CORRECTIVE ACTION STATUS EVALUATION REPORT

Chesapeake Energy Center
Industrial Landfill, Permit No. 440
Chesapeake, Virginia

Prepared for:

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March 10, 2023

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1.0 INTRODUCTION

The Chesapeake Energy Center (CEC) Industrial Landfill (Facility; Solid Waste Permit #440) is owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion Energy). The 36.5-acre Facility is located at 2701 Vepco Street, in Chesapeake, Virginia. The 213.6-acre CEC property is bounded to the north by the Norfolk and Western rail line and Military Highway (Route 13/460), to the east by the Southern Branch of the Elizabeth River (SBER), and to the west by a former non-contact cooling water discharge channel. The Facility was constructed in 1985 with a synthetic liner and was used exclusively for the disposal of coal combustion by-products generated at CEC. In accordance with the Facility's permit and the Virginia Solid Waste Management Regulations (VSWMR), Dominion Energy maintains a Phase II Monitoring Program at the Facility.

Consistent with the requirements of the Phase II Monitoring Program, Dominion Energy established groundwater protection standards (GPS) for the Facility on May 23, 2001. Subsequently, arsenic was reported in the uppermost water-bearing zone underlying the Facility at concentrations above the GPS during the 2002 second semi-annual sampling event (September 17, 2002). As a result, an Assessment of Corrective Measure (ACM) and Nature and Extent Study (NES) were completed and submitted to Virginia Department of Environmental Quality (DEQ) on June 19, 2003. In response to DEQ comments dated October 2, 2003, revised NES and ACM Reports including sulfide were submitted to the DEQ in January 2004.

In response to comments received from the DEQ, Dominion Energy installed six (6) deep wells at the following locations: CECW-2, CECW-3, CECW-8, CECW-5, PO-8, and PO-10 in November 2005. The wells were installed to generate additional hydrogeological data for the remedial alternative evaluation. Following installation of the additional wells, a Corrective Action Plan (CAP) was submitted to DEQ on January 23, 2007.

In response to identified concentrations of cobalt and beryllium above the GPS during the 2010 first semi-annual sampling event, Dominion Energy submitted an addendum to the ACM report on July 22, 2010. Subsequent to the addendum submittal, cobalt and beryllium were added to the CAP for the Facility on March 10, 2011, with the addition of the CAP (Revision 1) and Corrective Action Monitoring Plan (CAMP) to the Facility's solid waste permit.

As required in the CAMP, the first Corrective Action Site Evaluation (CASE) report, dated March 16, 2012, was submitted to DEQ to summarize the first year of CAP sampling. The CASE indicated that natural attenuation was occurring as expected and that the corrective action monitoring program should continue unchanged until the next CASE was due or until remedial objectives have been met.

On March 24, 2014, the second CASE report was submitted to the DEQ to evaluate CAP sampling results from the monitoring period of April 2011 to March 2014. CAP monitoring results indicated a geochemical environment conducive to the groundwater remedy and provided evidence that conditions at the Facility are suitable for Monitored Natural Attenuation (MNA).

In response to a confirmed concentration of selenium above the GPS during the 2016 first semi-annual sampling event, Dominion Energy has included selenium in the CAP for the site. An NES/ACM Report Addendum for selenium was submitted to the DEQ on August 5, 2016.

CEC ceased coal-fired generation in 2014 and the four (4) coal-fired generating units were demolished and removed in 2016. A temporary rain cover is currently in place over a portion of the landfill.

On March 10, 2017, the third CASE report was submitted to the DEQ to evaluate CAP sampling results from the monitoring period of March 2014 to March 2017. The report was reissued on April 27, 2018, in response to DEQ comments to include plume maps and complete laboratory reports for the CASE period. CAP monitoring results

continued to indicate a geochemical environment conducive to the groundwater remedy and provided evidence that conditions at the Facility are suitable for MNA.

Dominion Energy notified the DEQ of GPS exceedances for two (2) new constituents of concern (COCs; antimony and beta-BHC) on June 7, 2019. An NES/ACM Report Addendum for antimony and beta-BHC was submitted to the DEQ on December 4, 2019.

On March 10, 2020, the fourth CASE report was submitted to the DEQ to evaluate CAP sampling results from the monitoring period of March 2017 to March 2020. CAP monitoring results continued to indicate a geochemical environment conducive to the groundwater remedy and provided evidence that conditions at the Facility are suitable for MNA.

On September 24, 2021, Dominion Energy requested a minor permit modification to incorporate a revised Groundwater Monitoring Plan (GMP) into the SWP. The GMP includes groundwater monitoring provisions for the Bottom Ash Pond with the existing Facility, and consolidates the regulatory requirements and monitoring networks under the VSWMR and the federal Coal Combustion Residuals (CCR Rule). The GMP was revised and resubmitted to DEQ on July 22, 2022. GMP revisions were approved by DEQ on January 12, 2023, and the minor permit modification was issued on the same day. Note that the CAMP and the CAP monitoring network were not updated with this modification. Rather, an updated CAP and CAMP will be submitted with the pending closure removal permit modification request per condition I.D.2 of the Facility's permit.

The site-wide remedy, MNA, is protective of human health and the environment, and is capable of attaining the GPS within the areas of groundwater impact within a reasonable and practicable timeframe, given the characteristics of the aquifer and the plumes. However, on March 20, 2019, Governor Northam signed SB1355/HB2786 into law (Code of Virginia § 10.1-1402.03) requiring the closure by removal of the CEC landfill, bottom ash pond, and historic pond. As a result, an alternate remedy from the current CAP will be required. Dominion Energy will continue the existing CAP monitoring program and will coordinate with DEQ regarding permitting and updating the CAP as removal plans are finalized.

1.1 Corrective Action Status Evaluations

Four (4) previous CASE reports have been submitted to the DEQ, in accordance with the Facility permit. The current fifth CASE period includes March 2020 through March 2023 corrective action monitoring activities and results and is hereafter referred to as the current CASE period. It is noted that this CASE report includes evaluations of the performance of the selected remedy.

The DEQ has provided a guidance document for the preparation and submittal of MNA-based CASE reports, titled *Submission Instructions for Groundwater MNA-Based Corrective Action Site Evaluation (CASE) Reports at Solid Waste Landfills* [Submission Instruction (SI)-25] and dated July 13, 2012. In accordance with the SI-25, background and historical monitoring program information has been minimized, and this form-based CASE submittal has been prepared, with supporting text, tabular, and graphical information provided in referenced appendices. The following groundwater monitoring and corrective action documents may be referenced to provide up-to-date, detailed information regarding the Compliance and Corrective Action Monitoring Programs and the CAP for the Facility:

- AMEC Environment & Infrastructure, Inc. 2011. Corrective Action Plan (Revision 1). Chesapeake Energy Center Ash Landfill, Chesapeake Virginia. June.
- AECOM. 2016. Nature & Extent/Assessment of Corrective Measures Report Addendum for Selenium. Chesapeake Energy Center, Industrial Landfill – Solid Waste Permit No. 440, Chesapeake, Virginia. July.

- Golder. 2019. Nature and Extent Study and Assessment of Corrective Measures Addendum. Chesapeake Energy Center, Industrial Landfill, Permit No. 440, Chesapeake, Virginia. December.
- WSP. 2023. 2022 Annual Solid Waste Groundwater Monitoring Report. Chesapeake Energy Center Industrial Landfill, Solid Waste Permit No. 440. January.

1.2 SI-25 Form-1

Form-1 of SI-25 is included below. The subsequent sections of this CASE report provide concise answers to key MNA-based CASE evaluation items. Per SI-25, answers requiring additional supporting information reference an appendix of this CASE report corresponding to the appropriate section of Form-1.

MNA-based Corrective Action Site Evaluation (CASE) Report Summary		
4] Facility Name: **Chesapeake Energy Center**	**1**] DEQ Region: Tidewater	**2**] Date: March 10, 2023
	3] Solid Waste Permit Number:	**440**
	5] Landfill Type:	Lined industrial
6] Date of Groundwater Remedy Implementation (Permit Amendment Issuance):		3/10/2011
7] CASE Report Due Date: 3/10/2023	**8**] CASE Report Period:	March 2020 - March 2023
9] Was Public Repository copied on CASE submittal:	Yes	
10] Name and location (City/Town) of Public Repository: Major Hillard Library, Chesapeake	**11**] Which groundwater CASE report submittal (circle one) is this? 1st 2nd 3rd 4th (5th) 6th 7th 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:	10/27/2028
13] Based on CASE period data, what is the current anticipated MNA completion date?	7/9/2037
14] Were there any performance problems or Operations and Maintenance issues associated with MNA components during the CASE period?	N
15] (if yes to 14) Where these problems rectified during CASE period?	NA
16] Were GPS achieved in <u>all</u> portions of the plume during CASE period?	N
17] (if no to 15) List any MNA wells that did achieve GPS during CASE period:	MW-5, CECW-15
18] How many compliance wells continue to exceed GPS during CASE period?	10
19] Did any formerly '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 GW quality improve in at least some of the Sentinel wells during CASE period?	Y
22] Was there any evidence of lateral or vertical plume expansion during CASE period?	P
23] (if yes to 22) Were any new wells installed to address expansion during CASE period?	N
24] Are any MNA wells screened below the base of the GPS exceeding areas of the plume?	N
25] Are there clean sentinel wells (i.e., no GPS exceedance) located at the edge of the plume?	Y
26] Was remedy protective of human health and environment during entire CASE period?	Y
27] Was there a remedy component in place to control source of 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 wells 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?	Y
33] Did surface water sampling results show concentrations in excess of GPS in surface water?	N
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.	
34] Were all Permit-listed MNA network wells (list below) sampled during CASE period?	N
35] If not, list the wells which could not be sampled:	CECW-3
36] List the reason for the non-sampling during CASE period: Insufficient water	
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 constituents of Module XIV during CASE period?	N

40] (if no to 39) List the reason for the non-sampling of Permit required constituents:	Insufficient water
41] Were all analysis during CASE period conducted by VELAP certified facilities?	Y
42] Did analytical results support biologic destruction of the waste mass during the CASE period based on changes in downgradient parent/daughter ratios?	NA, See Appendix B
43] Did results of MNA performance parameter sampling support biologic destruction of waste mass based on changes in electron receptor/donors within the plume of contamination?	NA, See Appendix B
44] Are copies of all sampling event analytical results obtained during the CASE Period attached as an Appendix to this report in CD-ROM format?	Y
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.	
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?	P
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?	P
51] Is there any potential for vapor intrusion issues above the landfill contaminant plume?	N
52] Is groundwater currently used (or potentially used) on site for any reason?	N
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?	NA
55] Is there evidence (or potential for) plume discharge (levels above LOQ) to surface water?	N
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.	
56] What statistical method was used to assess groundwater trends during CASE Period?	Mann-Kendall
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 in any well (if so, list constituent(s) on the line below)?	Y
Arsenic (total) in well CECW-6D and sulfide (total) in well CECW-10R	
61] When looking solely at Performance well data during the CASE period, did any constituents show upward trending concentration behavior in any well (if so, list constituent(s) on the line below)?	Y
Arsenic (MW-5, CECW-1D, CECW-2D, PO-8) and sulfide (CECW-2, PO-10)	
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)?	Y
Arsenic (PO-8) and sulfide (CECW-2, CECW-10R, PO-10)	
63] Do the down-plume changes in stoichiometric Parent/Daughter ratios confirm breakdown of contaminant mass?	NA
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?	NA (see Appendix 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.	
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?	P
66] (if no to 65) Is Interim Measure use justifiable on site?	P
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?	NA
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?	Y
Attachments. The following attachments must be included in the CASE in the order prescribed.	

