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February 14, 2018

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Subject: Orrington Remediation Site, Orrington, Maine
Landfill 5 Groundwater Monitoring Program
2017 Annual Report

Dear Mr. Wainberg:

On behalf of Mallinckrodt US LLC, Sevee & Maher Engineers, Inc. is pleased to submit the enclosed 2017 Annual Report for the Detection and Assessment Monitoring Programs completed for Landfill 5 at the Orrington Remediation Site.

Please do not hesitate to contact me if you have any questions regarding the 2017 Annual Report.

Very truly yours,

SEVEE & MAHER ENGINEERS, INC.

A handwritten signature in black ink, appearing to read "Guy H. Cote Jr.", written over a horizontal line.

Guy H. Cote Jr., P.E.
President

Attachment: Electronic Deliverable of 2017 Annual Report

cc: Kathryn Zeigler, Mallinckrodt US LLC
Chris Swain, Maine DEP

**2017 ANNUAL REPORT
LANDFILL 5
GROUNDWATER MONITORING PROGRAM
FOR
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE**

Prepared for

MALLINCKRODT US LLC

February 2018



ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE

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**2017 ANNUAL REPORT
LANDFILL 5
GROUNDWATER MONITORING PROGRAM
FOR
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE**

1.0 INTRODUCTION

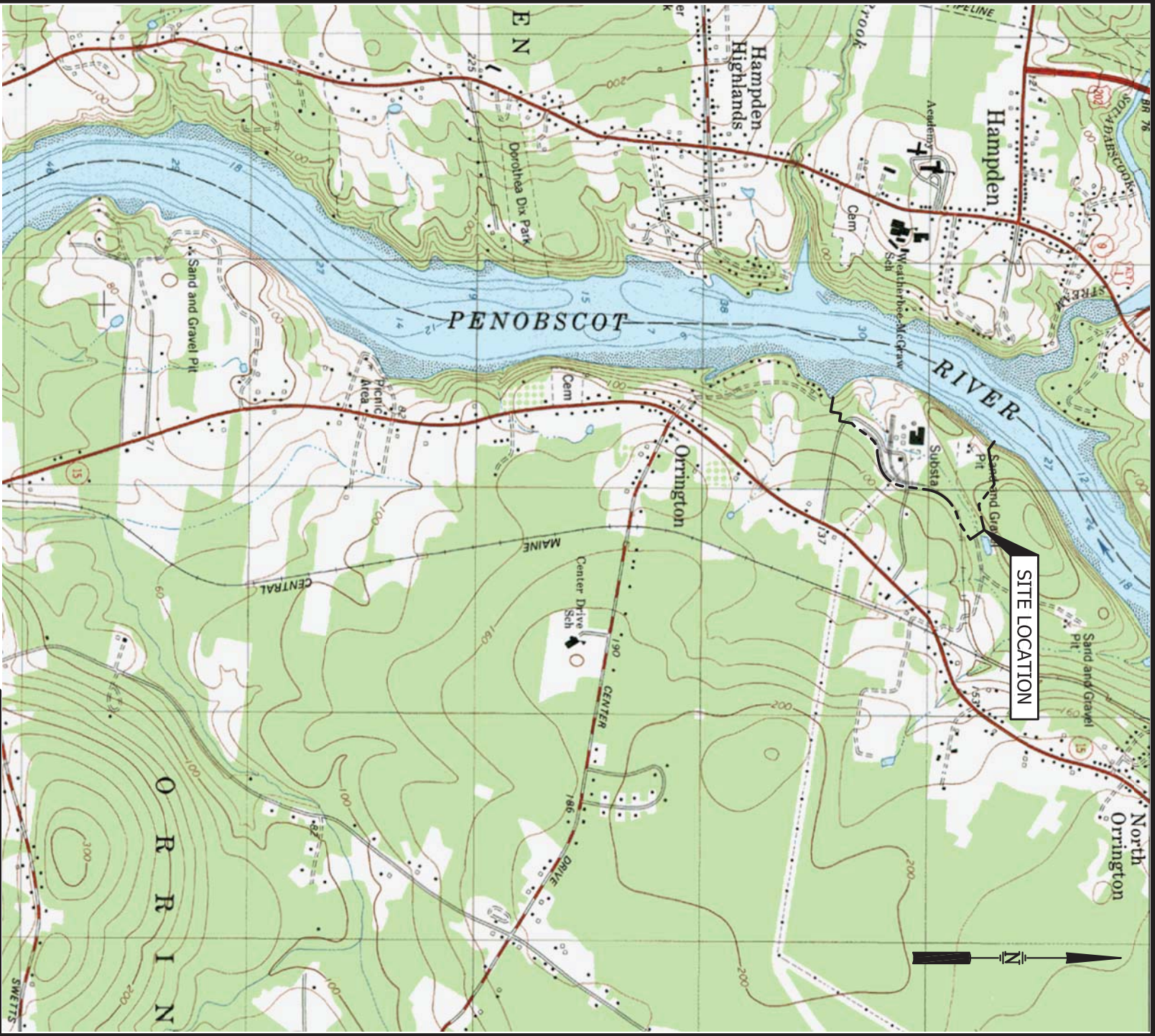
This Annual Report presents the results of 2017 groundwater quality monitoring associated with Landfill 5 at the Orrington Remediation Site (Site) in Orrington, Maine. Groundwater monitoring at the Site comprises semiannual detection monitoring and quarterly assessment monitoring of a group of wells designated the Landfill 5 Resource Conservation and Recovery Act (RCRA) wells.

