.  
310.1501.03

SCALE  
AS SHOWN

DRAWING NO.  
14A

DESIGNED: JGW  
DRAWN: DAS  
CHECKED: JAW  
APPROVED: JGW  
DATE: 10/17/14

**JOYCE ENGINEERING**  
1604 OWNBY LANE  
RICHMOND, VA 23220  
PHONE: (804) 355-4520

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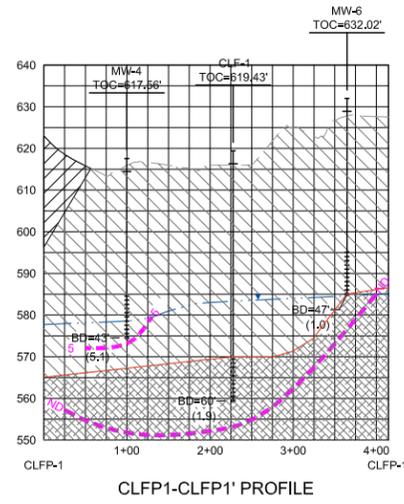
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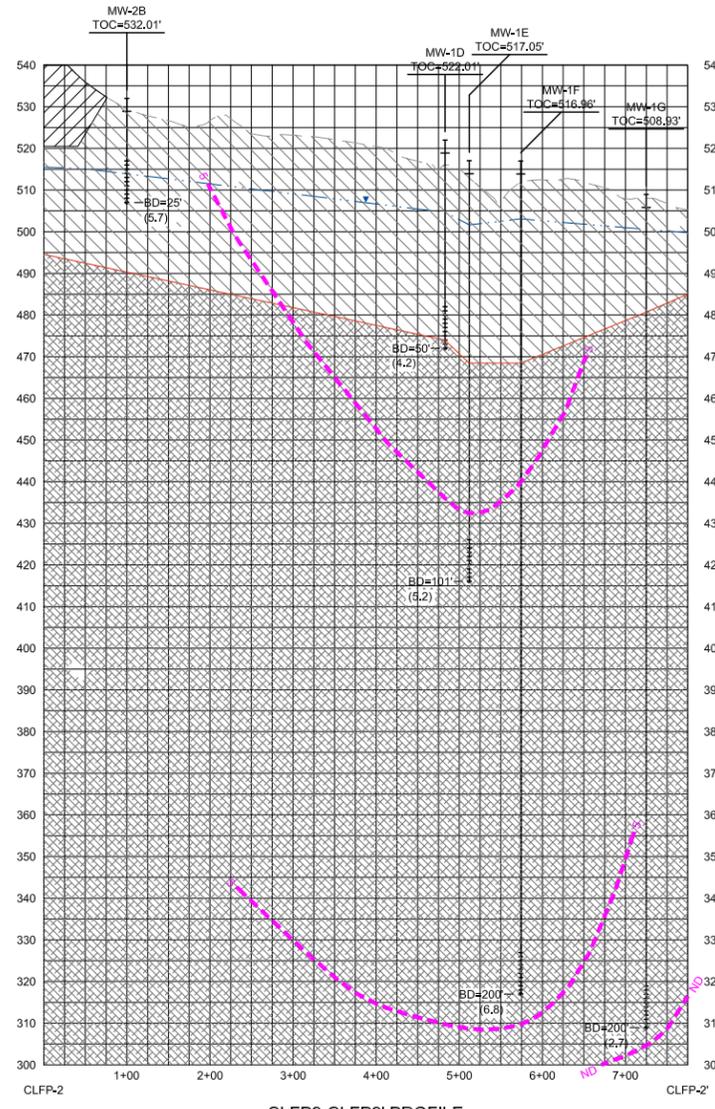




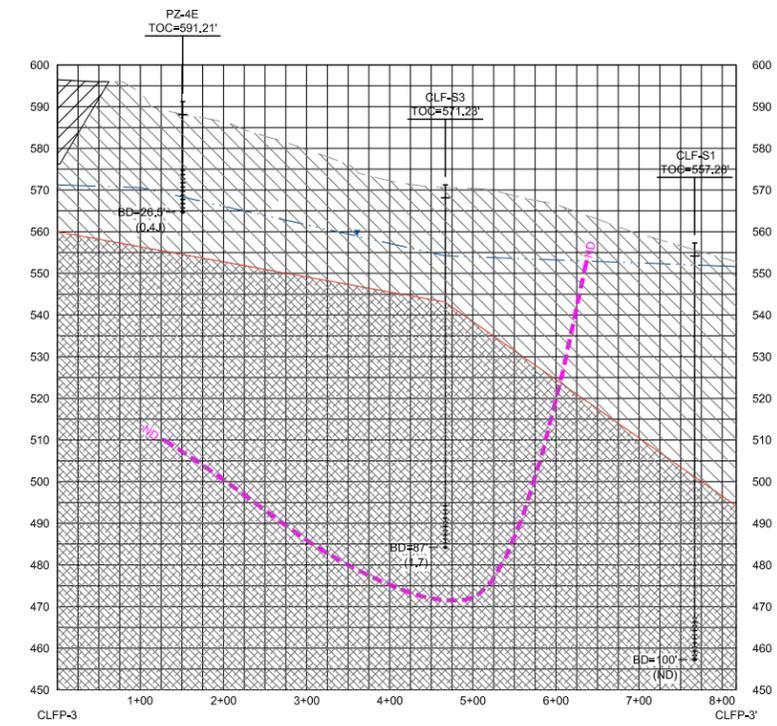




CLFP1-CLFP1' PROFILE

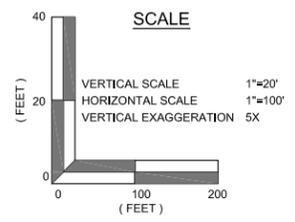


CLFP2-CLFP2' PROFILE



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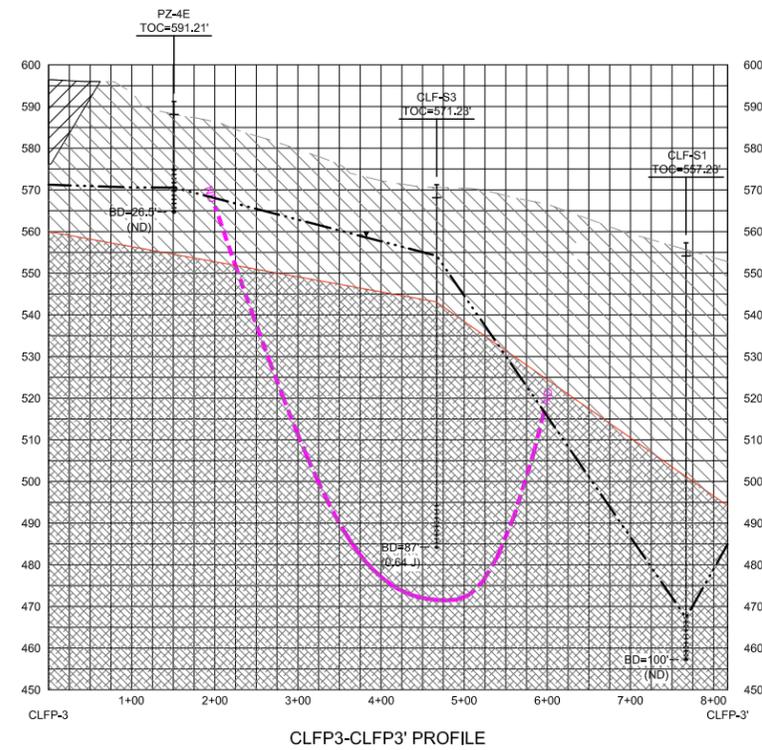
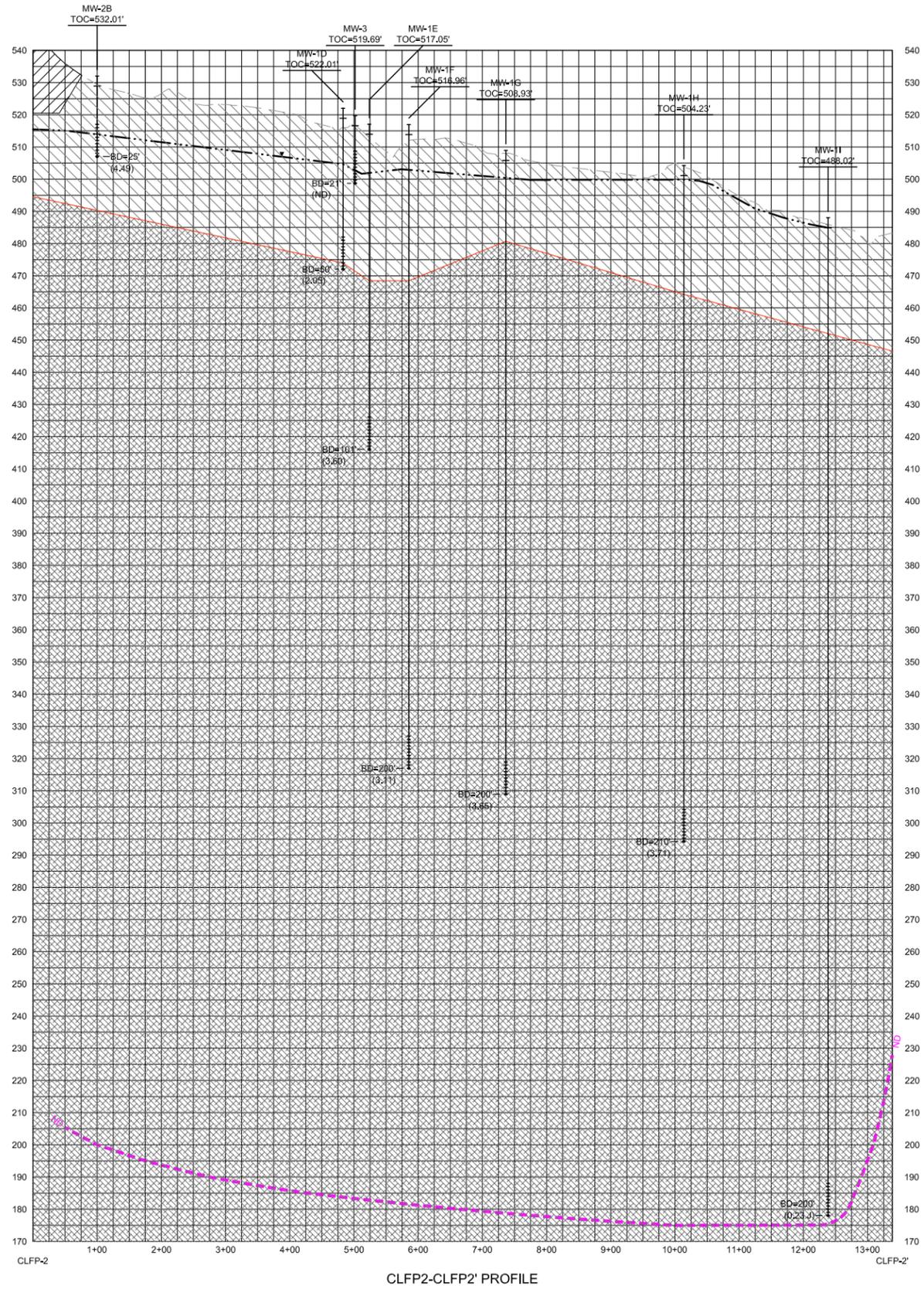
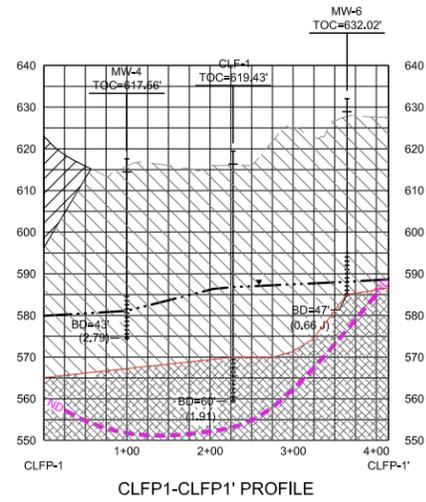
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**LEGEND**