Attachment I: Site Identified on a USGS 7 1/2-minute Topographic Map
Attachment II: Property Map(s)
Attachment III: Aerial Photograph(s)
Attachment IV: GW flow rate calculations (based on most recent CASE period sampling event)
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
Attachment VI: Table of constituents exceeding GPS, listed for each well, based on all available sampling data obtained post remedy implementation
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)
Attachment VIII: Statistical Analysis and Time Series Data Plots for each GPS exceeding constituent identified within individual wells sampled during the CASE period
Attachment IX: Complete Laboratory Analytical Reports (including Verification events) for each sampling event during the CASE period
Attachment X: Chain of Custody and Field Book documentation (including Verification events) for each sampling event during the CASE period
Note: Attachments IX and XI may be submitted in electronic format on CD
Appendices. The following should be included as needed following the instructions in the SI. If an Appendix is not going to be used, insert its title page followed by the work "reserved".
Appendix A - Remedy/Plume behavior, Detailed Discussion
Appendix B - Groundwater Sampling, Detailed Discussion
Appendix C - Risk Exposure Factors
Appendix D - Interpretation of Analytical Results, Detailed Discussion
Appendix E - Future Actions
Responsible Official Signature

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:	Title:
Signature:	Date:

2.0 APPENDIX A – REMEDY / PLUME BEHAVIOR DISCUSSION

The following sections of Appendix A provide additional detailed information in reference to specific line items of Section A (Remedy / Plume Behavior) of Form-1 provided in SI-25. As required by SI-25, additional information is provided below regarding "yes" or "possibly" responses provided in Form-1. Additional information is also provided regarding "no" or "not applicable" responses provided in Form-1, as determined appropriate by WSP.

2.1 Section A, Line 11

In accordance with the CAMP, the first CASE report was submitted after the first year of remedy implementation in March 2012. The second CASE submitted to the DEQ represented the first 3 years of monitoring since remedy implementation. The third CASE represented data collected from March 2014 through March 2017. The fourth CASE represented data collected from March 2017 to March 2020. This CASE submittal constitutes the fourth 3-year period (12 years total) of monitoring since remedy implementation; however, it is technically the fifth CASE submitted to DEQ.

2.2 Section A, Line 12

The June 2011 CAP – Revision 1, indicated that the maximum time to achieve the Groundwater Protection Standard (GPS) would be 17.4 years in well PO-10. Based on the date of the Revised CAP (June 8, 2011) and the timeframe of 17.4 years, the completion date of October 27, 2028, was used for Line #12.

2.3 Section A, Line 13

Mann-Kendall trend tests were performed for CAP parameters in selected wells as presented in Attachment VIII. Because arsenic (total) is the principal contaminant of concern, based on concentrations, this parameter was evaluated for trends to estimate the time to achieve GPS. Period of time calculations were based on the Theil-Sen trend lines presented in the trend statistical analyses in Attachment VIII. The Theil-Sen trend line is a non-parametric alternative to linear regression for estimating a linear trend and indicates how quickly the concentration level is changing with time. Only wells that exhibited decreasing trends in arsenic concentrations could be used to calculate an estimated time to achieve GPS and the time was calculated using the simple linear regression equation y=a+bx, similarly to the procedure that was used in the CAP.

A summary of time calculations is included in Table 1 to this Appendix. As seen in Table 1, based on the evaluated CAP data, the minimum estimated period to achieve GPS from the date of first sampling in April 2011 is 4.42 years in compliance/performance well CECW-2, which would mean CECW-2 should have achieved GPS in September 2015. During the CASE period, well CECW-2 did have concentrations below GPS; however, they have not remained consistently below GPS for a period of 3 years. The maximum period to achieve GPS is 23.3 years in compliance/performance well CECW-6I. From the date of first CAP sampling (April 6, 2011), this would put the current estimated MNA completion date at July 10, 2034. However, because three (3) consecutive years of GPS compliance is required for completion, an estimated date of July 9, 2037, was used for Line #13.

It is important to note that wells with constituent of concern (COC) concentrations above the GPS that currently exhibit no trend or increasing trends over time may not achieve GPS by this estimated period. Additional monitoring data will be necessary to evaluate arsenic concentration trends in these wells.

2.4 Section A, Line 16

As shown in Attachment VI, GPS have not been achieved in the portion of the (COC) plume that extends beyond the waste management unit boundary.

2.5 Section A, Line 17

Upgradient well MW-5 and sentinel well CECW-15 are the only wells that have shown concentrations of COCs below GPS during the current CASE period.

2.6 Section A, Line 18

The downgradient compliance wells continue to show exceedances of GPS within the last 3 years. Note that CECW-3 was not sampled during the CASE period due to insufficient water.

2.7 Section A, Line 20

During the most recent 3 years of CAP monitoring, the following wells have shown an improvement in groundwater quality. Please note that due to a June 2021 permit amendment, the GPS values for cobalt and sulfide are no longer compliance values as of the September 2021 sampling event. However, the GPS values will continue to be used for CAP assessment.

- Performance well CECW-1 – Previously this well exhibited concentrations above the GPS for arsenic and sulfide. Over the most recent 3 years, the sulfide concentration has remained below the GPS.
- Performance well CECW-2 – Previously, this well exhibited concentrations above the GPS for arsenic, beryllium, cobalt, and sulfide. In previous CASE periods, cobalt and sulfide GPS exceedances were based on the DEQ Alternate Concentration Limit (ACL) of 4.7 µg/L and the 2,400 µg/L limit of quantitation (LOQ), respectively. The current DEQ ACL for cobalt is 6.0 µg/L. Sulfide does not have a numerical GPS value; the LOQ at time of sampling was used as the ACL for sulfide for statistical comparison purposes during the first half of the CASE period. Over the most recent 3 years, the beryllium and cobalt concentrations in CECW-2 have remained below the GPS. CECW-2 is the only well that has historically exhibited exceedances of the beryllium GPS. Therefore, consistent with 9 VAC 20-81-250.H.1.a, WSP recommends that DEQ approve the removal of beryllium from the COC list since this constituent has not exceeded the GPS in any groundwater samples collected since July 2011 [more than three (3) consecutive years].
- Performance well CECW-2D – Previously this well exhibited concentrations above GPS for arsenic and sulfide. In the past 3 years, sulfide concentrations have remained below GPS.
- Performance well CECW-3D – Previously this well exhibited concentrations above the GPS for arsenic, cobalt, and sulfide. In the past 3 years, cobalt and sulfide concentrations have remained below GPS.
- Performance well PO-8D – Previously this well exhibited concentrations above GPS of arsenic, cobalt, and sulfide. Over the last 3 years, arsenic and sulfide concentrations have remained below the GPS.
- Performance well PO-10D - Previously this well exhibited concentrations above GPS of arsenic, cobalt, and sulfide. Over the last 3 years, cobalt and sulfide concentrations have remained below the GPS.
- Decreasing trends in arsenic and cobalt concentrations have been identified in several performance wells. Additional discussion on contaminant trends is presented in Appendix D.

2.8 Section A, Line 21

Based on the results of Mann-Kendall trend analyses (see Attachment VIII), groundwater quality has improved in several sentinel wells as follows:

- CECW-6D – Sulfide did not exceed the GPS during the last 3 years. In addition, cobalt concentrations in this well exhibit decreasing concentrations over time.

- CECW-8 – Arsenic did not exceed the GPS during the last 3 years.
- CECW-8D – Sulfide did not exceed the GPS during the last 3 years.
- CECW-15 – Sulfide did not exceed the GPS during the last 3 years. No other COCs have been detected in this well with concentrations that exceed their GPS.

2.9 Section A, Line 22

Planview isoconcentration and cross-sections for downgradient wells illustrating the horizontal and vertical extent of the groundwater impacts associated with the COCs are presented in Attachment VII. These maps and cross-sections were prepared with representative monitoring data obtained during the September 2022 sampling event. The plume extent for each COC is discussed in the following sections.