1.1 Site Background

The Site, which is located at 99 Industrial Way in Orrington, Maine, was developed in 1967 and facility operations closed in September 2000. A site location map is provided in Figure 1-1, and the locations of the Site's five landfills are shown in Figure 1-2. Each of these landfills were closed and capped over 25 years ago. Landfill 5 received hazardous waste after July 26, 1982 and consequently was designated as a regulated unit under RCRA. The other four landfills at the Site (Landfills 1 – 4) are not considered regulated units. As part of remediation activities at the Site during 2016, the Hypalon cap at Landfill 5 was replaced with a new cover system consisting of a geosynthetic clay liner, a 40-mil HDPE membrane, and a geosynthetic composite. Landfills 3 and 4 were capped and covered in a similar manner in 2016.

1.2 History of Landfill 5 Groundwater Monitoring Program

The Detection Monitoring Program at Landfill 5 was instituted in September 1989 under the conditions of 40 CFR § 265.90 through 265.94 and was incorporated by reference in Maine Department of Environmental Protection (MEDEP) Chapter 855 and the Maine Hazardous Waste, Septage and Solid Waste Management Act, 38 M.R.S.A. § 1310 et seq.



BASE MAP ADAPTED FROM 7.5 MIN
USGS TOPOGRAPHIC QUADRANGLE
HAMPDEN, ME-1982



DWG: SITELOC

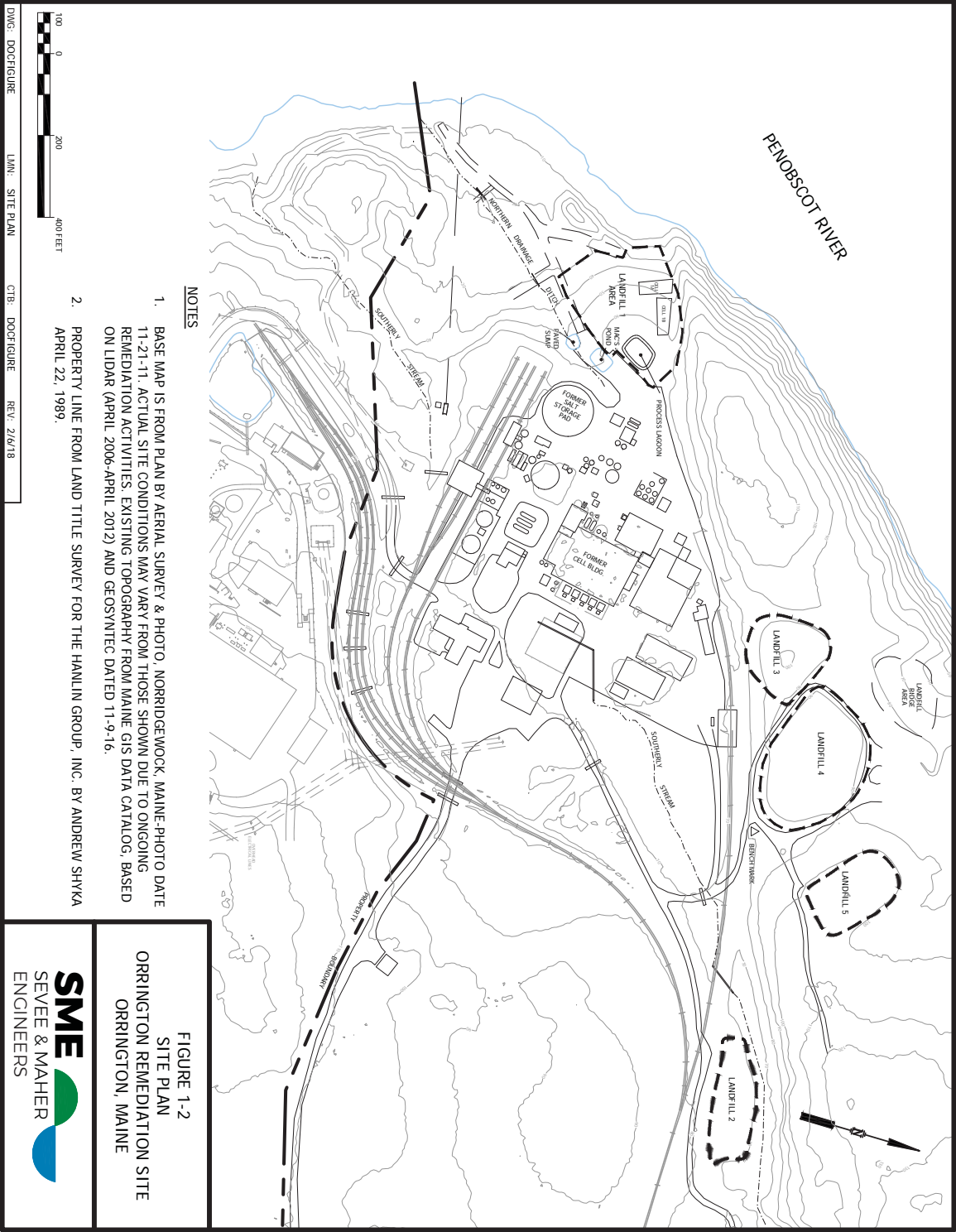
LMN: SITELOC

CTB: SME-STD

REV: 2/6/18

FIGURE 1-1
SITE LOCATION MAP
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE





Groundwater quality results from October 1994 revealed statistically significant increases in one of four indicator parameters monitored; i.e., total organic halogens (TOX) downgradient of Landfill 5 compared to the groundwater upgradient of the landfill. Consistent with the interim status requirements in MEDEP Chapter 855 and 40 CFR § 265, an Assessment Monitoring Program was initiated after the October 1994 groundwater results were confirmed in December 1994. Results of the Assessment Monitoring Program were submitted to MEDEP and U.S. Environmental Protection Agency (U.S.EPA) in March 1996 (Acheron¹). Detection and assessment monitoring at Landfill 5 has continued since then.