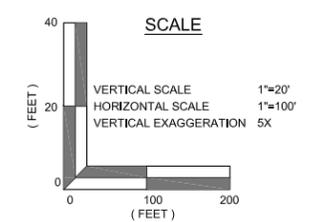
- MW-1G TOC=508.93' BORING IDENTIFICATION AND SURVEYED TOP OF CASING ELEVATION IN FEET ABOVE MEAN SEA LEVEL (AMSL)
- MW = MONITORING WELL
- TOP OF CASING
- GROUND SURFACE
- SCREENED INTERVAL
- BD=200' (2.7) BORING DEPTH IN FEET
- 1,1-DICHLOROETHANE CONCENTRATION (µg/L)
- ESTIMATED TOP OF BEDROCK
- POTENTIOMETRIC SURFACE
- SURFACE TOPOGRAPHY
- INFERRED 1,1-DICHLOROETHANE ISOCONCENTRATION CONTOUR (µg/L)
- SAPROLITE
- WASTE
- BEDROCK

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<b>LAUREL VALLEY CENTER SANITARY LANDFILL</b> <b>CULPEPER COUNTY, VIRGINIA</b> <b>CROSS SECTIONS - MAY 2011</b> <b>1,1-DICHLOROETHANE</b> <b>PERMIT NO. 251</b>			
<b>PROJECT NO.</b> <b>310.1501.03</b>			
<b>SCALE</b> <b>AS SHOWN</b>			
<b>DRAWING NO.</b> <b>16A</b>			



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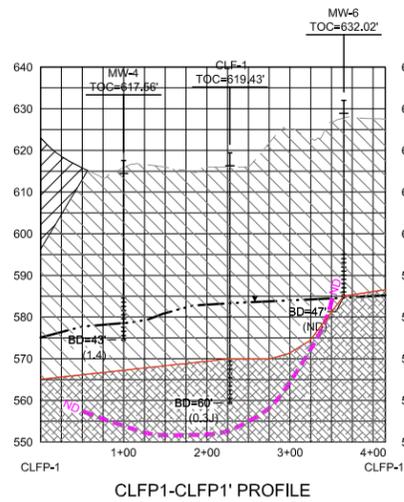
**LEGEND**

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- MW = MONITORING WELL
- TOP OF CASING
- GROUND SURFACE
- SCREENED INTERVAL
- BD=200' (3.65) BORING DEPTH IN FEET
- 1,1-DICHLOROETHANE CONCENTRATION (µg/L)
- ESTIMATED TOP OF BEDROCK
- POTENTIOMETRIC SURFACE
- SURFACE TOPOGRAPHY
- INFERRED 1,1-DICHLOROETHANE ISOCONCENTRATION CONTOUR (µg/L)
- SAPROLITE
- WASTE
- BEDROCK

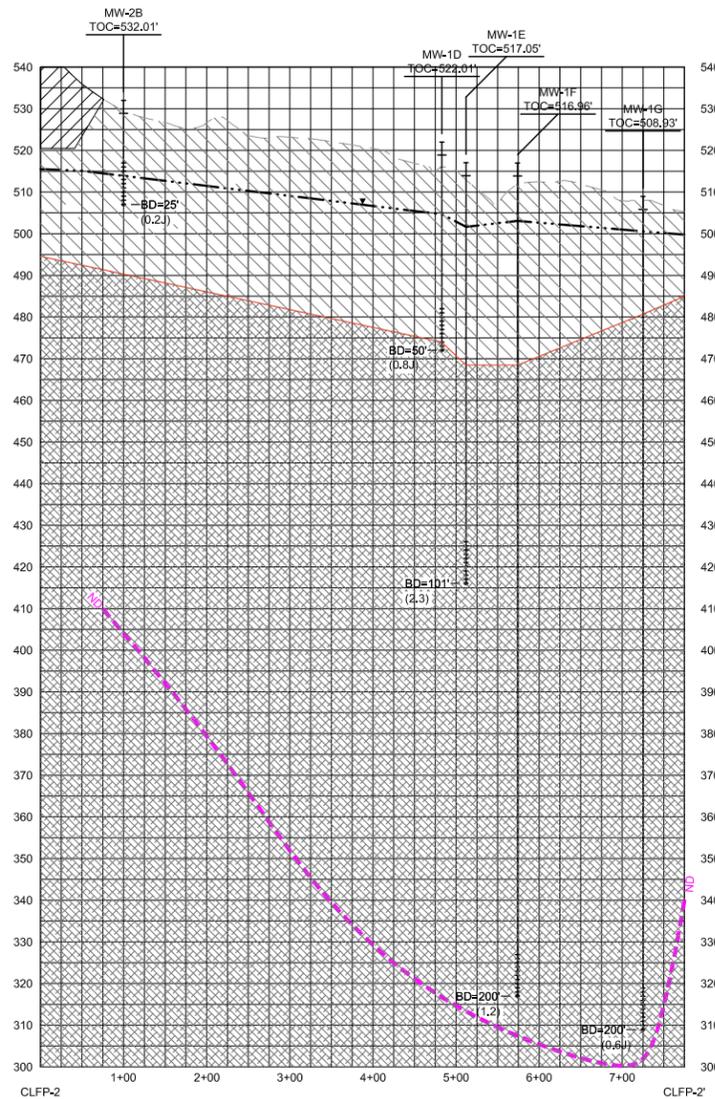
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<b>CROSS SECTIONS - APRIL 2014 1,1-DICHLOROETHANE PERMIT NO. 251</b>			
<b>PROJECT NO.</b> 310.1501.03			
<b>SCALE</b> AS SHOWN			
<b>DRAWING NO.</b> 16B			



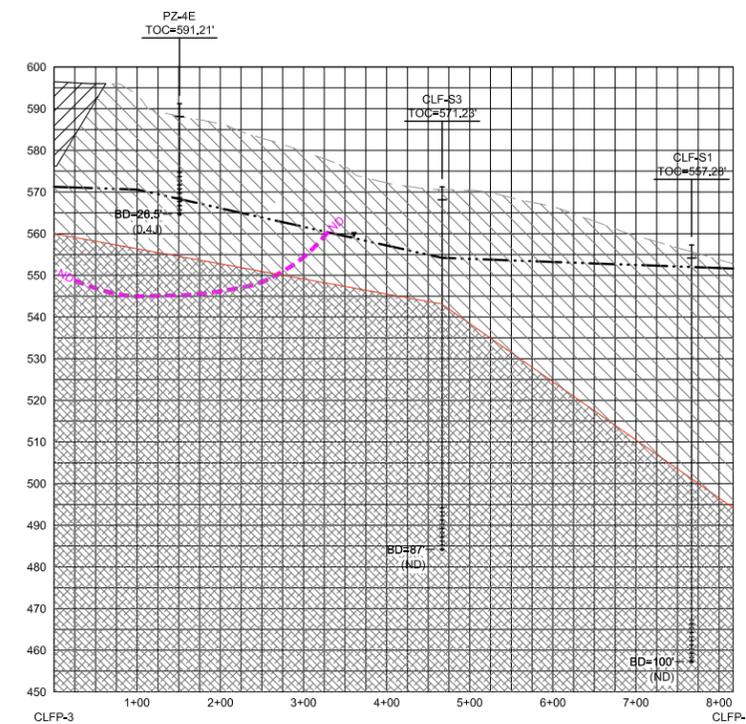




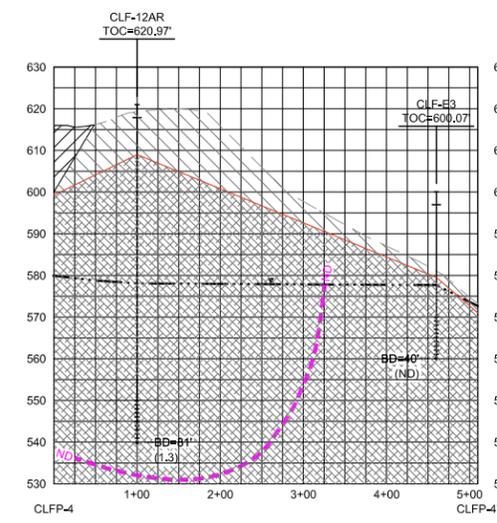
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CLFP2-CLFP2' PROFILE

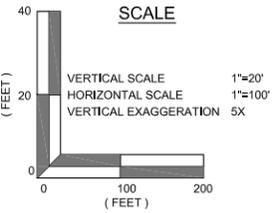


CLFP3-CLFP3' PROFILE



CLFP4-CLFP4' PROFILE

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**LEGEND**

- MW-1G TOC=508.93' - BORING IDENTIFICATION AND SURVEYED TOP OF CASING ELEVATION IN FEET ABOVE MEAN SEA LEVEL (AMSL)
- MW = MONITORING WELL
- TOP OF CASING
- GROUND SURFACE
- SCREENED INTERVAL
- BD=200' (0.6) - BORING DEPTH IN FEET
- TETRACHLOROETHENE CONCENTRATION (µg/L)
- TOP OF BEDROCK
- POTENTIOMETRIC SURFACE
- SURFACE TOPOGRAPHY
- INFERRED TETRACHLOROETHENE ISOCENTRATION CONTOUR (µg/L)
- SAPROLITE
- WASTE
- BEDROCK