- Antimony –Antimony has not exceeded its GPS in any well since it was added as a COC in 2019. As antimony has not been detected at concentrations above the GPS in almost 4 years, WSP recommends that antimony be removed from the COC list.
- Arsenic –Arsenic has been found at concentrations above the GPS in compliance wells MW-4R, CECW-2, CECW-3, CECW-4, CECW-5, CECW-6I, PO-8, PO-9, and PO-11.
  - Monitoring of the CAP wells during the last 3 years indicates total arsenic concentrations above the GPS in corrective action monitoring wells CECW-1, CECW-1D, CECW-2, CECW-2D, CECW-3D, CECW-6I, CECW-6D, CECW-8D, CECW-10R, PO-8, PO-10, and PO-10D. Currently, the highest total arsenic concentrations are found in wells nearest to the landfill (CECW-3D and CECW-6I) and concentrations are lowest at wells closest to the surface water and cooling channel (MW-5D, CECW-8, and CECW-15). Total arsenic was not detected in surface water samples collected as part of the CAMP at concentrations above the GPS. Dissolved arsenic concentrations (0.45-micron filtered samples) collected during the CASE period, mirror total arsenic results with the highest concentrations in wells CECW-3D and CECW-6I and lowest concentrations in wells near the cooling channel.
  - The fourth full CASE period monitoring confirms that the tidal surface water bodies surrounding the peninsula bound the horizontal extent of the arsenic plume. The bar graph provided in the attached Chart 1 for total arsenic concentrations along the flow path from near the landfill at CECW-3D towards PO-10, CECW-8, and surface water, documents the horizontal extent of the arsenic along this transect and demonstrates that arsenic concentrations are attenuating as groundwater flows towards surface water.
  - The vertical extent of the plume generally appears to be limited to the sediments above the Pliocene Yorktown Formation, with expansion and higher concentrations of dissolved arsenic trending toward the shallow portion of the aquifer in the northern portion of the peninsula and the deeper portion of the aquifer near the southern portion of the peninsula at CECW-2D, CECW-3D, CECW-8D, and PO-10D. This may be in part associated with the upward gradient that is observed between the Yorktown Formation and the overlying sediments. The bar graphs presented in Chart 2 graphically show average dissolved arsenic concentrations in shallow and deep well clusters.
- Beryllium –There have been no confirmed beryllium GPS exceedances in any site wells since July 2011. Since more than 5 years of monitoring has been conducted during which beryllium concentrations have remained below the GPS, WSP recommends that this constituent be removed from the COC list.

- Beta-BHC –The results from the eight (8) CAP sampling events conducted since 2019 indicate that there have been no detections above the reporting limit in the site wells. Since more than 3 years of monitoring have been conducted during which beta-BHC concentrations have remained below the GPS, WSP recommends that this constituent be removed from the COC list.
- Cobalt –In previous CASE periods, the GPS for cobalt was based on the DEQ ACL of 4.7 µg/L. The current DEQ ACL for cobalt is 6.0 µg/L. Under the current DEQ ACL, cobalt has been detected above the GPS in compliance wells CECW-2 and CECW-3.
  - Monitoring during this CASE period indicates concentrations of total cobalt above the GPS at CAP wells MW-5D, CECW-6D, and PO-8D. The highest total cobalt concentrations are found in wells MW-5D and PO-8D and concentrations are lowest at wells closest to the tidal surface water bodies. Total cobalt was not detected in surface water samples collected under the CAMP at concentrations above the GPS.
  - Since the highest concentrations of cobalt are found upgradient of the landfill (MW-5D), the cobalt plume may be related to background conditions at the Site. A site-specific GPS for cobalt should be established. Based on recent CAP monitoring results, cobalt concentrations in downgradient performance and sentinel wells are less than the background concentration of 18 ug/L for the site.
- Selenium –Since the initial GPS exceedance in 2016, selenium concentrations have not exceeded the GPS in compliance wells. As selenium has not been detected at a concentration that exceeds the GPS for almost 7 years, WSP recommends that selenium be removed from the COC list.
- Sulfide – Sulfide (total) initially exceeded its GPS of 2,400 ug/L (limit of quantitation; LOQ) during the 2003 first semi-annual sampling event in downgradient compliance well CECW-2. Sulfide does not have a numerical GPS value and the LOQ is used as the ACL for statistical comparison purposes. The current LOQ for sulfide is 3,000 µg/L. Since the initial GPS exceedance, sulfide has also been found at concentrations above the LOQ in compliance wells MW-5, CECW-1, CECW-2, CECW-4, CECW-5, CECW-6I, CECW-10R, PO-8, and PO-10.
  - Monitoring of the CAP wells during the current CASE period identified sulfide concentrations above the LOQ (3,000 ug/L) at wells CECW-2, CECW-8, CECW-10R, and PO-10. The highest total sulfide concentrations are found in well CECW-8.
  - Total sulfide was not detected above the GPS in surface water samples during the CASE period.

2.10 Section A, Line 24

The performance and sentinel monitoring networks include both shallow and deep upper aquifer wells; however, there are no MNA wells screened in the Yorktown formation.

2.11 Section A, Line 25

Except for sulfide, there have been no MCL, risk-based ACL, or background-based GPS exceedances in sentinel well CECW-15, since remedy implementation. Total sulfide does not have a numerical GPS and the LOQ is used as the ACL for statistical comparison purposes. Historically there have been sulfide GPS exceedances detected in samples from CECW-15; however, there were no GPS exceedances for sulfide in CECW-15 during this CASE period.

2.12 Section A, Line 26

Other than trained technicians that collected and analyzed the groundwater samples or performed geotechnical evaluations, there was no known exposure of human receptors to the groundwater. In addition, surface water

sampling did not indicate any impacts relating to the detected GPS exceeding concentrations of antimony, arsenic, beryllium, beta-BHC, cobalt, and selenium; therefore, no plant, terrestrial, or aquatic receptors are known to have been exposed to these COCs.

2.13 Section A, Line 27

The approved MNA remedy does not currently include a source control component. CEC ceased coal-fired generation in 2014, and the four (4) coal-fired generating units were demolished and removed in 2016. A temporary rain cover is currently in place over a portion of the landfill.

2.14 Section A, Line 28

MCL-based GPSs exceeded during the CASE period consist of:

- Arsenic –CECW-1, CECW-1D, CECW-2, CECW-2D, CECW-3D, CECW-6I, CECW-6D, CECW-8D, CECW-10R, PO-8, PO-10, and PO-10D

2.15 Section A, Line 29

Background-based GPSs exceeded during the case period consist of:

- Sulfide (no numerical GPS; but concentrations were detected above the LOQ) –CECW-2, CECW-3D, CECW-8, CECW-10R, PO-8, PO-10, and PO-10D.

2.16 Section A, Line 30

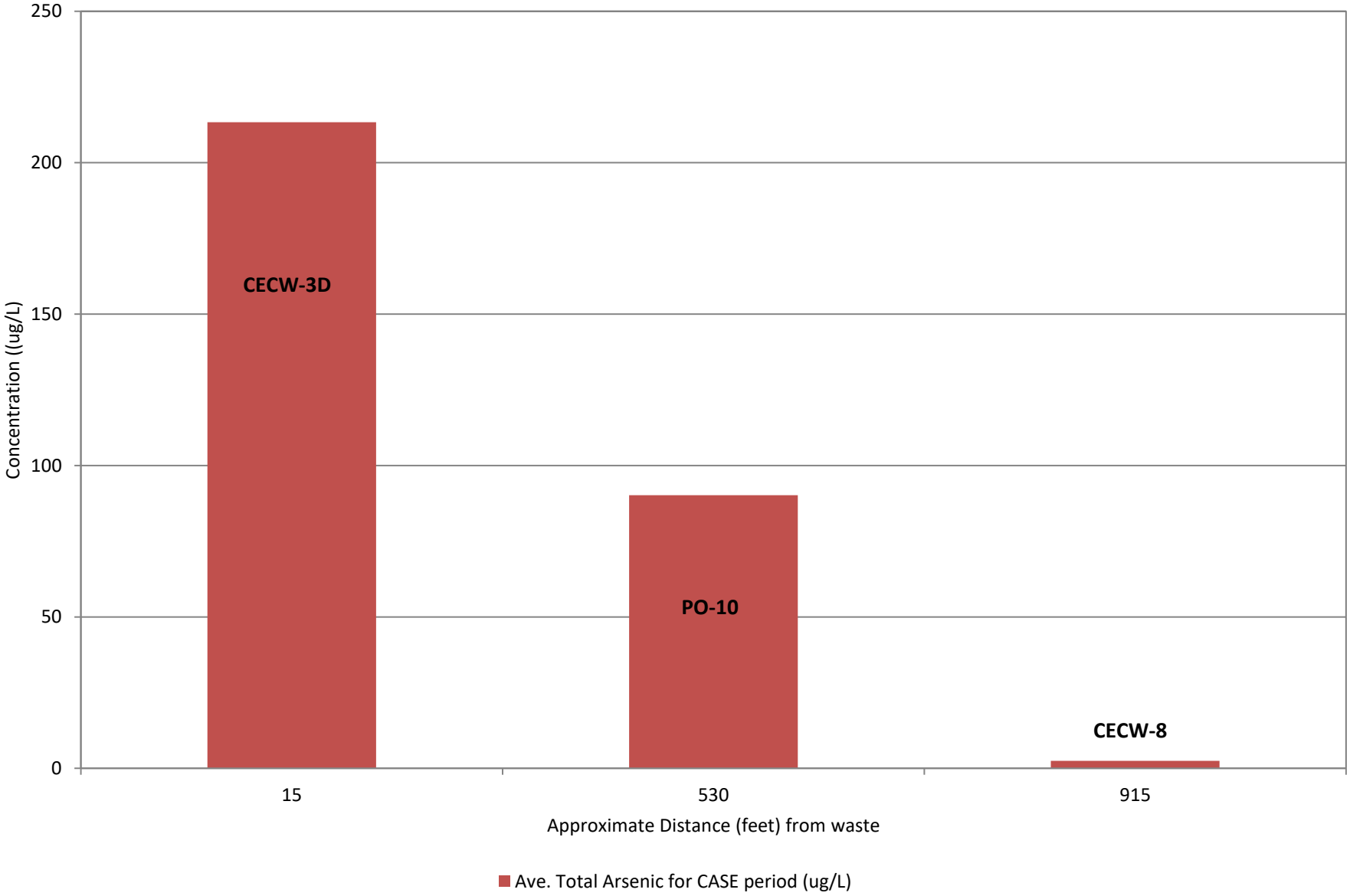
ACL-based GPS exceedances during the CASE period consist of:

- Cobalt –MW-5D, CECW-6D, and PO-8D

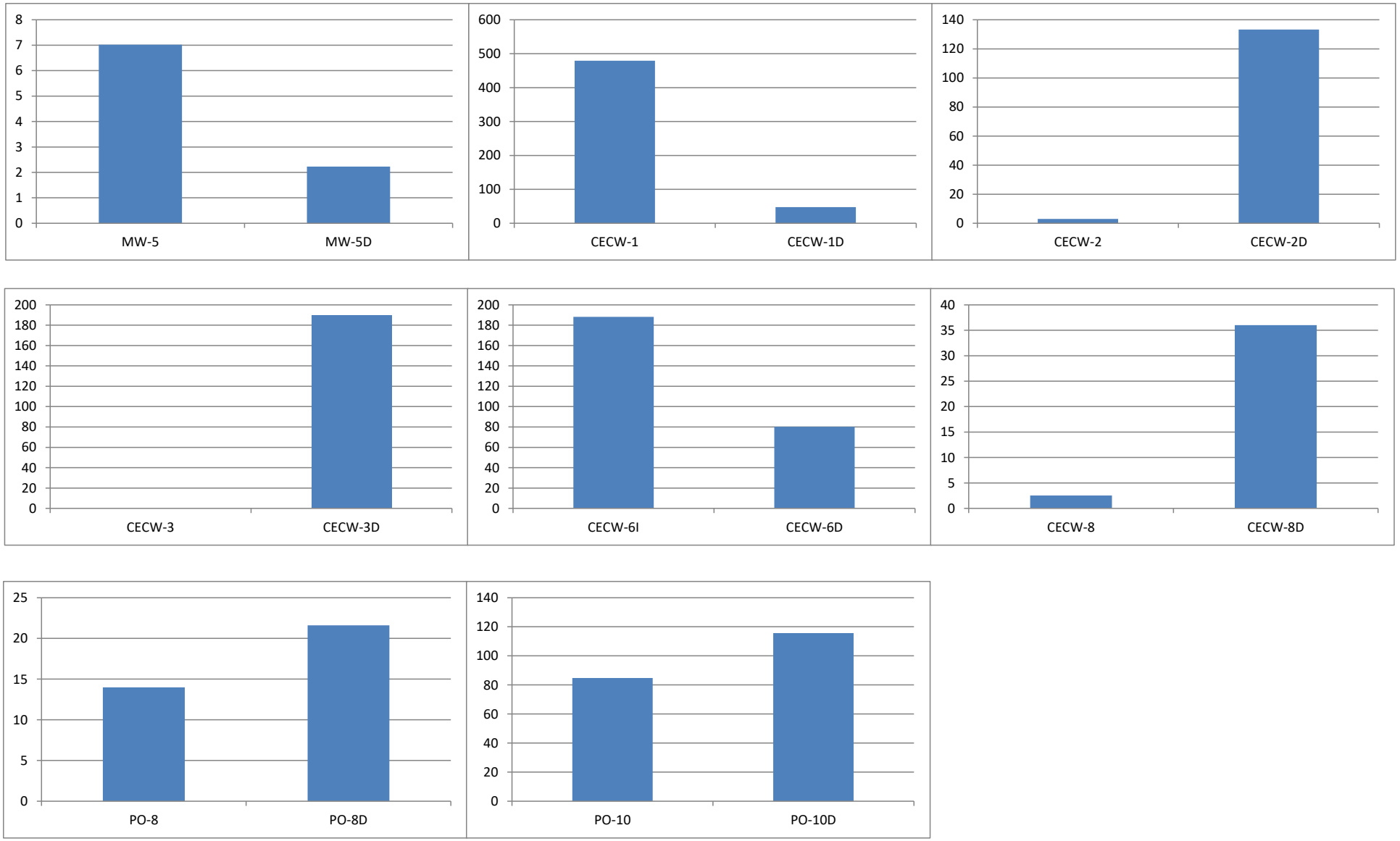
2.17 Section A, Line 31

Because the landfill lies on a peninsula with little space beyond the waste boundary, an ideal corrective action program well network layout with performance wells located directly downgradient of compliance wells is not feasible in all cases. However, most compliance wells have a deep performance well located directly adjacent to the compliance well.

Appendix A - Chart 1
Average Total Arsenic Concentrations Along Flow Path



Appendix A - Chart 2
Average Dissolved Arsenic Concentrations During CASE Period - Shallow and Deep Well Clusters
Corrective Action Status Evaulation 2023
Chesapeake Energy Center Industrial Landfill - Permit No. 440



Appendix A - Table 1
GPS Achievement Calculations
Corrective Action Status Evaluation 2023
Chesapeake Energy Center Industrial Landfill - Permit No. 440

Well ID	Above GPS in Last 3 Years?	Arsenic (total) Trend	a Total Arsenic Y-Intercept (ug/L)	b Theil-Sen Slope	y Desired Concentration GPS (ug/L)	x Time (days)	Time (years)	Date of Estimated GPS Achievement
MW-5	No	Increasing	5.1202	0.0005	10	--	--	Achieved
MW-5D	No	None	2.550	0.0000	10	--	--	Achieved
CECW-1	Yes	**Decreasing**	56.4362	-0.0090	10	5160	14.1	**5/21/2025**
CECW-1D	Yes	Increasing	17.6642	0.0094	10	--	--	--
CECW-2	Yes	**Decreasing**	16.1241	-0.0038	10	1612	4.42	**9/3/2015**
CECW-2D	Yes	Increasing	82.6537	0.0200	10	--	--	--
CECW-3	Not sampled	**--**	--	--	10	--	--	--
CECW-3D	Yes	None	191.6923	0.0048	10	--	--	--
CECW-6I	Yes	**Decreasing**	280.2004	-0.0318	10	8497	23.3	**7/10/2034**
CECW-6D	Yes	Increasing	7.0994	0.0202	10	--	--	--
CECW-8	No	**Decreasing**	3.8595	-0.0005	10	--	--	Achieved
CECW-8D	Yes	Increasing	12.8763	0.0044	10	--	--	--
CECW-10R	Yes	**Decreasing**	77.8564	-0.0082	10	8275	22.7	**12/1/2033**
CECW-15	No	**Decreasing**	2.8998	-0.0002	10	--	--	Achieved
PO-8	Yes	Increasing	17.7881	0.0013	10	--	--	--
PO-8D	No	None	4.1007	-0.0380	10	--	--	Achieved
PO-10	Yes	**Decreasing**	154.0905	-0.0184	10	7831	21.5	**9/13/2032**
PO-10D	Yes	None	146.1938	-0.0062	10	--	--	--

Notes:

GPS = Groundwater Protection Standard

ug/L = Micrograms per liter

Linear regression equation:

$y = a + bx$

where:

a = y intercept

b = slope of the line

y = dependent variable (desired groundwater concentration)

x = explanatory variable (days to achieve desired groundwater concentration)

3.0 APPENDIX B – GROUNDWATER SAMPLING DISCUSSION

The following sections of Appendix B provide additional detailed information in reference to specific line items of Section B (Groundwater Sampling) of Form-1 provided in SI-25. As required by SI-25, additional information is provided below regarding "yes" or "possibly" responses provided in Form-1. Additional information is provided regarding "no" or "not applicable" responses provided in Form-1, as determined appropriate by WSP. A summary of CAP monitoring results has been provided in a table before the analytical laboratory reports in Attachment IX.

3.1 Section B, Line 34, 35, 36

During the CASE period, one (1) well was unable to be sampled during the regular semi-annual sampling events:

- Performance well CECW-3 – this well was unable to be sampled during this CASE period due to low water levels and insufficient water for sampling. It is believed that the temporary cover over a portion of the landfill has reduced the amount of infiltration into the unit. This reduction and the cessation of station sluice water to the adjacent bottom ash pond are likely responsible for the observed water level decline in CECW-3.

3.2 Section B, Line 37

Corrective Action Program monitoring activities were conducted on a semi-annual frequency during the CASE period. Except for the well listed above, the wells in the permitted corrective action network were sampled as required under Module XIV of the solid waste permit.

3.3 Section B, Line 39

Except for CECW-8, the corrective action program wells were sampled for the permit-required constituents and parameters during the CASE period. During the second semi-annual 2022 sampling event, CECW-8 was not sampled for dissolved sulfide or beta-BHC due to insufficient water. Dissolved sulfide and beta-BHC were not detected at CECW-8 during the remaining sampling events in the CASE period.

3.4 Section B, Line 41

Laboratory analyses during the CASE period were conducted by the following laboratories:

- Eurofins TestAmerica Laboratories, Inc. – all required analyses for all sampling events
  - Eurofins Canton VELAP ID: 460175 (all events)
  - Eurofins Pittsburgh VELAP ID 10043 (first semi-annual 2022 event only)
  - Eurofins Seattle – Arsenic speciation, not VELAP certifiable, no VELAP ID available (all events)

3.5 Section B, Line 42, 43

The CEC landfill remedy of adsorption MNA is designed to address metals GPS exceedances. The chlorinated solvent paradigm of parent/daughter ratios does not apply to the metals adsorption remedy. However, the following remedy effectiveness evaluations have been performed for the MNA metals remedy using the following performance parameters.

- Arsenic Speciation - The purpose of arsenic speciation monitoring is to evaluate whether the MNA remedy is performing as predicted in reducing the mobility and toxicity of arsenic. Previous studies have identified geochemical reactions within the aquifer that oxidize reduced arsenic from a soluble state (As(III)) to a relatively insoluble state (As(V)), thereby reducing the dissolved arsenic concentrations in water.

- As(III) and As(V) speciation results for CAP monitoring during the CASE period are summarized in the attached Appendix B Table 1. Similar to total and dissolved arsenic concentrations, the highest concentrations of As(III) are found in wells CECW-1, CECW-6I, CECW-3D, CECW-2D, and PO-10D and the lowest concentrations are found in wells CECW-15, CECW-2, MW-5D, and PO-8D. The highest concentrations of As(V) are found in well CECW-1 and CECW-6I and the lowest are found in wells CECW-15, CECW-2, MW-5D, and PO-8D.
- The ratio of As(III) to As(V) is included in Appendix B Table 1 to determine the dominant arsenic species in the aquifer beneath the Site. Consistent with previous studies, CAP monitoring results indicate As(III) is the predominate arsenic species in wells located proximate to the waste mass and as groundwater moves away from the waste area and upwards within the aquifer, the more oxidized species As(V) is the predominant species. This confirms the conceptual model for the Site and indicates that the MNA remedy is still viable in reducing arsenic mobility and toxicity based on distance from the waste area.