Groundwater quality monitoring at Landfill 5 comprises two sampling programs: (1) the semiannual Detection Monitoring Program utilizing wells B-304-B1, B-304-O1, B-306-B3, B-307-B1, B-307-B2 and B-307-O1, and (2) the quarterly Assessment Monitoring Program for wells B-303-B1, B-303-B2, B-303-B3, B-303-O1, B-306-B1 and B-306-B2. The locations of these wells are shown in Figure 1-3 and the well installation details are summarized in Table 1-1.

¹ Acheron, 1996. *Report on Initial Groundwater Quality Assessment Monitoring – Landfill 5.*

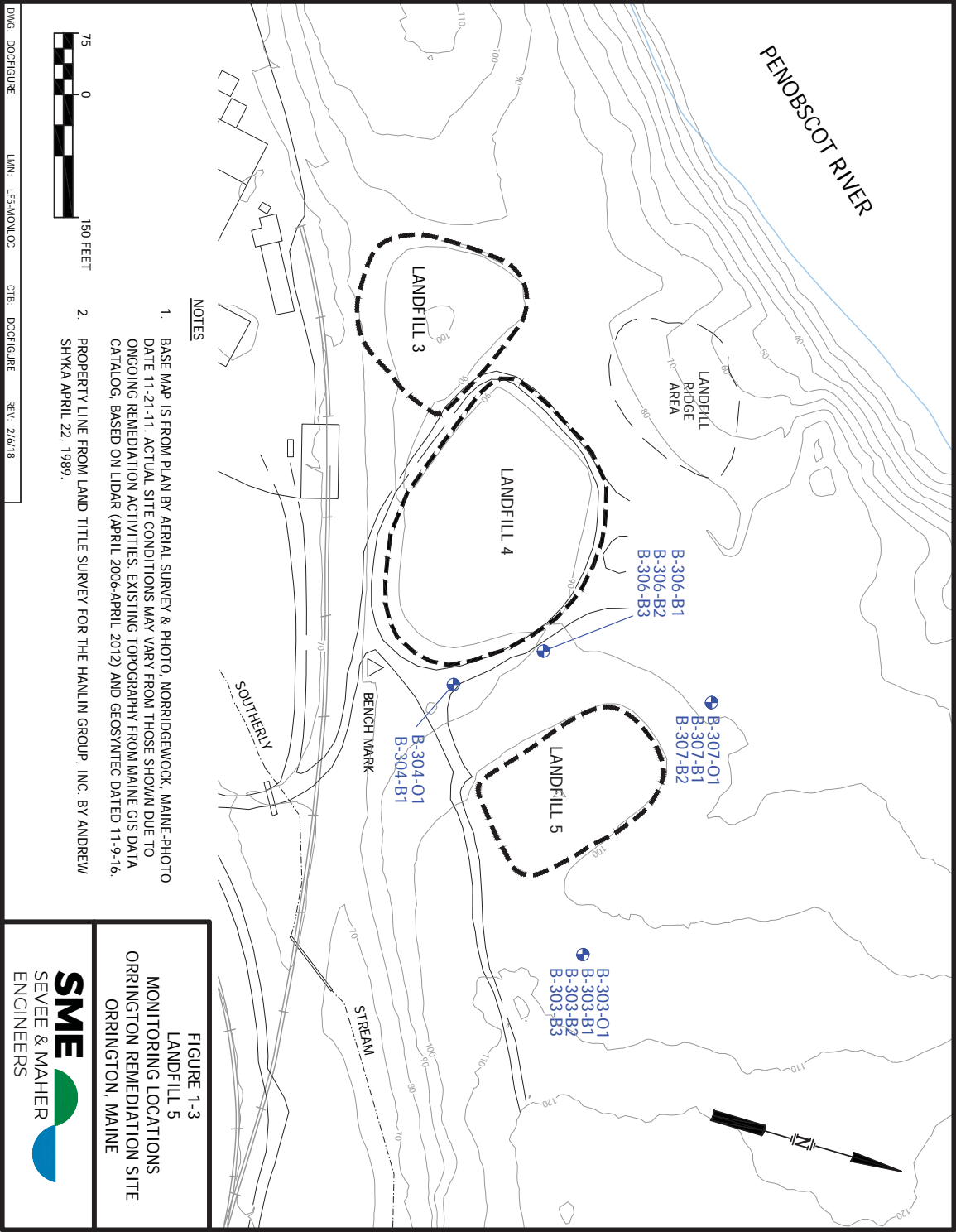


TABLE 1-1

WELL DETAILS FOR LANDFILL 5 RCRA MONITORING WELLS

| Well | Elevation ⁽¹⁾ | | Hydraulic Position Relative to Landfill 5 | Screened Unit | Total Boring Depth ft bgs | Well Screen | | Sand Pack Interval | | Bedrock Depth ft bgs |
|----------|--------------------------|------------------------|---|---------------|------------------------------|--------------------|--------------|--------------------|--------------|-------------------------|
| | Ground ft NAVD | Well Casing ft NAVD | | | | Interval ft bgs | Length ft | Interval ft bgs | Length ft | |
| B-303-B1 | | 106.48 | Upgradient | Bedrock | 120 | 98.0 - 108.0 | 10 | 96.0 - 110.0 | 14 | 7 |
| B-303-B2 | 104.39 | 106.28 | | Bedrock | | 23.0 - 33.0 | 10 | 21.0 - 34.5 | 13.5 | |
| B-303-B3 | | 106.21 | | Bedrock | | 11.5 - 16.5 | 5 | 10.5 - 17.0 | 6.5 | |
| B-303-O1 | | 106.35 | | Soil | | 4.0 - 6.5 | 2.5 | 3.0 - 7.0 | 4 | |