NO.	BY	DATE	REVISIONS AND RECORD OF ISSUE

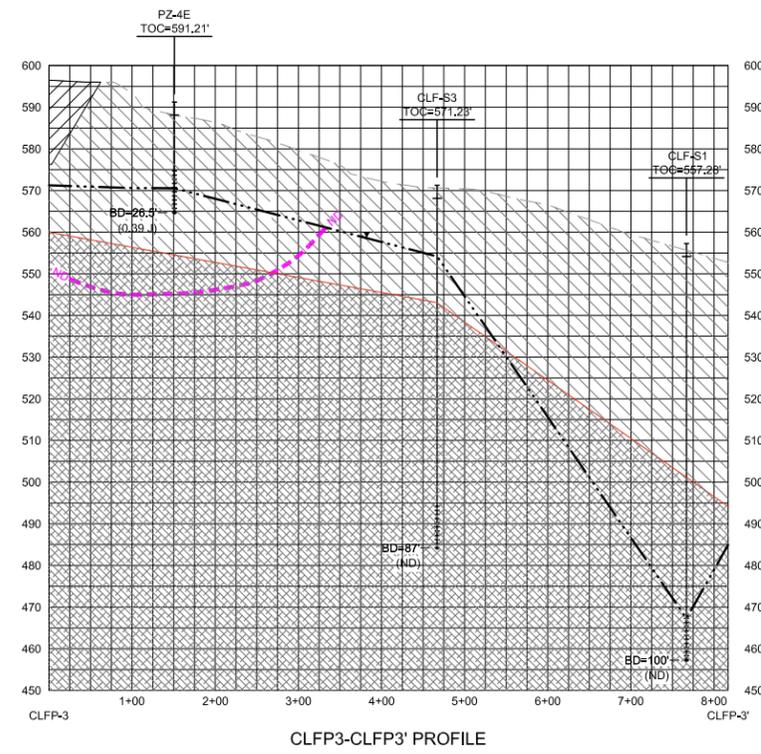
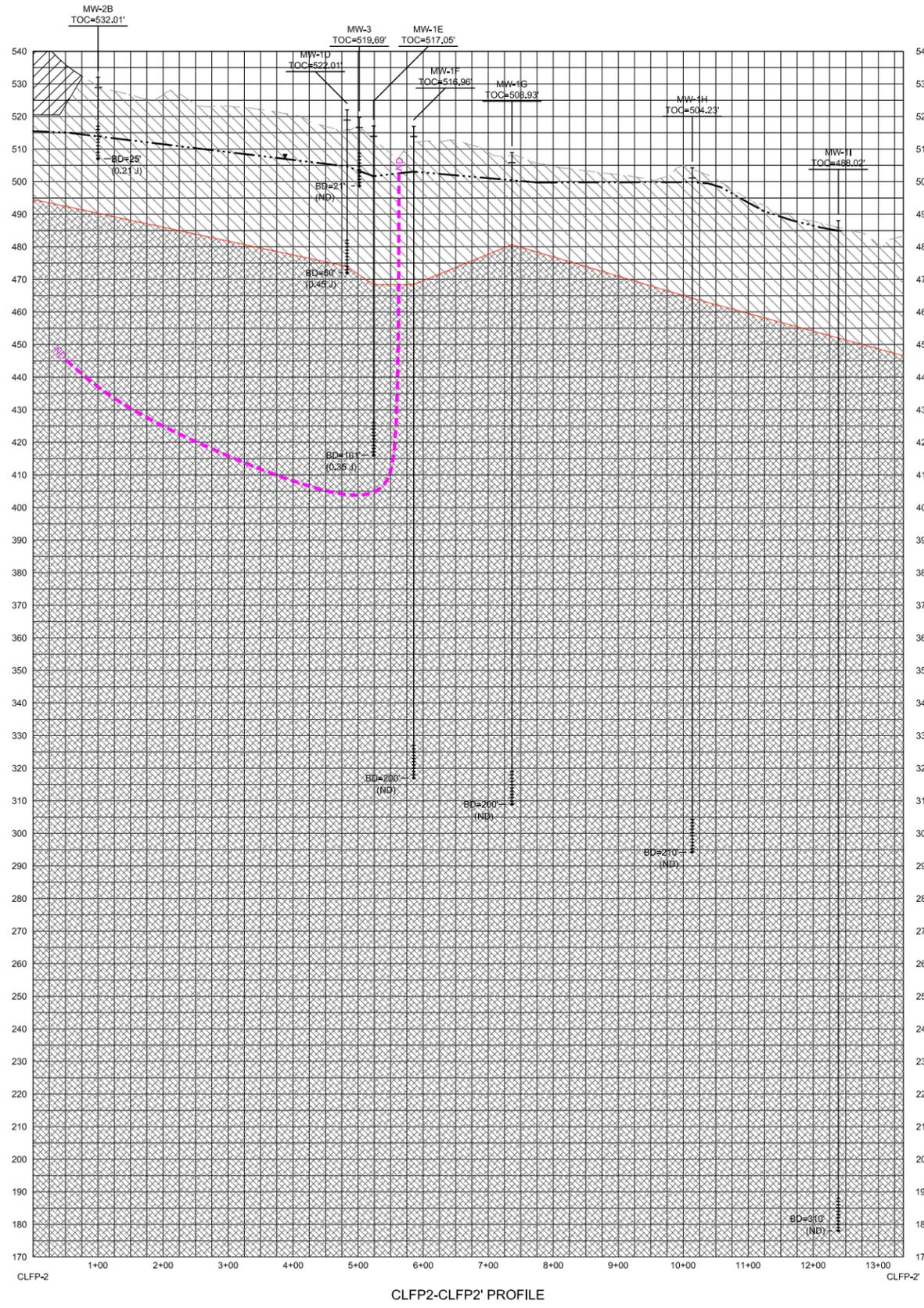
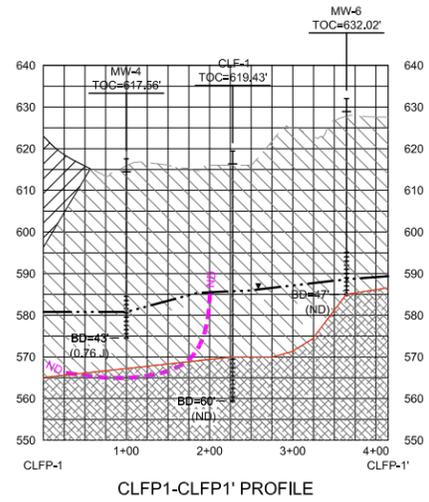
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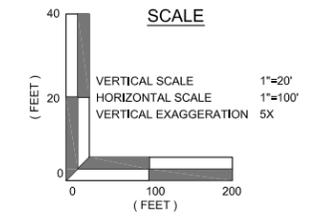
LAUREL VALLEY CENTER SANITARY LANDFILL  
CULPEPER COUNTY, VIRGINIA  
CROSS SECTIONS - MAY 2011  
TETRACHLOROETHENE  
PERMIT NO. 251

PROJECT NO.  
310.1501.03  
SCALE  
AS SHOWN  
DRAWING NO.  
18A



**NOTES:**

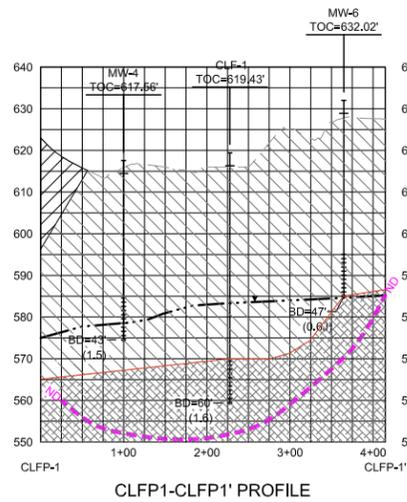
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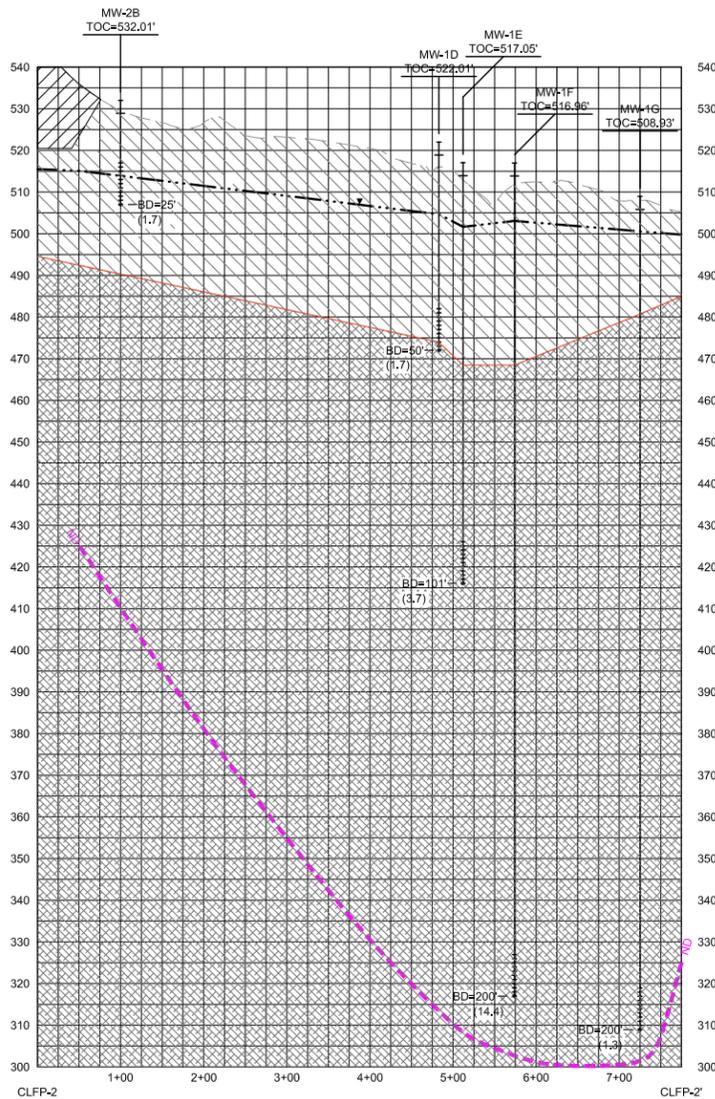
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- MW = MONITORING WELL
- ← TOP OF CASING
- ← GROUND SURFACE
- ← SCREENED INTERVAL
- ← BD=200' (ND) ← BORING DEPTH IN FEET
- ← ← TETRACHLOROETHENE CONCENTRATION (µg/L)
- TOP OF BEDROCK
- POTENTIOMETRIC SURFACE
- SURFACE TOPOGRAPHY
- INFERRED TETRACHLOROETHENE ISOCONCENTRATION CONTOUR (µg/L)
- SAPROLITE
- WASTE
- BEDROCK