- Iron and Manganese – The purpose of sampling for iron and manganese is to provide indicators for the adsorption-based remedy process. Previous studies have found dissolved iron and manganese to be oxidizing in the subsurface below the surface waters surrounding the landfill. The oxidizing environment results in sand grains of the aquifer being coated with rust (iron oxyhydroxides) and manganese oxides, both of which strongly sorb arsenic, beryllium, cobalt, selenium, and other cations. These sorbs cations are generally considered immobilized provided geochemical conditions in the aquifer remain sufficiently oxidizing to prevent the dissolution of the iron oxyhydroxide minerals and any co-precipitated manganese oxides (AMEC, 2010).
  - Total and dissolved iron (assumed to be ferrous iron) have been detected at each CAP monitoring location with the highest concentrations generally found in wells CECW-15 and CECW-8D and the lowest concentrations found in surface water and wells PO-8, CECW-3D, CECW-8, PO-8D, and PO-10. Attached Appendix B Chart 3 shows average total versus dissolved iron concentration at CAP monitoring locations. The presence of higher ferrous iron concentrations in deeper wells with concentrations that decrease in proximity to the tidal surface water bodies indicates that the geochemical environment in the uppermost aquifer along the fringe of the regulated unit is oxidizing ferrous iron to relatively insoluble ferric iron. Thus, the natural environment is creating conditions that are conducive to the removal of arsenic and other cations from the water column, thereby validating the adsorption-based remedy approach.
  - Manganese has been detected in each well during CAP monitoring events with the highest concentrations generally found in well MW-5D and the lowest concentrations in wells MW-5, PO-10, PO-10D, and CECW-3D. Similar to iron, the presence of higher manganese concentrations in deeper wells relative to the lower concentrations observed in the shallower wells located near the tidal surface water bodies suggest that geochemical conditions in the aquifer are oxidizing, which results in the removal of reduced manganese from the water column. This finding supports the efficacy of the adsorption-based remedy being implemented at the Facility. Chart 4 shows graphically that, in general, higher manganese concentrations result in lower dissolved arsenic concentrations.

- Field Water Quality Parameters
  - Dissolved Oxygen (DO) – DO is measured in the field during sample collection. DO is an indicator of the type of aquifer environment (aerobic or anaerobic). As expected, DO concentrations are generally lowest in the deep wells where iron and manganese are in solution, and highest in surface water and shallow wells where the iron and manganese are oxidized. It is expected that higher DO concentrations would be

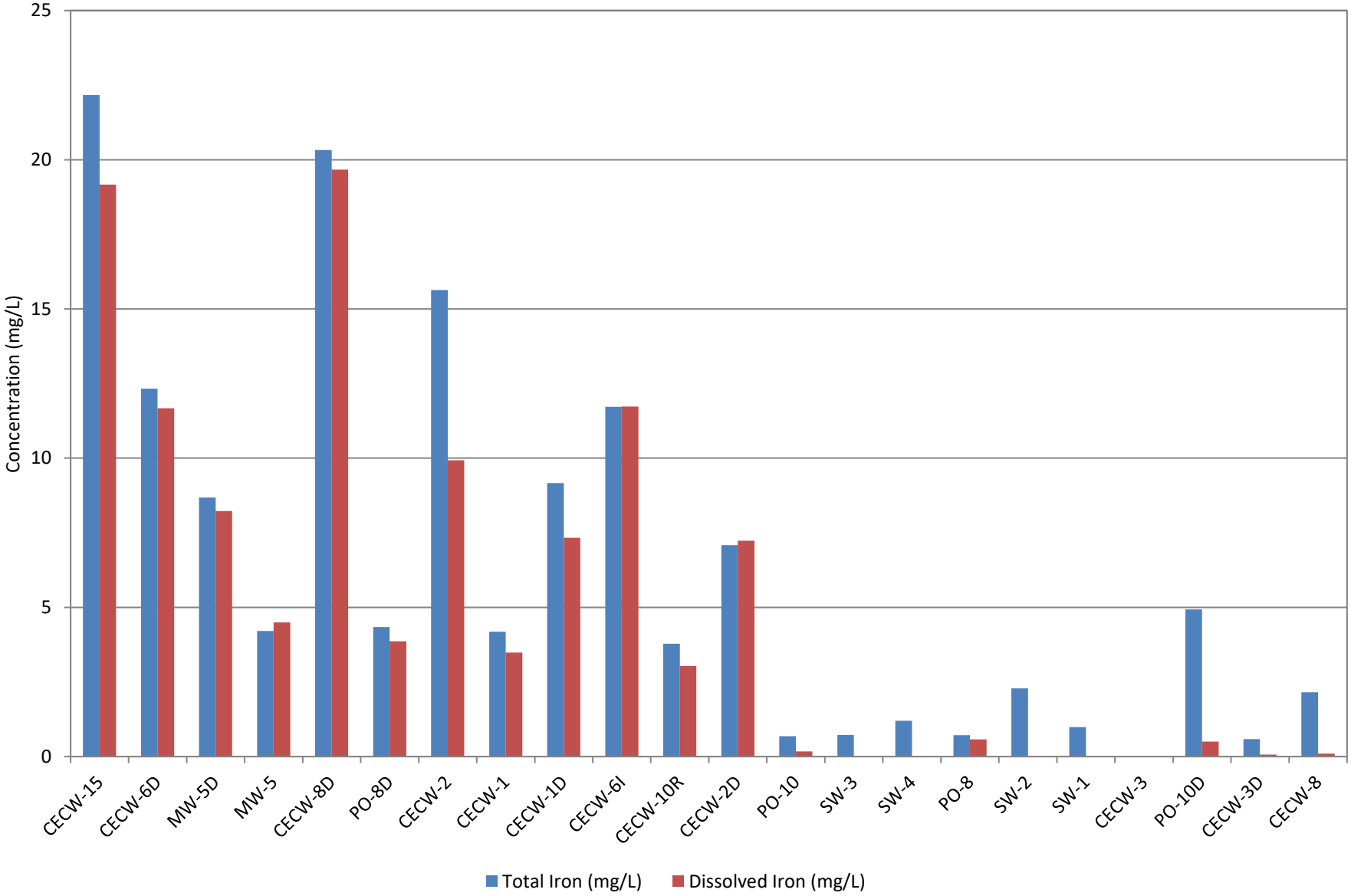
correlated to reduced dissolved iron and arsenic concentrations; as presented in Appendix B Charts 5 and 6, the data shows some visual correlation.

- pH – The pH of groundwater beneath the Site is an indicator of the type of aquifer environment. Average pH measurements recorded from Site wells during the CASE period ranged from 4.49 to 8.02 standard units (S.U.) with the lowest measurements found in well CECW-15 and the highest found in well PO-10D. In general, the more acidic the groundwater, the higher the dissolved iron concentration. As seen in Appendix B Chart 7, lower pH measurements generally coincide with higher dissolved iron concentrations. At the Site, the lower pH measurements are generally found in the deeper wells and the pH generally increases as groundwater migrates toward the tidal surface water bodies where a more neutral pH is present. The pH measurements obtained to date continue to indicate a suitable geochemical environmental for the adsorption-based remedy.

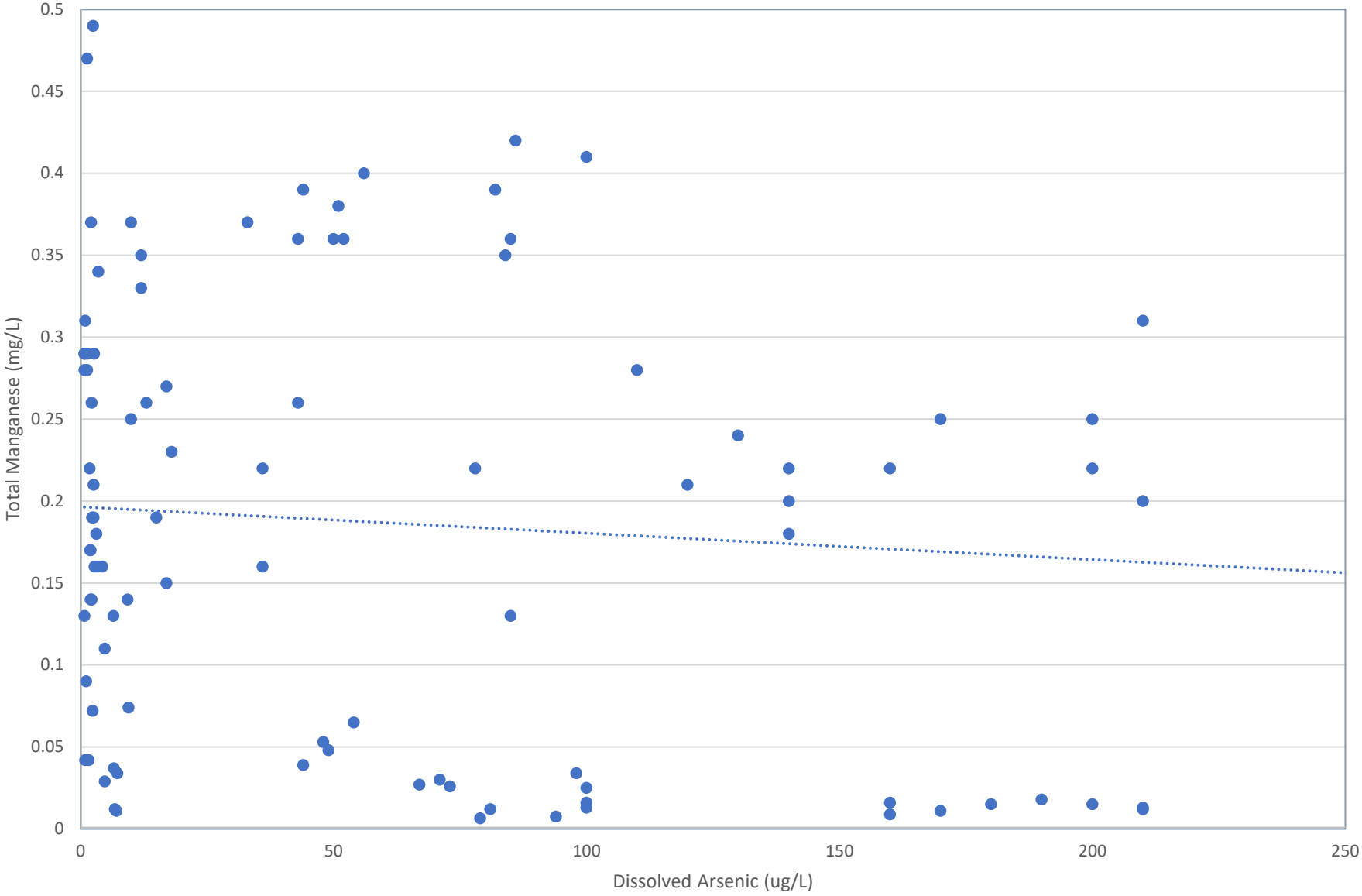
- Specific Conductivity – Specific conductivity is related to the concentration of dissolved ionic constituents in the groundwater. In general, higher specific conductivity values are indicative of higher concentrations of constituents in the groundwater. Site conductivity levels during the CASE period ranged from 223.7 to 28,737 microSiemens per centimeter (µS/cm), with the highest conductivity measurements found in wells CECW-15, CECW-8, CECW-8D, and CECW-2D. These wells are located in the far southern point of the peninsula at low elevations within the Southern Branch Elizabeth River (SBER) tidal flats and thus the higher conductivity values in these wells are likely associated with the brackish water in the SBER.