| B-304-B1 | 86.26 | 88.64 | Downgradient | Bedrock | 115 | 74.0 - 79.0 | 5 | 70.0 - 85.0 | 15 | 7 |
| B-304-O1 | | 88.48 | | Soil | | 4.0 - 6.5 | 2.5 | 3.5 - 7.0 | 3.5 | |
| B-306-B1 | | 94.84 | | Bedrock | 119 | 26.0 - 36.0 | 10 | 25.0 - 37.0 | 12 | |
| B-306-B2 | 92.08 | 94.83 | | Bedrock | | 15.0 - 20.0 | 5 | 14.0 - 21.0 | 7 | |
| B-306-B3 | | 94.86 | | Bedrock | | 5.0 - 10.0 | 5 | 4.0 - 11.0 | 7 | |
| B-307-B1 | | 91.62 | | Bedrock | 119 | 64.0 - 69.0 | 5 | 62.0 - 72.0 | 10 | 5.5 |
| B-307-B2 | 88.88 | 91.62 | | Bedrock | | 50.5 - 55.5 | 5 | 48.5 - 57.5 | 9 | |
| B-307-O1 | | 91.69 | | Soil | | 4.0 - 5.0 | 1 | 3.5 - 5.5 | 2 | |

Notes:

1. Elevations based on a field survey completed between October 19 and 20, 2010. Elevations referenced to M.D.O.T. Benchmark BOB-15-V published elevation of 132.615 (NAVD 1988).

Abbreviations:

ft - feet

ft bgs - feet below ground surface

ft NAVD - feet North American Vertical Datum

Source:

Acheron, 1991. Well details (except elevation survey data) from *Interim Report to LCP Chemicals - Maine on the Nature, Extent, and fate of Environmental Contaminants at the Orrington, Maine Facility; January 15, 1991.*

2.0 DETECTION MONITORING PROGRAM

Monitoring well sampling, laboratory analytical procedures, groundwater quality results, and statistical testing for the semiannual Detection Monitoring Program conducted in 2017 at Landfill 5 are discussed in Section 2.0.