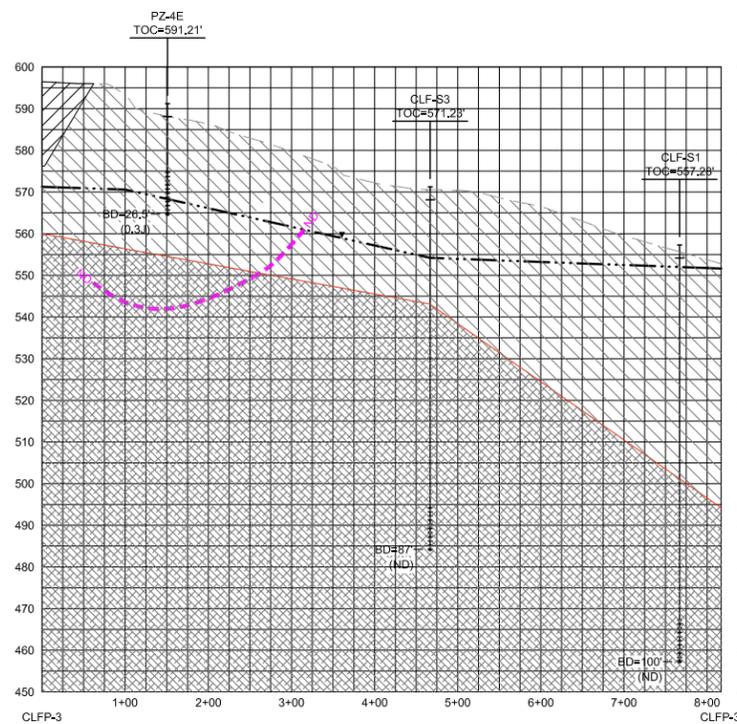
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<b>PROJECT NO.          310.1501.03</b>			
<b>SCALE          AS SHOWN</b>			
<b>DRAWING NO.          18B</b>			



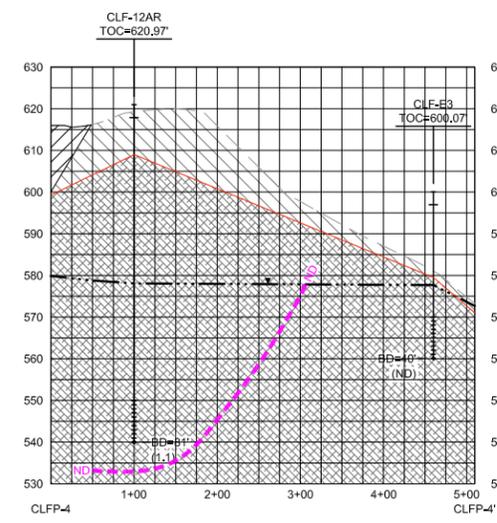
CLFP1-CLFP1' PROFILE



CLFP2-CLFP2' PROFILE

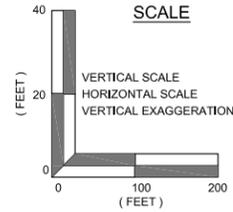


CLFP3-CLFP3' PROFILE



CLFP4-CLFP4' PROFILE

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- TOP OF CASING
- GROUND SURFACE
- SCREENED INTERVAL
- BD=200' (1.3) (BORING DEPTH IN FEET)
- ESTIMATED TOP OF BEDROCK
- POTENTIOMETRIC SURFACE
- SURFACE TOPOGRAPHY
- INFERRED TRICHLOROETHENE ISOCENTRATION CONTOUR (µg/L)
- SAPROLITE
- WASTE
- BEDROCK

NO.	BY	DATE	REVISIONS AND RECORD OF ISSUE

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 CHECKED: JAW  
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LAUREL VALLEY CENTER SANITARY LANDFILL  
 CULPEPER COUNTY, VIRGINIA

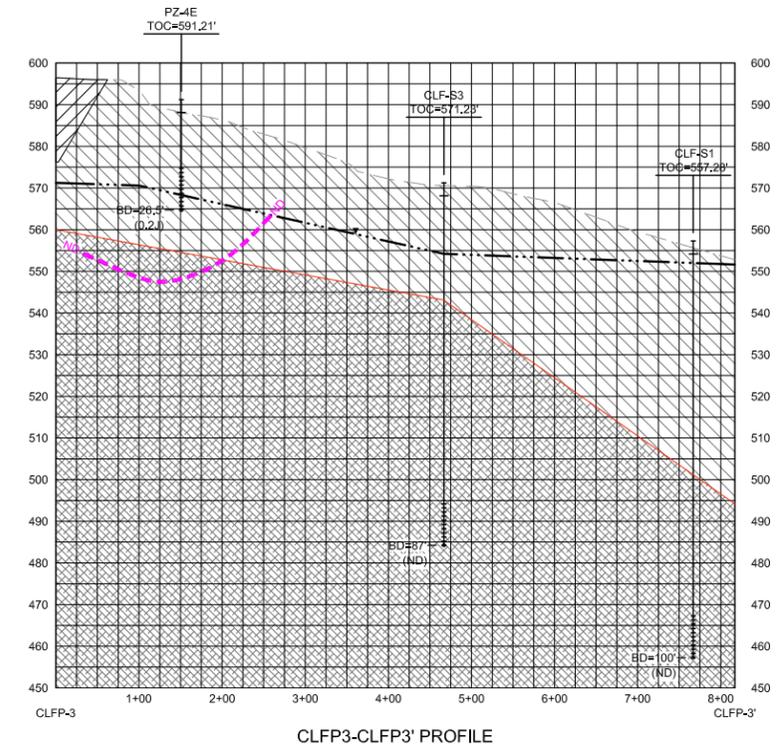
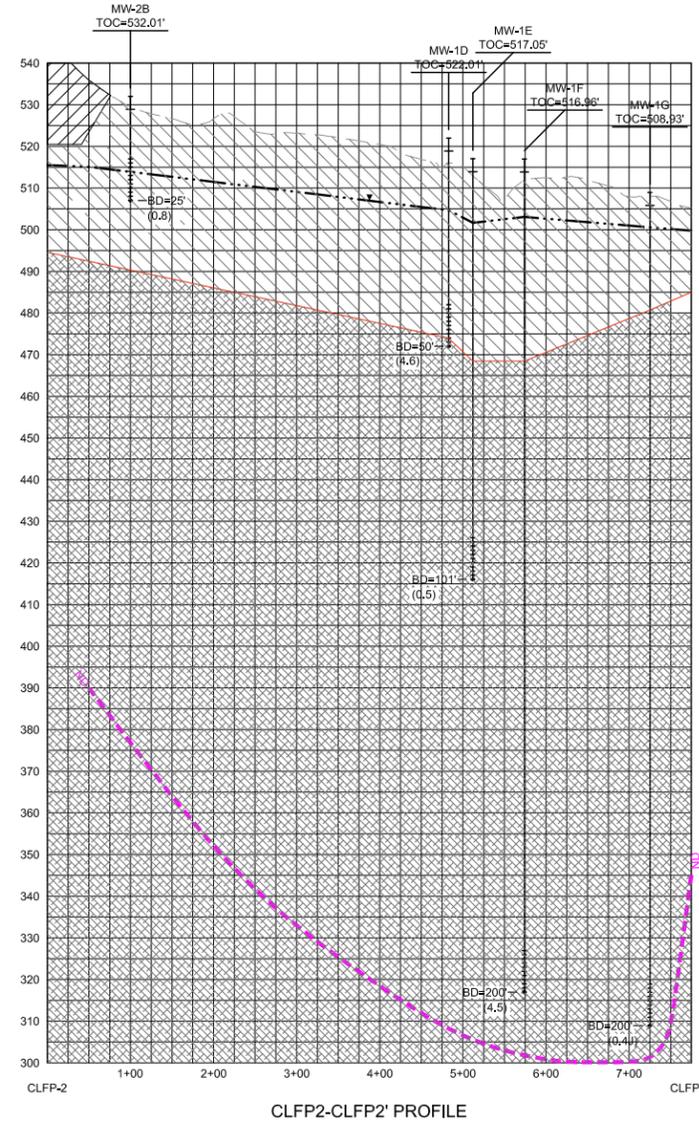
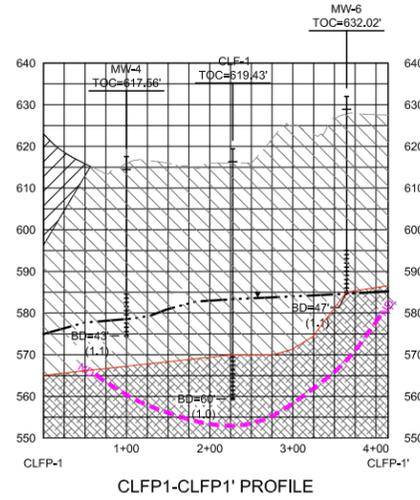
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 TRICHLOROETHENE  
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SCALE  
 AS SHOWN