- Oxidation Reduction Potential (ORP) – ORP is an indicator of the amount oxidizing potential (availability of electrons) of the geochemical environment. Positive readings indicate an oxidizing environment and negative readings indicate a reducing environment. Field measurements are generally collected with a silver-silver-chloride reference probe with the results corrected to the reference standard hydrogen electrode. The lowest ORP measurements were recorded in wells near the surface water and swamp areas and the highest ORP readings were recorded in the deep wells and in surface water. This finding confirms that as groundwater moves away from beneath the landfill, redox reactions can take place and the environment is conducive to the adsorption-based remedy.

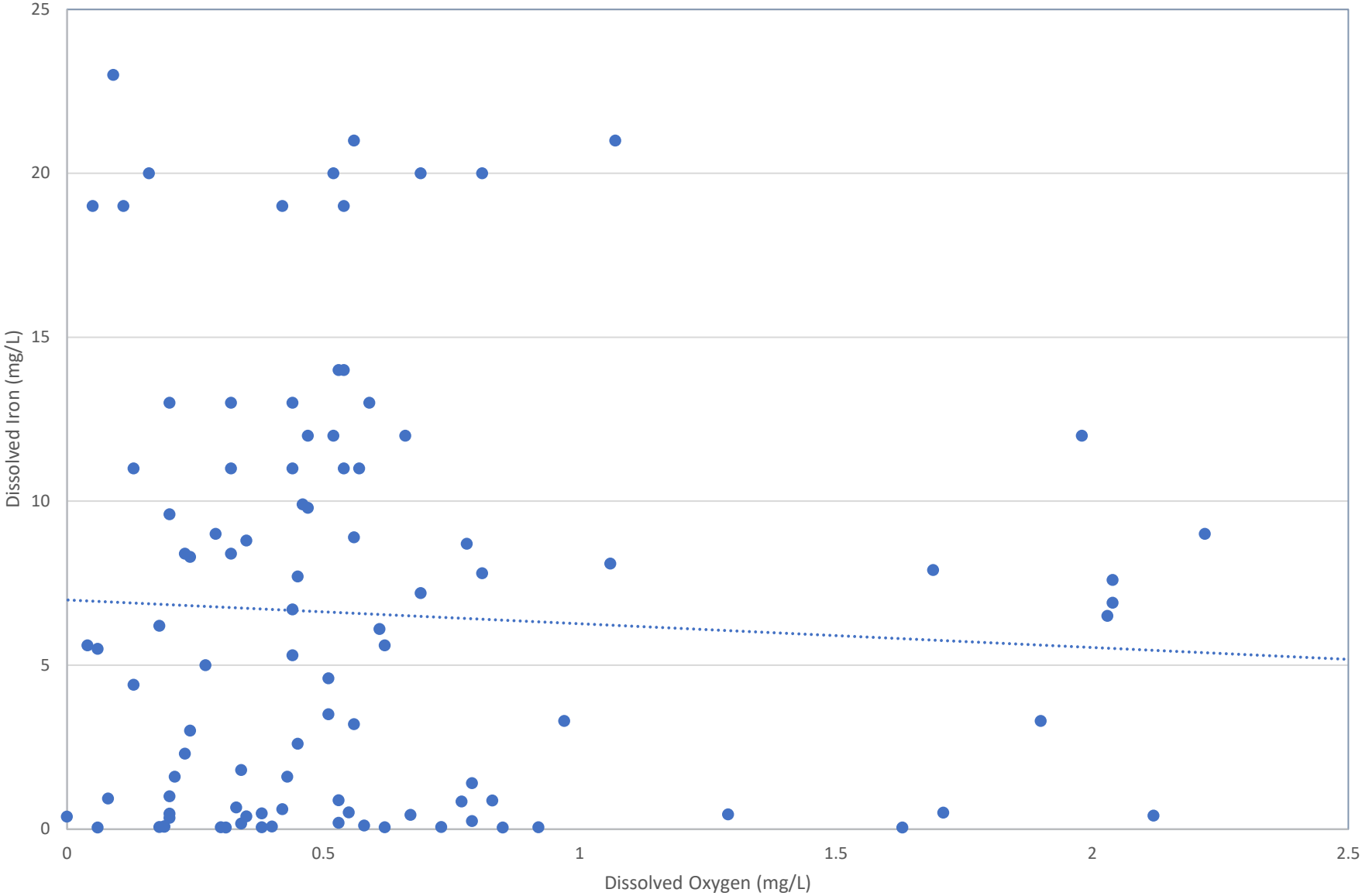
Appendix B - Chart 3
Average Total Iron vs. Average Dissolved Iron



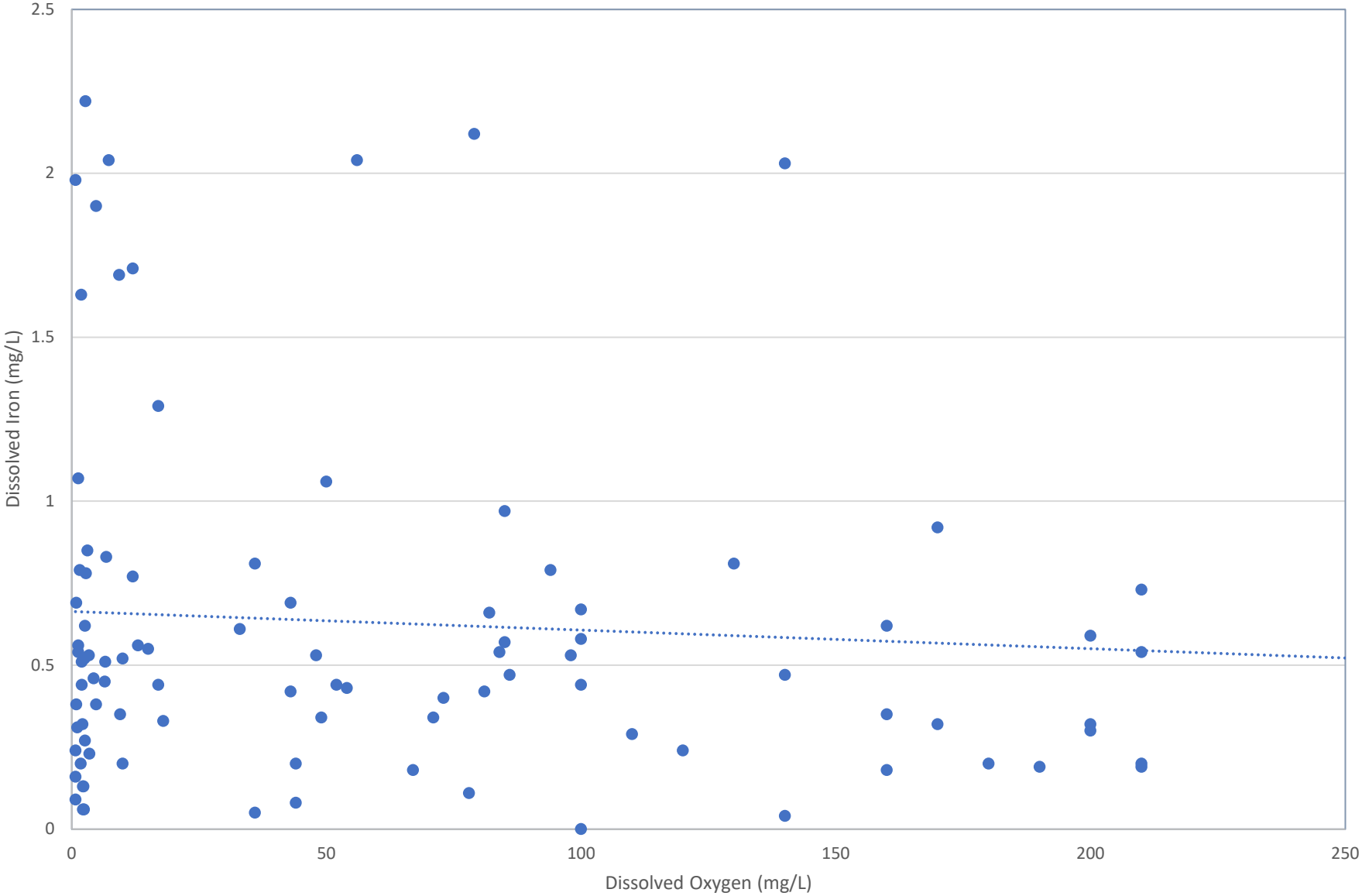
Appendix B - Chart 4
Total Manganese vs. Dissolved Arsenic