2.1 2017 Sampling Program

Groundwater sampling for the Detection Monitoring Program was completed in March and September of 2017 by Sevee & Maher Engineers, Inc. (SME) of Cumberland, Maine. A summary of the Detection Monitoring Program is provided in Table 2-1. Groundwater samples were analyzed for four "indicator" parameters and seven parameters of groundwater quality consisting of metals, inorganics, and phenols. Analytical methods for the analysis of groundwater samples are detailed in Table 2-2.

**TABLE 2-1
DETECTION MONITORING PROGRAM**

| Date | Event | Monitoring Wells | Sample Parameters | Comments |
|--------------------|---------------------------------|---|---|--|
| March 21, 2017 | Semiannual detection monitoring | B-304-B1/O1 ⁽¹⁾ B-306-B3 ⁽¹⁾ B-307-B1/B2 B-307-O1 ⁽¹⁾ | TOX, TOC, pH, specific conductance, temperature, iron, manganese, sodium, mercury, chloride, sulfate, phenols | Statistical exceedance observed for specific conductance in B-304-B1, and B-307-B1 |
| September 11, 2017 | Semiannual detection monitoring | B-304-B1/O1 ⁽¹⁾ B-306-B3 ⁽¹⁾ B-307-B1/B2 B-307-O1 ⁽¹⁾ | TOX, TOC, pH, specific conductance, temperature, iron, manganese, sodium, mercury, chloride, sulfate, phenols | Statistical exceedance observed for specific conductance in B-304-B1 |

Note:
1. Monitoring wells B-304-O1, B-306-B3, and B-307-O1 were either dry or yielded an insufficient quantity of groundwater to obtain a sample during the March and September 2017 sampling events.

Abbreviations:
TOC - total organic carbon
TOX - total organic halogens

TABLE 2-2
PARAMETERS AND ANALYTICAL METHODS
DETECTION MONITORING PROGRAM

| Date | Parameter ⁽¹⁾ | Analytical Method ⁽²⁾ | Method Detection Limit |
|-----------------------|---------------------------|----------------------------------|------------------------|
| March 21, 2017 | EPA Water Quality: | | |
| | Iron | Method 6010C | 0.01 mg/L |
| | Manganese | Method 6010C | 0.002 mg/L |
| | Sodium | Method 6010C | 0.12 mg/L |
| | Chloride | Method 9056 | 0.054 mg/L |
| | Sulfate | Method 9056 | 0.15 mg/L |
| | Phenols | EPA 420.1 | 0.01 mg/L |
| | Indicator: | | |
| | TOC | Method 5310C | 0.114 mg/L |
| | TOX | Method 9020B | 0.01 mg/l |
| | pH | Method 9040 | -- |
| | Specific Conductance | Method 9050 | -- |
| | Miscellaneous: | | |
| September 11, 2017 | Mercury | Method 7074A | 0.00006 mg/L |
| | EPA Water Quality: | | |
| | Iron | Method 6010C | 0.009 mg/L |
| | Manganese | Method 6010C | 0.002 mg/L |
| | Sodium | Method 6010C | 0.12 mg/L |
| | Chloride | Method 9056 | 0.084 mg/L |
| | Sulfate | Method 9056 | 0.16 mg/L |
| | Phenols | EPA 420.1 | 0.01 mg/L |
| | Indicator: | | |
| | TOC | Method 5310C | 0.114 mg/L |
| | TOX | Method 9020B | 0.01 mg/L |
| | pH | Method 9040 | -- |
| | Specific Conductance | Method 9050 | -- |
| | Miscellaneous: | | |
| | Mercury | Method 7074A | 0.00006 mg/L |

Notes:

1. Specific conductance and pH were measured in the field.
2. *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods*. EPA Publication SW-846. Third Edition, Updates I-IV, 2007.
3. *Methods for Chemical Analysis of Water and Wastes*. EPA 600/4-79-020, revised March 1983.
4. *Standard Methods for the Examination of Water and Wastewater*. APHA-AWWA-WPCF, Standard Methods Online.