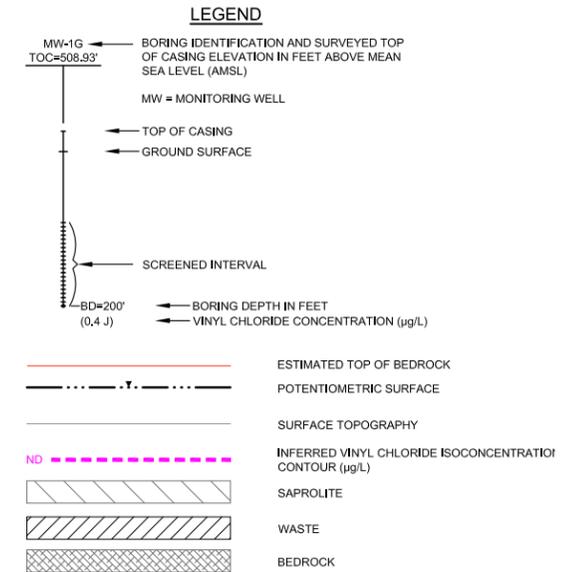
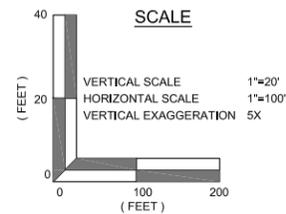
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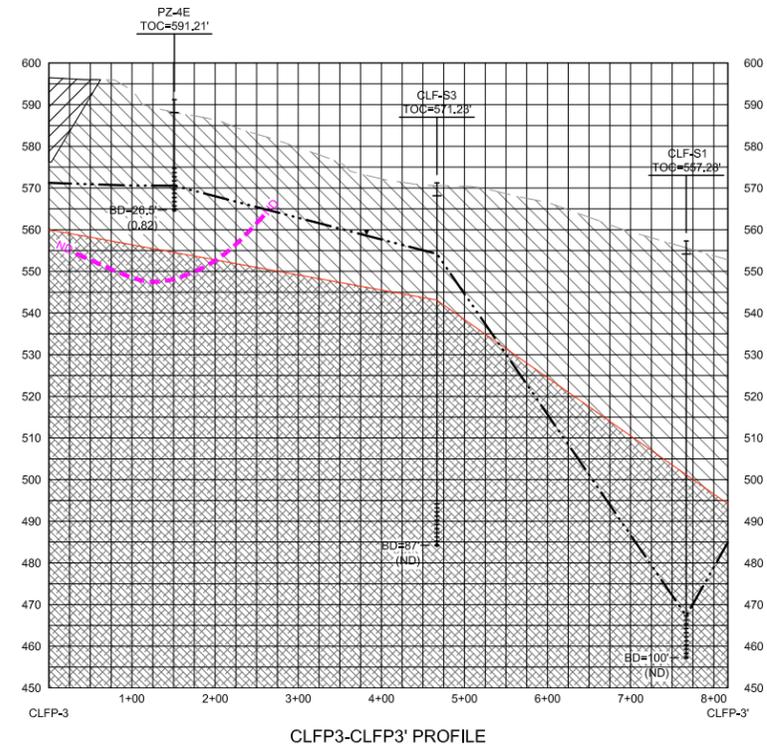
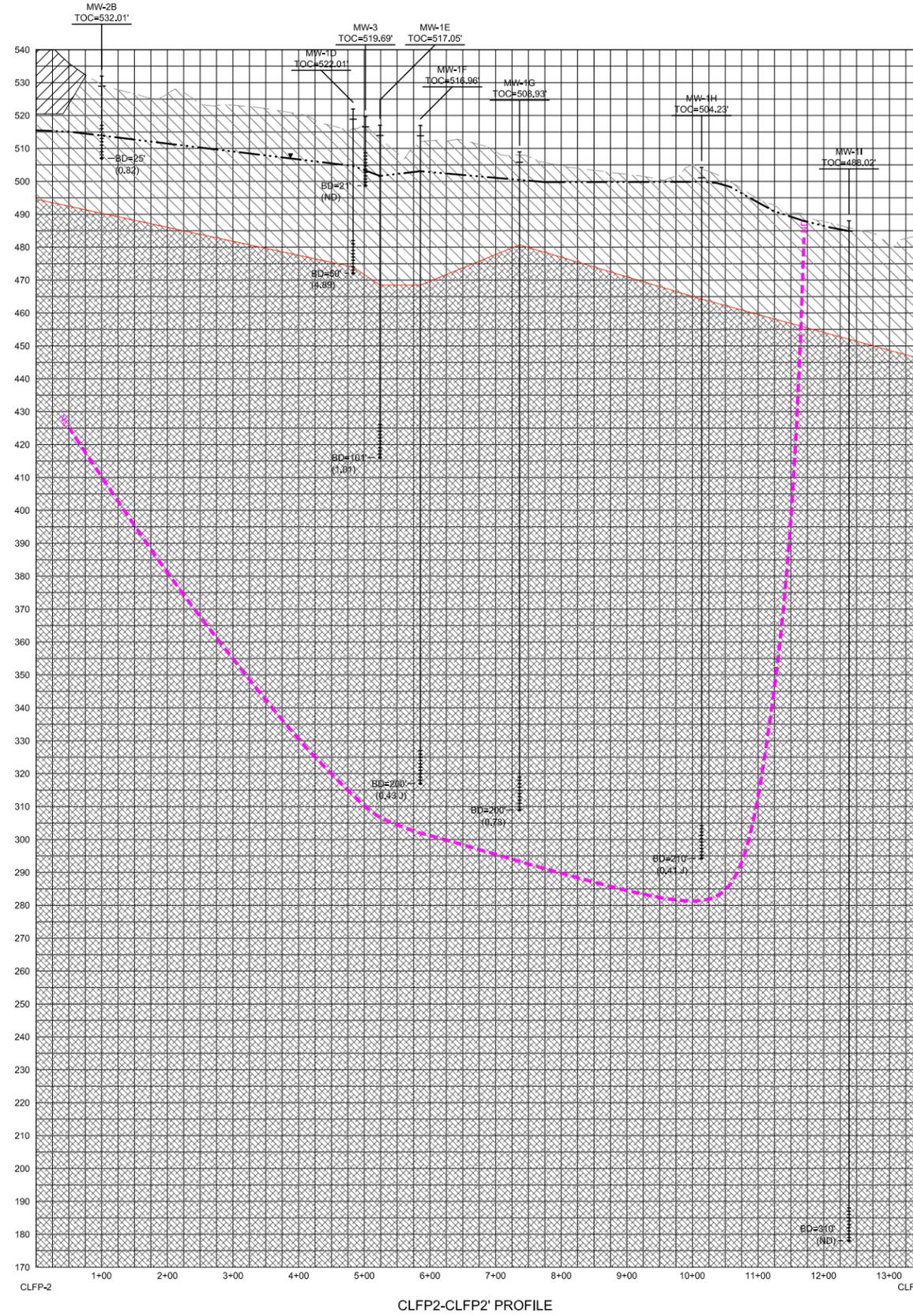
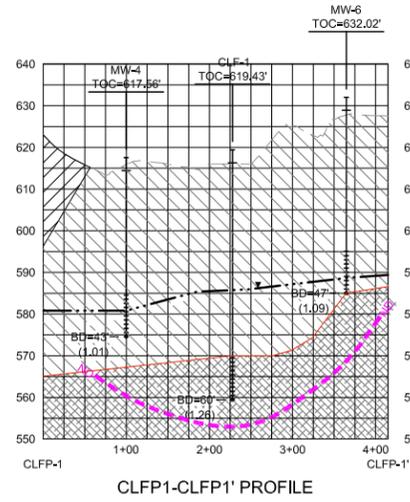


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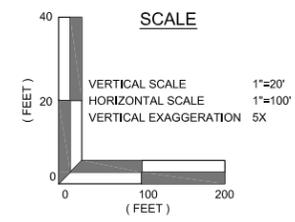
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<b>LAUREL VALLEY CENTER SANITARY LANDFILL          CULPEPER COUNTY, VIRGINIA</b>		<b>CROSS SECTIONS - MAY 2011          VINYL CHLORIDE          PERMIT NO. 251</b>	
PROJECT NO. 310.1501.03			
SCALE AS SHOWN			
DRAWING NO. 20A			



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  - MW = MONITORING WELL
  - TOP OF CASING
  - GROUND SURFACE
  - SCREENED INTERVAL
  - BD=200' (0.73) BORING DEPTH IN FEET
  - VINYL CHLORIDE CONCENTRATION (µg/L)
  - ESTIMATED TOP OF BEDROCK
  - POTENTIOMETRIC SURFACE
  - SURFACE TOPOGRAPHY
  - INFERRED VINYL CHLORIDE ISOCONCENTRATION CONTOUR (µg/L)
  - SAPROLITE
  - WASTE
  - BEDROCK

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PROJECT NO. 310.1501.03			
SCALE AS SHOWN			
DRAWING NO. 20B			

## **Attachment VIII:**

Statistical Analysis and Time Series Data Plots for each GPS exceeding constituent identified within individual wells sampled during the CASE period

### **Trend Charts**

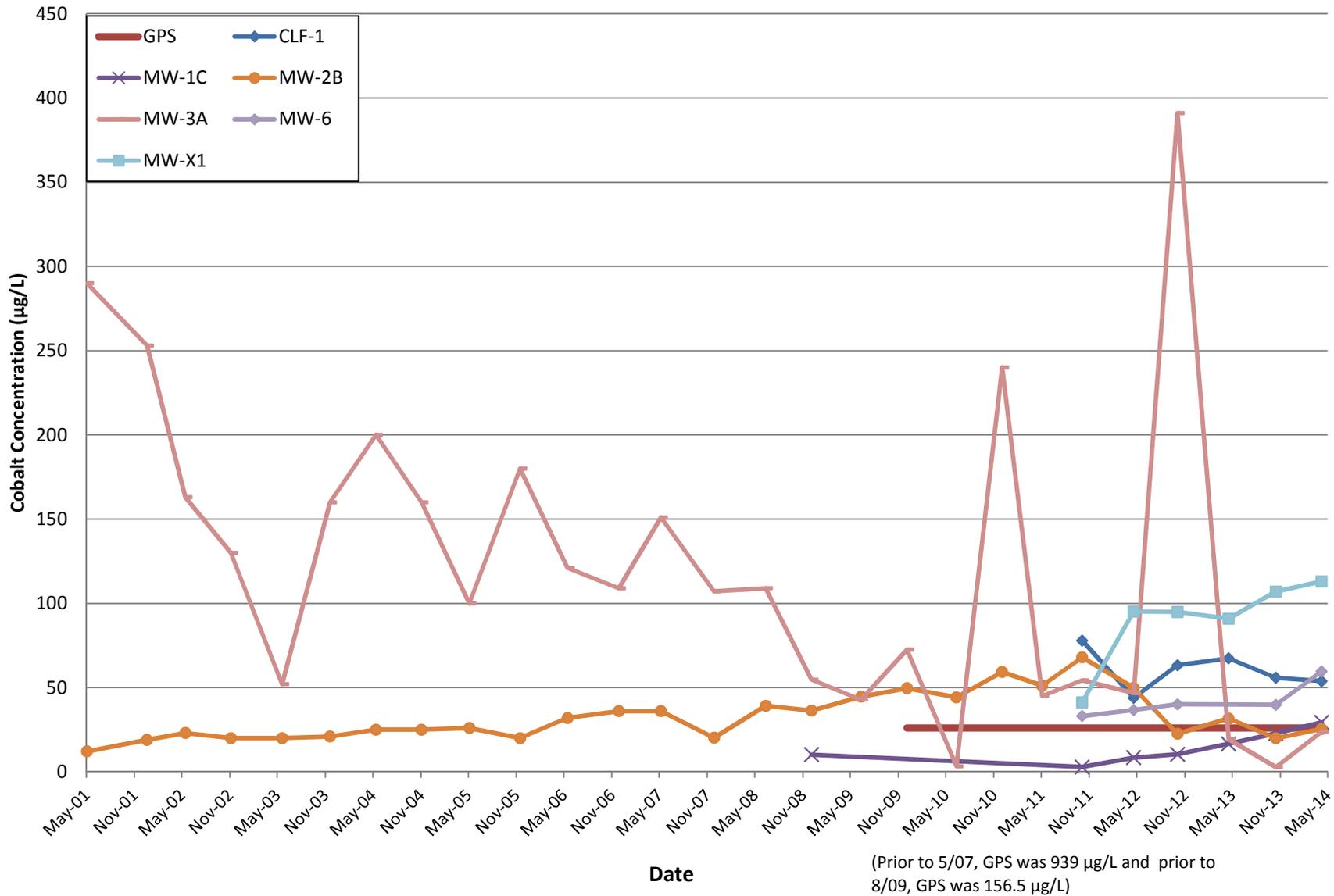
<b>Constituent of Concern</b>	<b>Trend Chart</b>
Cobalt	Chart 1
Mercury	Chart 2
Benzene	Chart 3
1,1-Dichloroethane	Chart 4
Naphthalene	Chart 5
Tetrachloroethene	Chart 6
Trichloroethene	Chart 7
Vinyl Chloride	Chart 8