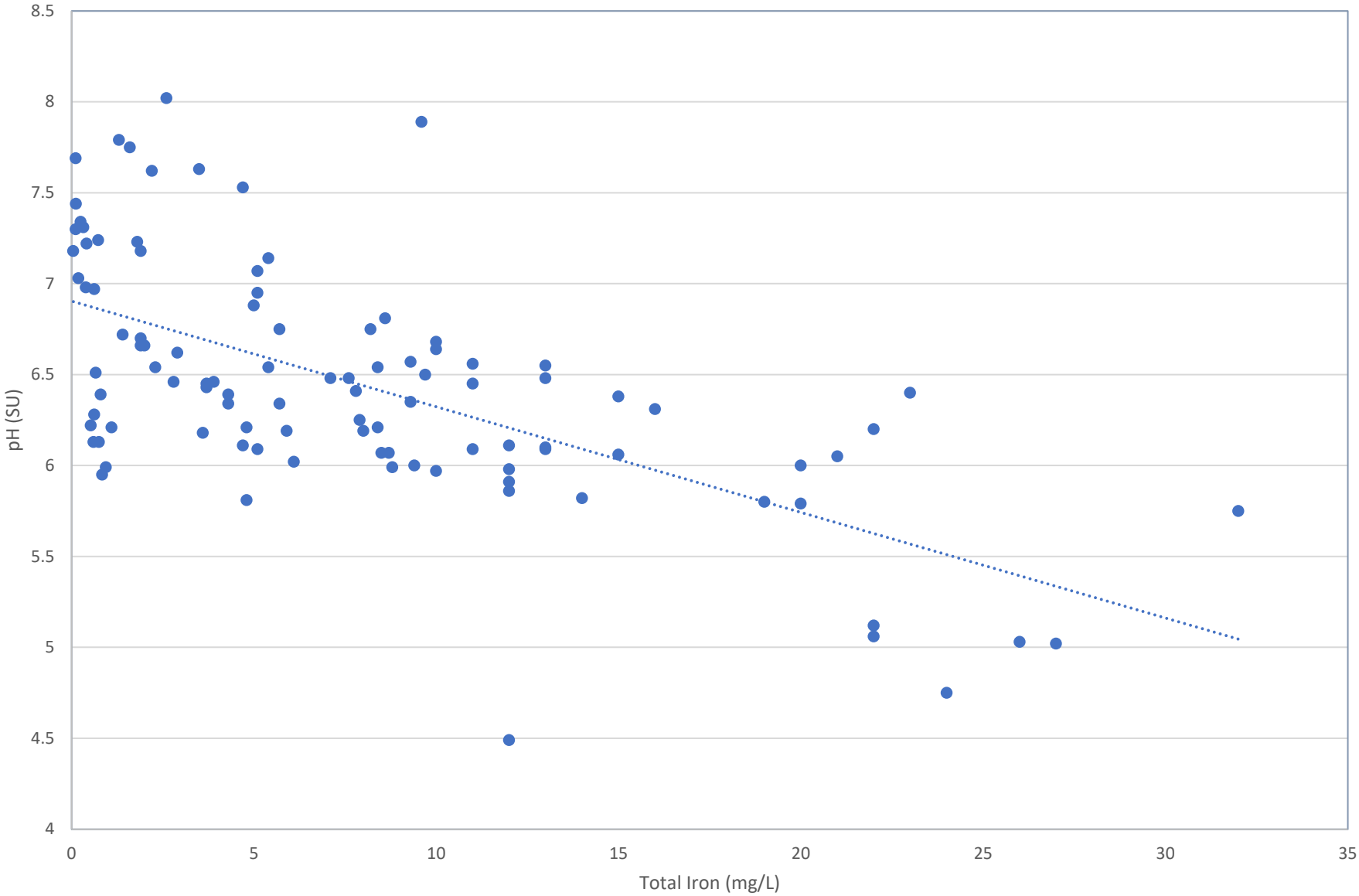
Appendix B - Chart 5
Dissolved Oxygen vs. Dissolved Iron



Appendix B - Chart 6
Dissolved Arsenic vs. Dissolved Oxygen



Appendix B - Chart 7
Total Iron vs. pH



Appendix B - Table 1
Summary of Arsenic Speciation Results
Corrective Action Status Evaluation 2023
Chesapeake Energy Center Industrial Landfill - Permit No. 440

Parameter Name	MW-5					
	3/9/2020	9/29/2020	3/30/2021	9/27/2021	4/18/2022	9/26/2022
Arsenic III	3.45	1.88	< 1.48	3.75	2.1	8.7
Arsenic V	2.92	5.38	1.32 J	< 0.345	2.6	1.3
AsIII/AsV Ratio	1.18	0.35	1.12	10.87	0.81	6.69

Parameter Name	MW-5D					
	3/9/2020	9/29/2020	3/30/2021	9/27/2021	4/18/2022	9/26/2022
Arsenic III	0.508	1.91	< 1.87	2.17	1.3	1.8
Arsenic V	0.566	< 0.345	< 0.345	< 0.345	< 0.35	< 0.35
AsIII/AsV Ratio	0.90	5.54	5.42	6.29	3.71	5.14

Parameter Name	CECW-1					
	3/10/2020	9/30/2020	3/30/2021	9/27/2021	4/19/2022	9/29/2022
Arsenic III (ug/L)	556	107	5.78	705	780	300
Arsenic V (ug/L)	< 30.0	< 10.4	1.59	< 10.4	< 52	90
AsIII/AsV Ratio	18.53	10.29	3.64	67.79	15.00	3.33

Parameter Name	CECW-1D					
	3/10/2020	9/30/2020	3/30/2021	9/27/2021	4/19/2022	9/29/2022
Arsenic III	43.5	0.84	40.7	12.2	11	0.97
Arsenic V	7.18	42.2	< 2.76	36.2	17	51
AsIII/AsV Ratio	1.45	0.02	14.75	0.34	0.65	0.02

Parameter Name	CECW-2					
	3/11/2020	9/29/2020	3/31/2021	9/30/2021	4/19/2022	9/29/2022
Arsenic III	1.31	3.25	1.2	1.81	1.3	0.34 J
Arsenic V	< 0.500	< 0.345	11.8 J	< 0.345	< 0.35	< 0.35
AsIII/AsV Ratio	2.62	9.42	0.12	5.25	3.71	16.00

Parameter Name	CECW-2D					
	3/10/2020	9/30/2020	3/31/2021	9/30/2021	4/19/2022	9/29/2022
Arsenic III	95.5	109	94.9	115.0	98	110
Arsenic V	< 15.0	< 10.4	< 8.28	< 5.18	< 5.2	10 J
AsIII/AsV Ratio	6.37	10.48	11.46	22.20	18.85	11.00

Parameter Name	CECW-3					
	3/10/2020	9/30/2020	09/90/20201	9/27/2021	4/19/2022	9/29/2022
Arsenic III	NS	NS	NS	NS	NS	NS
Arsenic V	NS	NS	NS	NS	NS	NS
AsIII/AsV Ratio	--	--	--	--	--	--

Parameter Name	CECW-3D					
	3/10/2020	9/30/2020	4/1/2021	9/30/2021	4/18/2022	9/28/2022
Arsenic III	181	138	131	186	140	190
Arsenic V	< 15.0	11.2	< 4.14	< 5.18	< 13	< 13
AsIII/AsV Ratio	12.07	12.32	31.64	35.91	10.77	14.62

Parameter Name	CECW-6I					
	3/9/2020	9/30/2020	4/1/2021	9/27/2021	4/18/2022	9/28/2022
Arsenic III	218	102	223	162	160	130
Arsenic V	< 15.0	< 10.4	< 10.4	< 5.18	< 17	50
AsIII/AsV Ratio	14.53	9.81	21.44	31.27	9.41	2.60

Parameter Name	CECW-6D					
	3/10/2020	9/30/2020	4/1/2021	9/27/2021	4/18/2022	9/28/2022
Arsenic III	97.6	75.3	79.5	88.2	66	53
Arsenic V	< 15.0	7.93	10.6 J	< 5.18	< 5.2	< 3.5
AsIII/AsV Ratio	6.51	9.50	7.50	17.03	12.69	15.14

Parameter Name	CECW-8					
	3/11/2020	9/30/2020	4/1/2021	9/30/2021	4/21/2022	9/29/2022
Arsenic III	<1.00	< 0.51	1.08	0.832	1.2	0.7
Arsenic V	<1.00	< 2.07	< 0.345	< 0.345	< 0.35	< 0.35
AsIII/AsV Ratio	1.00	0.25	3.13	2.41	3.43	2.00

Parameter Name	CECW-8D					
	3/11/2020	10/1/2020	4/1/2021	9/29/2021	4/21/2022	9/26/2022
Arsenic III	10.9	19.2	8.65	35	32	70
Arsenic V	< 1.00	21	0.895	< 2.07	9.0	15
AsIII/AsV Ratio	10.90	0.91	9.66	16.91	3.56	4.67

Appendix B - Table 1
Summary of Arsenic Speciation Results
Corrective Action Status Evaluation 2023
Chesapeake Energy Center Industrial Landfill - Permit No. 440

Parameter Name	CECW-10R					
	3/10/2020	9/30/2020	4/4/2021	9/29/2021	4/21/2022	9/28/2022
Arsenic III	29.4	48.7	33.7	36.4	13	6.0
Arsenic V	< 6.00	< 10.4	< 0.765	< 1.04	< 1.7	< 1.0
AsIII/AsV Ratio	4.90	4.68	44.05	35.00	7.65	6.00

Parameter Name	CECW-15					
	3/10/2020	10/1/2020	4/1/2021	9/30/2021	4/22/2022	9/28/2022
Arsenic III	0.578	0.633	2.16 J	0.541	< 0.26	0.73
Arsenic V	< 0.500	< 0.345	< 2.07	< 0.345	0.60	< 0.35
AsIII/AsV Ratio	1.16	1.83	1.04	1.57	0.43	2.09

Parameter Name	PO-8					
	3/11/2020	9/29/2020	3/31/2021	9/27/2021	4/19/2022	9/29/2022
Arsenic III	11.1	16.2	6.13	12.1	58	11
Arsenic V	< 6.00	< 2.76	< 2.07	< 0.345	< 0.69	1.0 J
AsIII/AsV Ratio	1.85	5.87	2.96	35.07	84.06	11.00

Parameter Name	PO-8D					
	3/11/2020	9/30/2020	3/31/2021	9/27/2021	4/19/2022	9/29/2022
Arsenic III	2.42	0.891	0.989	0.671	1.4	2.4
Arsenic V	< 1.00	0.484	< 2.07	< 0.345	0.40 J	0.70
AsIII/AsV Ratio	2.42	1.84	0.48	1.94	3.50	3.43