Abbreviations:

mg/L - milligrams per liter
TOC - Total Organic Carbon
TOX - Total Organic Halides

Water levels in wells associated with the Landfill 5 monitoring program were obtained at a quarterly frequency in 2017. Groundwater elevations calculated from the water level measurements are summarized and discussed in Section 2.8. The groundwater elevation data were used to infer the horizontal groundwater flow direction around Landfill 5.

2.2 Sampling Procedures

Groundwater sampling, sample handling, and documentation were conducted consistent with U.S.EPA and MEDEP-approved protocols. The physical conditions of monitoring wells were observed prior to sampling, including the ground surface seal, the protective casing (steel standpipe), and the security of the well cap (lock). The physical condition of each monitoring well was recorded on the Monitoring Well Sample Purging Forms completed in the field, which are compiled in Appendix A for each sampling round conducted during the 2017 monitoring period.

After the well condition was documented, the water level in the well casing was measured to the nearest 0.01 foot with a clean electronic sounding probe. Depth to water was referenced to the top of the PVC well casing and entered onto the Monitoring Well Sample Purging Form (see Appendix A). Artesian flow occurred in monitoring wells B-303-B1 and B-303-B2 during periods of the year. Temporary PVC extensions were connected to the top of each well riser to determine the water level in B-303-B1 and B-303-B2. Water level probes and associated electronic leads were washed with consecutive rinses of deionized water between well locations.

SME initiated low-flow sampling procedures in September 2010 at the request of MEDEP. Dedicated polyethylene tubing compatible with peristaltic or bladder pumps was installed in monitoring wells. To minimize the drawdown and disturbance within the water column, groundwater purge rates were limited to no more than 200 milliliters per minute (mL/min).

During the well sampling process, water level measurements were obtained from a monitoring well at 5-minute intervals until drawdown stabilization was achieved. Field parameters (i.e., pH, specific conductance, dissolved oxygen, and turbidity) were also monitored at 5-minute intervals

during this period. Field parameter readings were obtained by attaching a continuously-flowing pump discharge line to a flow-through cell equipped with an electronic multiprobe sonde to determine pH, specific conductance, and dissolved oxygen. Readings from the probes were recorded on a multimeter (e.g., YSI multiparameter meter or equivalent), which were then entered on the Monitoring Well Sample Purging Form. Turbidity measurements were obtained using a turbidometric glass cell that was filled with groundwater directly exiting the pump discharge tubing, which was placed in a portable turbidity meter (e.g., Hach 2100Q or equivalent).

Once drawdown stabilization was achieved, field parameter stabilization was verified by three successive field parameter measurements at 3-minute intervals. Field parameters were recorded on the Monitoring Well Sample Purging Form. Field parameter stabilization guidelines are summarized in Table 2-3.

TABLE 2-3
FIELD PARAMETER STABILIZATION GUIDELINES

| Field Parameter | Stabilization Guideline |
|------------------------|---|
| pH | ± 0.1 standard unit of the previous pH measurement |
| Specific Conductance | ± 5% of previous measurement |
| Turbidity | ± 10% of previous measurement when turbidity is above 10 Nephelometer Turbidity Units (NTU) ±1 NTU with respect to previous measurement when turbidity is below 10 NTU |
| Dissolved Oxygen (DO) | ± 1 milligrams per liter (mg/L) when DO is greater than 1 mg/L ± 0.1 mg/L when DO is less than 1 mg/L |

Some of the Site wells sampled did not reach stabilization within 3 feet of drawdown during the initial well performance evaluation testing completed in September 2010. The potential existed that a well could be dewatered, or continuously drawdown even at the lowest practically

attainable pumping rate (approximately 80 to 90 mL/min) as a result of slow recharge from the formation. Therefore, these wells potentially required a set of field parameter measurements after a minimum of one volume of the sample tubing was purged prior to obtaining a grab sample from the well.