### **Statistical Trend Analyses**

<b>Constituent of Concern (with GPS Exceedances)</b>	<b>Wells</b>
Cobalt	CLF-1, MW-1C, MW-2B, MW-3A, MW-6, and MW-X1
Mercury	PZ-4E
Benzene	MW-4
1,1-Dichloroethane	CLF-15A, MW-1B, MW-1C, MW-1D, MW-1E, MW-1F, MW-1G, MW-1H, MW-2B, and MW-4
Naphthalene	MW-4 and MW-6
Trichloroethene	CLF-15A, MW-1C, MW-1E, MW-1F, MW-1G, and MW-1H
Vinyl Chloride	MW-1B, MW-1C, MW-1D, MW-1F, MW-1G, and MW-1H

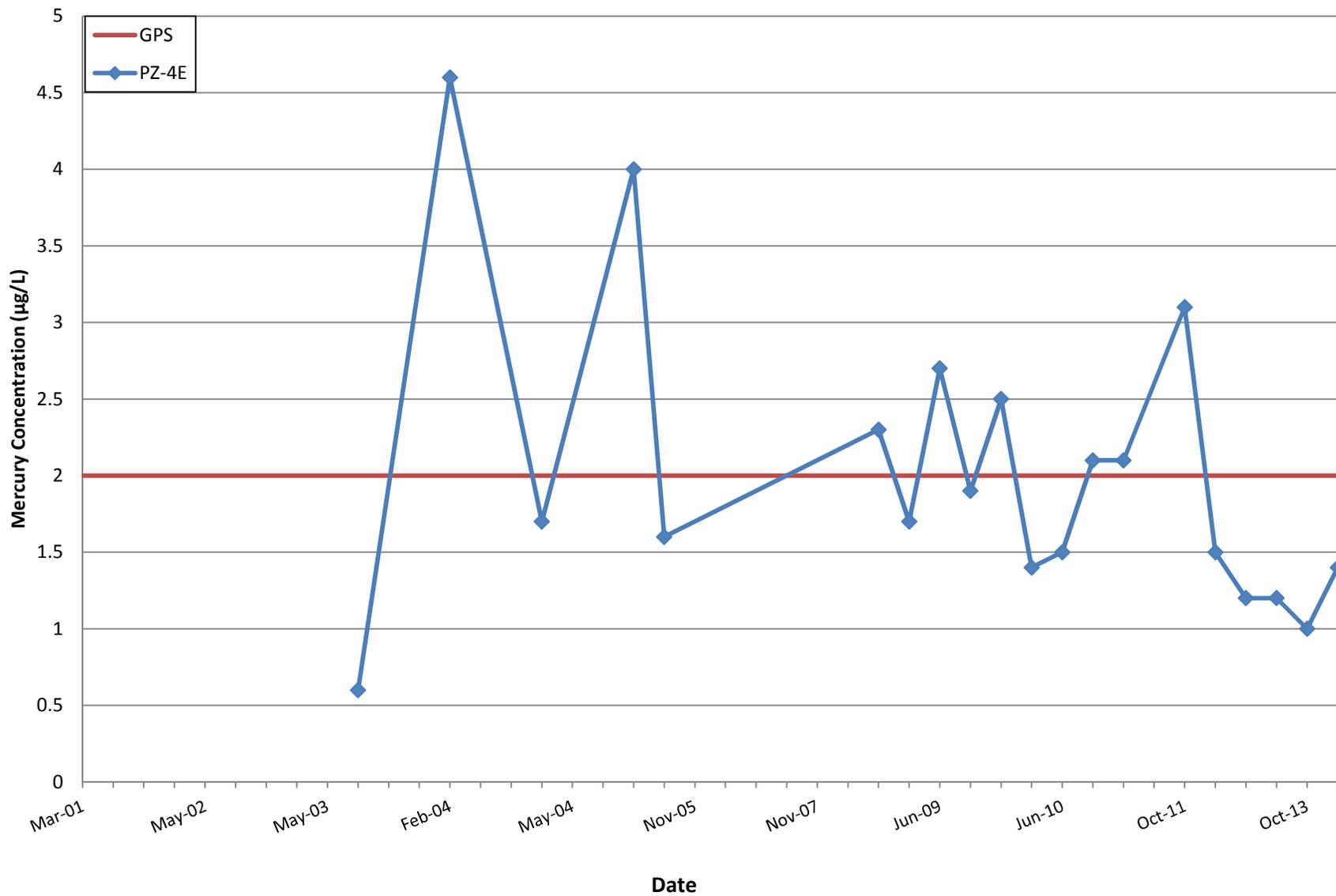