Parameter Name	PO-10					
	3/10/2020	9/30/2020	4/1/2021	9/28/2021	5/23/2022	9/26/2022
Arsenic III	107	64.1	71.6	74.7	45	65
Arsenic V	< 15.0	< 10.4	< 2.04	< 2.07	< 2.6	< 3.5
AsIII/AsV Ratio	7.13	6.16	35.10	36.09	17.31	18.57

Parameter Name	PO-10D					
	3/11/2020	9/30/2020	4/1/2021	9/30/2021	5/23/2022	9/26/2022
Arsenic III	214	136	69.4	62.5	45	97
Arsenic V	< 15.0	< 10.4	< 2.07	< 2.07	< 2.1	< 5.2
AsIII/AsV Ratio	14.27	13.08	33.53	30.19	21.43	18.65

Parameter Name	SW-1					
	3/11/2020	10/1/2020	4/1/2021	09/30/20201	4/19/2022	9/28/2022
Arsenic III	< 0.500	< 0.255	0.646 J	< 0.255	< 0.26	0.27 J
Arsenic V	0.404 J	1.05	2.4 J	0.975	0.43 J	0.58
AsIII/AsV Ratio	1.24	0.24	0.27	0.26	0.60	0.47

Parameter Name	SW-2					
	3/11/2020	10/1/2020	4/1/2021	9/30/2021	4/19/2022	9/28/2022
Arsenic III	< 0.500	< 0.255	0.334 J	< 0.255	< 0.26	0.31 J
Arsenic V	0.874 J	0.998	< 0.345	0.729	0.45 J	0.79
AsIII/AsV Ratio	0.57	0.26	0.97	0.35	0.58	0.39

Parameter Name	SW-3					
	3/11/2020	10/1/2020	4/1/2021	9/30/2021	4/19/2022	9/28/2022
Arsenic III	< 0.500	< 0.255	< 0.255	< 0.255	0.3 J	< 0.26
Arsenic V	0.47 J	0.795	0.758 J	0.904	< 0.35	1.7
AsIII/AsV Ratio	1.06	0.32	0.34	0.28	0.86	0.15

Parameter Name	SW-4					
	3/11/2020	10/1/2020	4/1/2021	9/30/2021	4/19/2022	9/28/2022
Arsenic III	< 0.500	< 0.255	< 0.255	< 0.255	< 0.26	< 0.26
Arsenic V	0.0826 J	0.912	0.484 J	1.41	0.5	< 1.3
AsIII/AsV Ratio	6.05	0.28	0.53	0.18	0.52	0.20

Notes:

Arsenic data is in micrograms per liter (µg/L)

>1	= Arsenic III is predominant
<1	= Arsenic V is predominant

4.0 APPENDIX C – RISK EXPOSURE FACTORS DISCUSSION

The following sections of Appendix C provide additional detailed information in reference to specific line items of Section C (Risk Exposure Factors) of Form-1 provided in SI-25. As required by SI-25, additional information is provided below regarding "yes" or "possibly" responses provided in Form-1. Additional information is provided regarding "no" or "not applicable" responses provided in Form-1, as determined appropriate by WSP.

4.1 Section C, Line 45

Virginia Electric and Power Company (VEPCO) d/b/a Dominion Energy Virginia, the owner and operator of the CEC Landfill, owns the areas currently underlain by impacted (above GPS) groundwater. VEPCO property boundaries are shown in Attachment II.

4.2 Section C, Line 47

The property is located in a general industrial zoned district (M-2) and groundwater beneath the landfill is not used for any purpose. As a result, other than trained environmental professionals, there was no potential for exposure to humans or environmental receptors.

4.3 Section C, Line 48

Land use in the vicinity of the landfill generally did not change during the CASE period.

4.4 Section C, Line 49

The landfill was constructed with a synthetic liner. A temporary rain cover is currently in place over a portion of the landfill to reduce infiltration.

4.5 Section C, Line 50

Other than routine sampling and analysis of water samples by trained technicians using appropriate personal protective equipment, there were no remedy related site activities that may have created any short-term risk to workers or the environment.

4.6 Section C, Line 51

There are no structures onsite or offsite which sit above the groundwater plume.

4.7 Section C, Line 52, 53

Groundwater is not used onsite for any reason.

4.8 Section C, Line 55

Surface water monitoring results are included in Attachment IX. As presented, the total COC results for the samples collected during this CASE period are below the LOQ. The detected concentrations in surface water were significantly below their respective GPS and do not indicate an unacceptable cross-media transfer of contaminants.

5.0 APPENDIX D – INTERPRETATION OF ANALYTICAL RESULTS DISCUSSION

The following sections of Appendix D provide additional detailed information in reference to specific line items of Section D (Interpretation of Analytical Results) of Form-1 provided in SI-25. As required by SI 25, additional information is provided below regarding "yes" or "possibly" responses provided in Form 1. Additional information is provided regarding "no" or "not applicable" responses provided in Form 1, as determined appropriate by WSP.

5.1 Section D, Line 56

Groundwater trends were assessed with Mann-Kendall trend tests. The Mann-Kendall was selected because it is a non-parametric trend test that does not require the underlying data to follow a specific distribution. This test can determine increasing or decreasing trends over time. A summary of trend analysis results is provided in a table located at the beginning of Attachment VIII.

5.2 Section D, Line 57

Data used for the trend tests include the data collected since remedy implementation in 2011 [four (4) full CASE periods].

5.3 Section D, Line 59

Time series plots for each well and monitored parameter are included in Attachment VIII.

5.4 Section D, Line 60

Trend tests performed on COCs in sentinel wells indicated the following upward trends:

- Arsenic in well CECW-6D and CECW-8D
- Sulfide in well CECW-10R

Upward trends in arsenic (arsenite), iron (total), manganese, and sulfide (total and dissolved) concentrations, as well as pH, were also found in the following wells; however, these are performance/geochemical parameters and are not COCs:

- Dissolved arsenic (likely to be arsenite) – CECW-6D
- Arsenic (arsenite) – CECW-6D, CECW-10R, CECW-15
- pH – CECW-6D
- Manganese –CECW-8
- Total iron – CECW-10R
- Dissolved sulfide – well CECW-10R

5.5 Section D, Line 61

Trend tests performed on the COCs in performance wells indicated the following upward trends:

- Arsenic (total)
  - MW-5 (upgradient), CECW-1D, CECW-2D, PO-8

- Sulfide (total)
  - CECW-2, PO-10

Increasing trends were identified for the following performance/geophysical parameters:

- Arsenic (dissolved likely to be arsenite)
  - MW-5 (upgradient), CECW-1D, CECW-2D
- Arsenic (arsenite)
  - MW-5D (upgradient), CECW-2D, PO-8
- Arsenic (arsenate)
  - CECW-1D and CECW-2D
- Cobalt (dissolved)
  - CECW-6I
- Iron (total)
  - MW-5 (upgradient) and PO-8
- Iron (dissolved)
  - MW-5 (upgradient) andPO-8
- Sulfide (dissolved)
  - CECW-2 and PO-10
- pH
  - MW-5D (upgradient), CECW-3D, CECW-6D, PO-10, and PO-10D
- Oxidation-Reduction Potential
  - CECW-1, CECW-2, PO-8, and PO-8D
- Manganese
  - CECW-8

5.6 Section D, Line 62

Increasing trends were identified for the following COCs in the indicated compliance wells:

- Arsenic (total)
  - PO-8
- Sulfide (total)
  - CECW-2, CECW-10R, PO-10

Increasing trends were also identified for the following performance parameters:

- Arsenic (arsenite)
  - CECW-10R, PO-8
- Cobalt (dissolved)
  - CECW-6I
- Iron (total)
  - CECW-10R, PO-8
- Iron (dissolved)
  - PO-8
- Sulfide (dissolved)
  - CECW-2, CECW-10R, PO-10

5.7 Section D, Line 63

The CEC landfill remedy of adsorption MNA is designed to mitigate GPS exceedances for selected metals. The chlorinated solvent paradigm of parent/daughter ratios does not apply to the metals adsorption remedy.

5.8 Section D, Line 64

Appendix B includes a discussion of performance and geochemical parameter sampling results for the CASE period.

6.0 APPENDIX E – FUTURE ACTIONS DISCUSSION

The following sections of Appendix E provide additional detailed information in reference to specific line items of Section E (Future Actions) of Form-1 provided in SI-25. As required by SI-25, additional information is provided below regarding "yes" or "possibly" responses provided in Form 1. Additional information is provided regarding "no" or "not applicable" responses provided in Form 1, as determined appropriate by WSP.

6.1 Section E, Line 65

The Corrective Action Program monitoring activities completed during this CASE period continue to indicate a geochemical environment conducive to the *insitu* oxidation-based MNA groundwater remedy. The anoxic groundwater beneath the landfill and the oxidizing environments near the tidal surface water bodies provide conditions that are suitable for the remedy. In addition, decreasing trends in COCs concentrations for the following constituents in the indicated wells signifies that the remedy is decreasing concentrations of COCs in groundwater:

- Antimony – PO-10D
- Arsenic – CECW-1, CECW-2, CECW-3, CECW-6I, CECW-8, CECW-10R, and PO-10
- Cobalt – CECW-2, CECW-6D, and PO-8D

As discussed in Appendix A, the estimated timeframe to achieve GPS is in approximately 23 years. This estimated timeframe is based on wells that exhibited decreasing arsenic trends over time; however, four (4) deep wells (CECW-1D, CECW-2D, CECW-6D, and CECW-8D) are exhibiting increasing arsenic concentrations over time. The increasing trends in arsenic concentrations in these deep wells may indicate that the remedy may not be able to achieve GPS within the initially identified timeframe. Three (3) of the wells of interest (CECW-1D, CECW-2D, and CECW-6D) are located directly adjacent to the landfill.

6.2 Section E, Line 66, 70

On March 20, 2019, Governor Northam signed SB1355/HB2786 into law (Code of Virginia § 10.1-1402.03) requiring the closure by removal of the CEC landfill, bottom ash pond, and historic pond. As a result, an alternate remedy from the current CAP will be required. Dominion Energy will continue the existing CAP monitoring program and will coordinate with DEQ regarding permitting and updating the CAP as removal plans are finalized.

7.0 REFERENCES

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