# Chart 1

## Cobalt in Wells with GPS Exceedances vs. Time



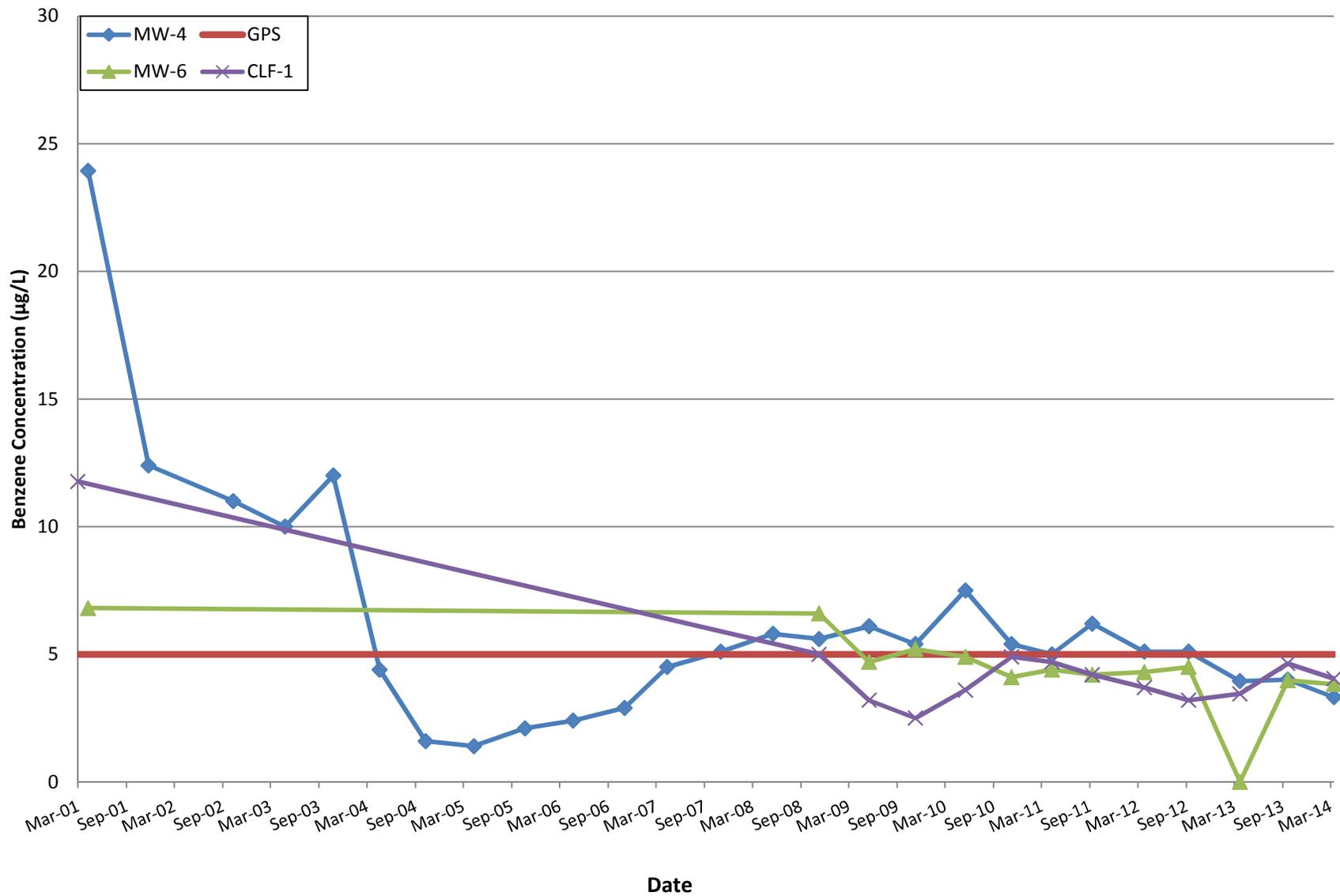
### Chart 2

## Mercury in Wells with GPS Exceedances vs. Time

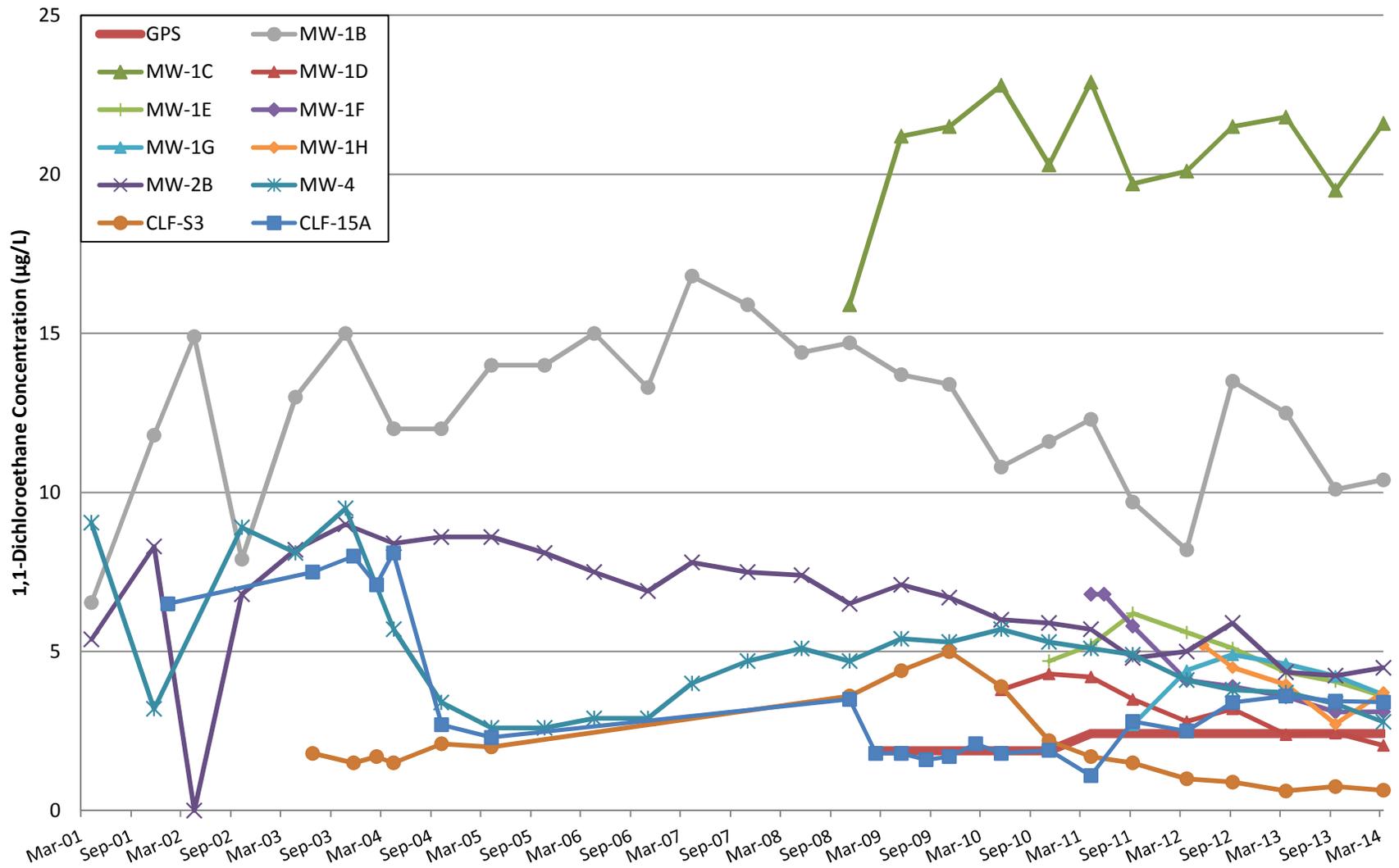


### Chart 3

#### Benzene in Wells with GPS Exceedances vs. Time

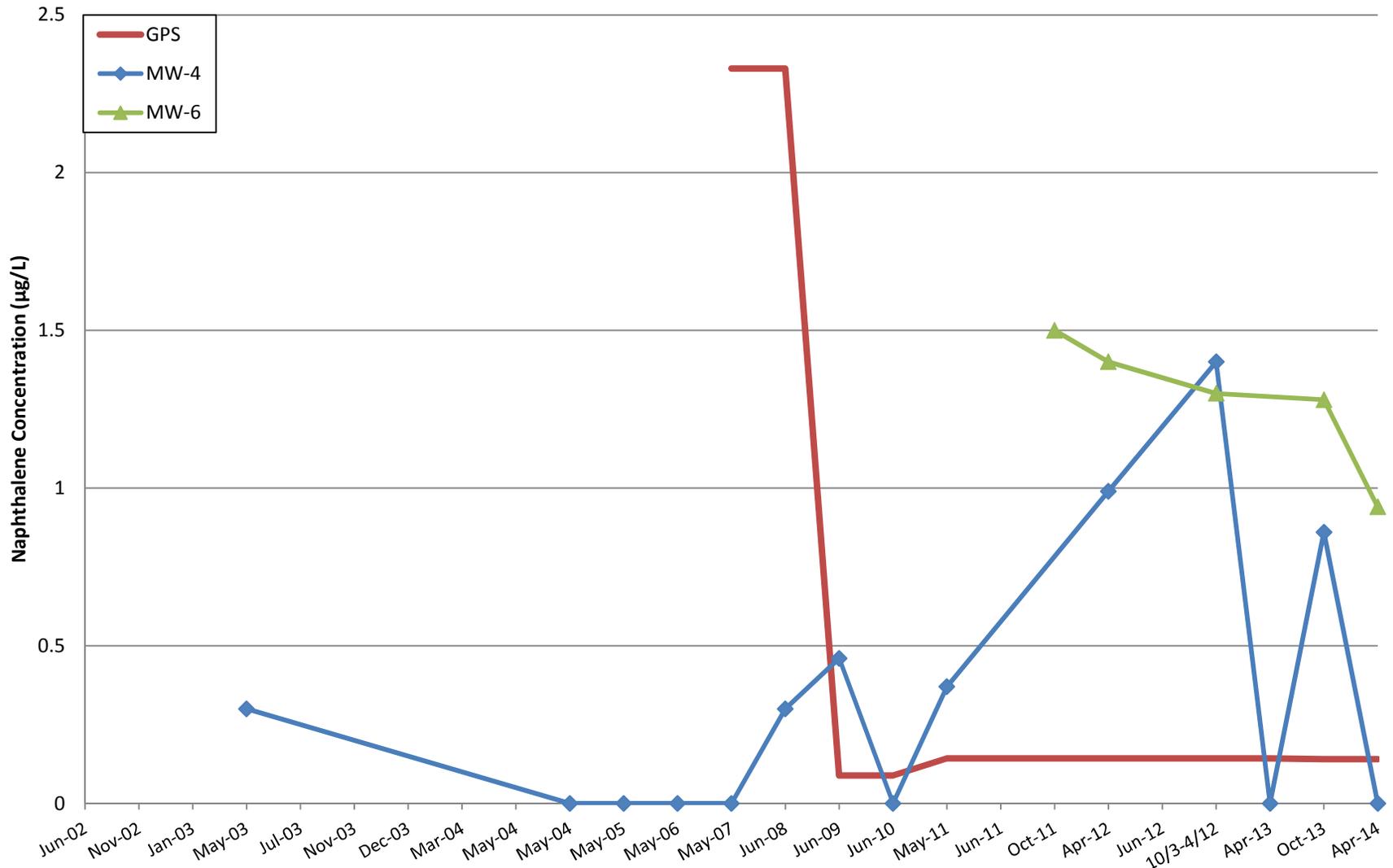


### Chart 4 1,1-Dichloroethane in Wells with GPS Exceedances vs. Time



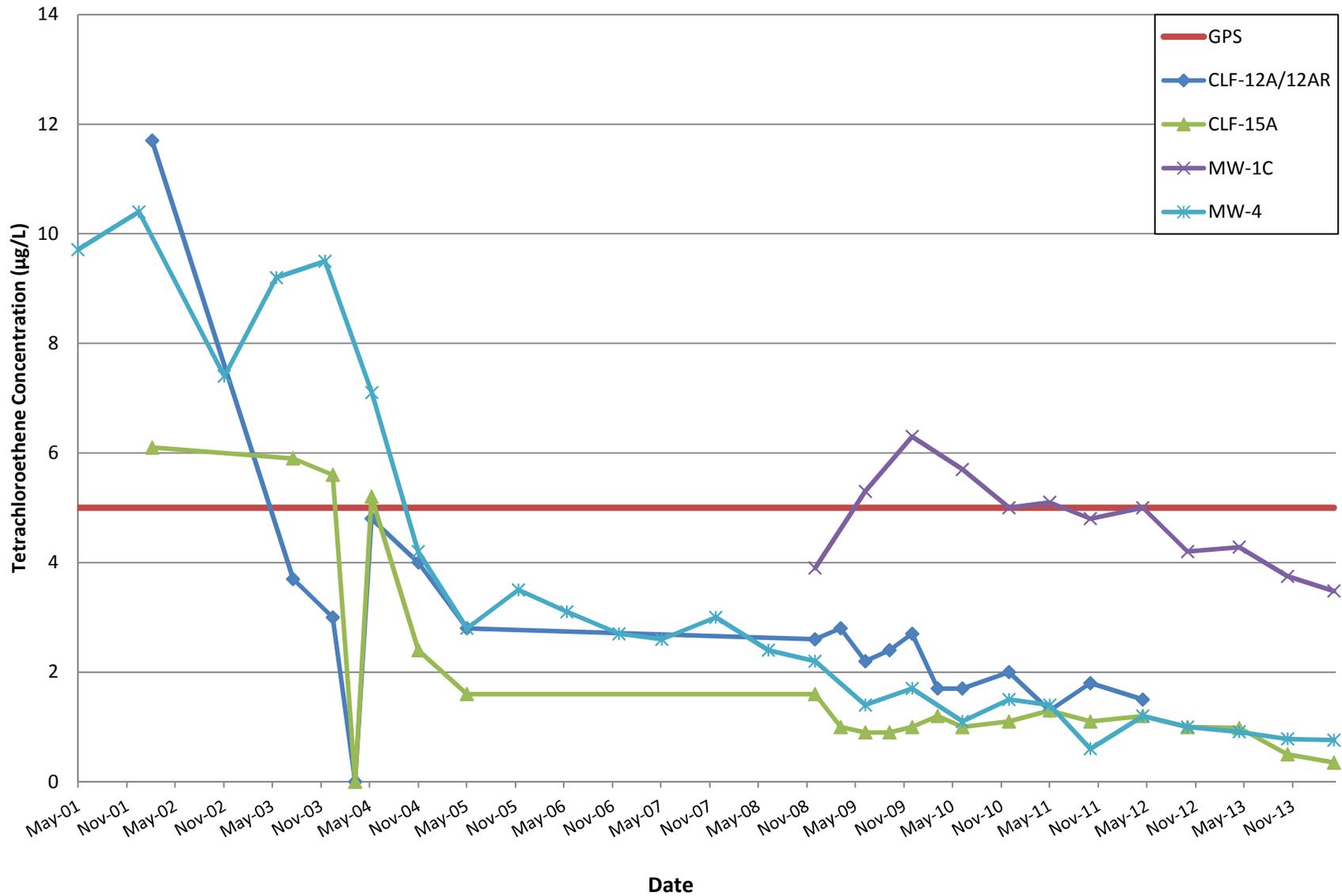
(Prior to 5/07, GPS was 301 µg/L, prior to 1/09, GPS was 327 µg/L, and prior to 3/11 GPS was 1.88 µg/L)

### Chart 5 Naphthalene in Wells with GPS Exceedances vs. Time



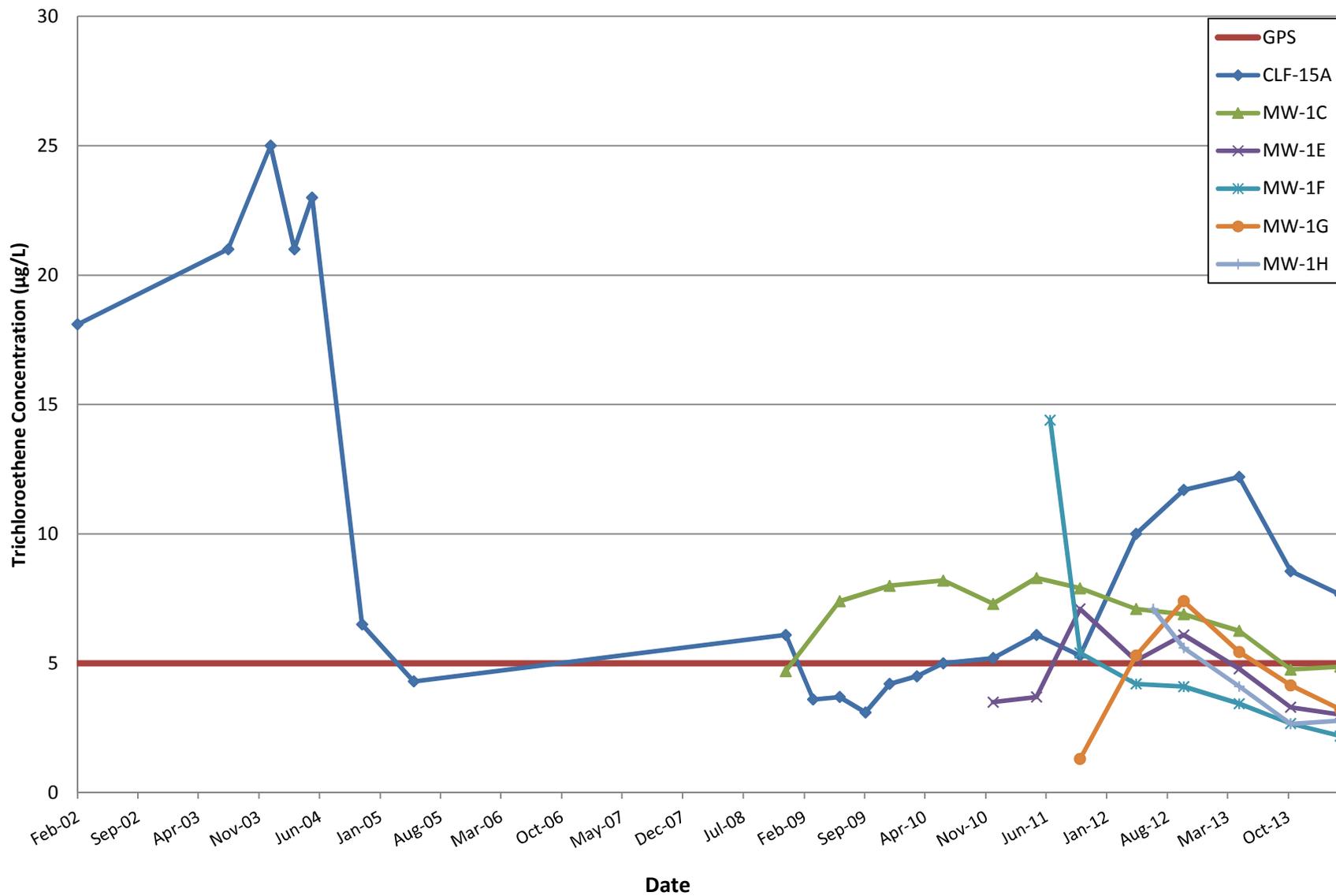
(Prior to 7/1/13, GPS was 0.143, prior to 3/1/11, GPS was 0.089 µg/L, prior to 1/27/09, GPS was 2.33 µg/L, and prior to 5/8/07 GPS was 626 µg/L)

**Chart 6**  
**Tetrachloroethene in Wells with GPS Exceedances vs. Time**

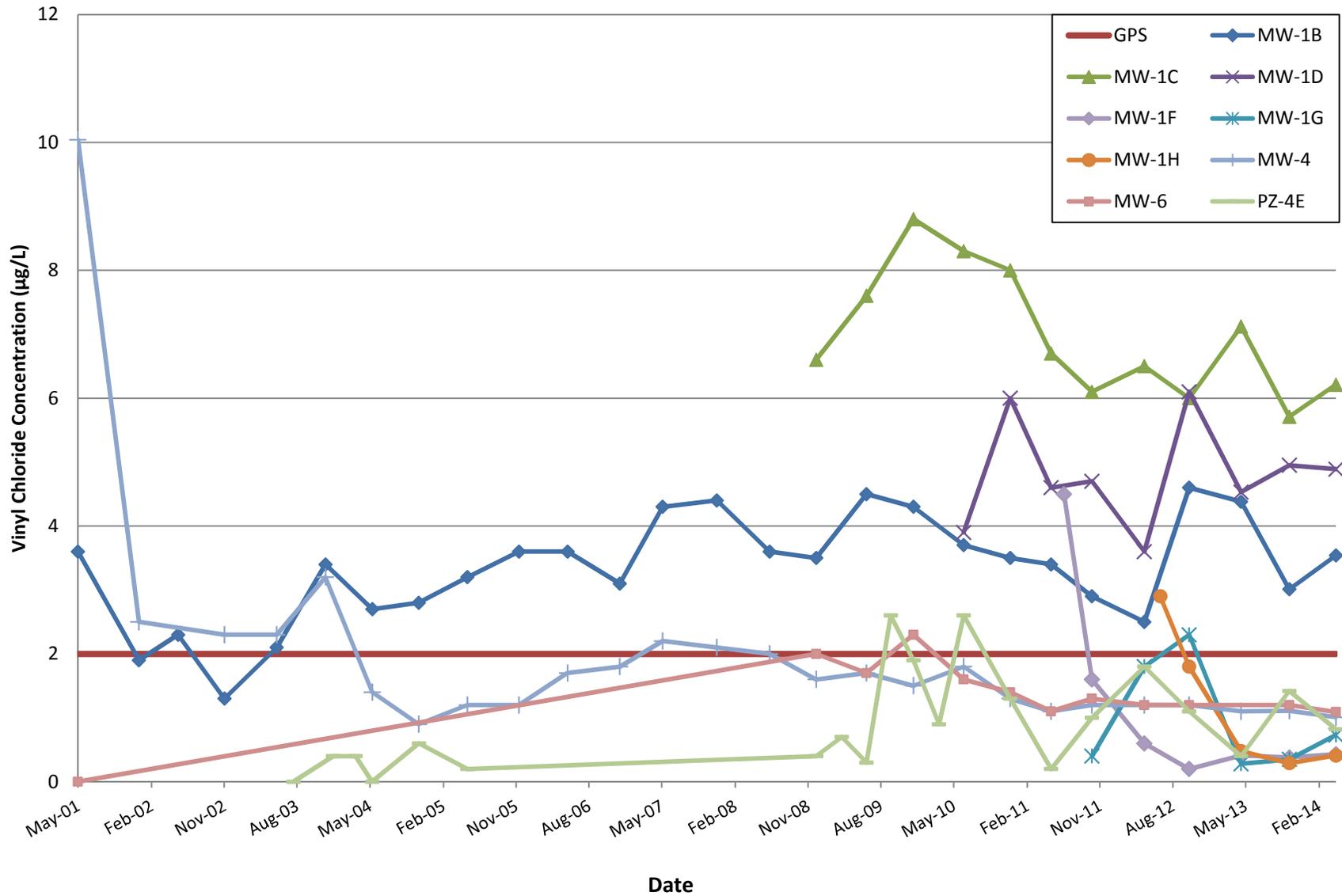


### Chart 7

## Trichloroethene in Wells with GPS Exceedances vs. Time



### Chart 8 Vinyl Chloride in Wells with GPS Exceedances vs. Time



**Attachment VIII**

**Summary of Statistical Trend Evaluations  
Culpeper Laurel Valley Sanitary Landfill  
Permit No. 251**

Constituent-of-Concern	Monitoring Well	Plume	Statistical Analysis Results (March 2001 - April 2014)		
			Mann -Kendall	Spearman's	Sen's Slope
Cobalt	CLF-1	CLFP-1	No Trend	No Trend	No Trend
	MW-1C	CLFP-2	Upward Trend	Upward Trend	Upward Trend
	MW-2B	CLFP-2	Upward Trend	Upward Trend	Upward Trend
	MW-3A	CLFP-2	No Trend	No Trend	Downward Trend
	MW-6	CLFP-1	Upward Trend	No Trend	Upward Trend
	MW-X1	CLFP-1	No Trend	No Trend	No Trend
Mercury	PZ-4E	CLFP-3	No Trend	No Trend	Downward Trend
Benzene	MW-4	CLFP-1	No Trend	No Trend	No Trend
1,1-Dichloroethane	CLF-15A	CLFP-3	No Trend	No Trend	No Trend
	MW-1B	CLFP-2	No Trend	No Trend	No Trend
	MW-1C	CLFP-2	No Trend	No Trend	No Trend
	MW-1D	CLFP-2	No Trend	No Trend	Downward Trend
	MW-1E	CLFP-2	No Trend	No Trend	Downward Trend
	MW-1F	CLFP-2	No Trend	No Trend	No Trend
	MW-1G	CLFP-2	No Trend	No Trend	No Trend
	MW-1H	CLFP-2	No Trend	No Trend	Downward Trend
	MW-2B	CLFP-2	No Trend	No Trend	Downward Trend
	MW-4	CLFP-1	No Trend	No Trend	No Trend
Naphthalene	MW-4	CLFP-1	No Trend	No Trend	No Trend
	MW-6	CLFP-1	No Trend	No Trend	Downward Trend
Trichloroethene	CLF-15A	CLFP-3	No Trend	No Trend	No Trend
	MW-1C	CLFP-2	No Trend	No Trend	No Trend
	MW-1E	CLFP-2	No Trend	No Trend	No Trend
	MW-1F	CLFP-2	No Trend	No Trend	Downward Trend
	MW-1G	CLFP-2	No Trend	No Trend	No Trend
	MW-1H	CLFP-2	No Trend	No Trend	Downward Trend
Vinyl Chloride	MW-1B	CLFP-2	Upward Trend	Upward Trend	Upward Trend
	MW-1C	CLFP-2	No Trend	No Trend	Downward Trend
	MW-1D	CLFP-2	No Trend	No Trend	No Trend
	MW-1F	CLFP-2	No Trend	No Trend	No Trend
	MW-1G	CLFP-2	No Trend	No Trend	No Trend
	MW-1H	CLFP-2	No Trend	No Trend	Downward Trend

Notes:

No Trend - Refers to data having no evidence of an upward trend.

Upward Trend - Refers to data having evidence of an upward trend.

Downward Trend - Refers to data having evidence of a downward trend.

Out of Range - Refers to table being out of range during the statistical analysis.