After the stabilization or grab sample guidelines were achieved, unfiltered groundwater samples were obtained directly from the pump discharge line by flow into appropriately pre-preserved containers supplied by the analytical laboratory. Samples were stored in iced coolers for transport to the analytical laboratory. Monitoring wells were secured and locked after the groundwater samples were obtained, and the field instrumentation cleaned with a deionized water rinse. Documentation for the field sampling activities is provided on Monitoring Well Sample Purging Forms in Appendix A.

2.3 Equipment Maintenance and Calibration

Field instruments were calibrated on at least a daily basis according to the manufacturer's instructions and the calibration information documented on the Field Instrument Calibration/Daily Operating Log included in Appendix A. Equipment maintenance (if required) was documented on SME's Monitoring Well Sample Purging Forms and calibration logs.

2.4 Sample Identification, Chain-of-Custody and Sample Tracking

A unique sample identification code was created for each groundwater sampling location prior to the sampling event for the purpose of sample tracking. The SME sample labels placed on the sample containers incorporated the sample identification codes. The sample identification code was entered on the field sampling forms and a Chain-of-Custody Record. These codes were used in the Site's water quality database to link laboratory data with the correct location and time of sampling.

The Chain-of-Custody Record was completed in the field by the sampling crew prior to the transport of samples to the laboratory. The Chain-of-Custody Record documented information on the date and time of sample collection, the sampler's signature, the number of containers of

each sample being shipped, and an itemization of the laboratory analyses requested for each sample along with any pertinent remarks deemed appropriate for the laboratory's benefit. The Chain-of-Custody Record was then signed each time physical possession of the samples changed, with the signatures of the person relinquishing and receiving the sample, as well as the time of exchange being indicated on the record.

2.5 Data Evaluation Review

Sample results were reviewed and validated to ensure that they were representative according to the guidelines in the U.S.EPA *National Functional Guidelines for Superfund Organic Methods*,² U.S.EPA *National Functional Guidelines for Inorganic Superfund Data Review*³ and U.S.EPA New England *Environmental Data Review Supplement*.⁴ Laboratory quality control (QC) data were evaluated in various laboratory samples, including: (1) method blanks, (2) laboratory control samples and laboratory control sample duplicates [LCS/LCSD], (3) matrix spikes and matrix spike duplicates [MS/MSD] (4) laboratory duplicates and (5) volatile organic compound (VOC) surrogate recoveries. The groundwater sampling process in the field was assessed with a field blank prepared at Landfill 5 with laboratory-supplied deionized water, and sample transport conditions with lab-supplied trip blanks. Sampling and analysis precision was evaluated in field duplicate samples collected at select well locations.

Analytical laboratory services for the Landfill 5 groundwater monitoring program were provided by Alpha Analytical (ALPHA) of Westborough, Massachusetts, a Maine Certified Laboratory. ALPHA evaluated detectable concentrations to their Method Detection Limits (MDL). Results between the MDL and the laboratory's Reporting Limits (RL) were qualified by ALPHA as estimated (J) values. ALPHA laboratory reports, which include case narratives, are contained in Appendix B. A summary of the validated data review by SME for the March and September 2017 semiannual detection monitoring rounds follows:

² U.S.EPA, 2016. *National Functional Guidelines for Superfund Organic Methods Data Review*, Office of Superfund Remediation and Technology Innovation, U.S.EPA-540-R-2016-002; Washington, DC; September 2016.

³ U.S.EPA, 2016. *National Functional Guidelines for Inorganic Superfund Data Review*, Office of Superfund Remediation and Technology Innovation, U.S.EPA-540-R-2016-001; Washington, DC; September 2016.

⁴ U.S.EPA New England, 2013; *Environmental Data Review Supplement*, Quality Assurance Unit, U.S.EPA New England; April 22, 2013.

March 2017

- No analytes were detected in method blanks associated with metals (mercury, iron, manganese, and sodium), inorganics (chloride and sulfate), phenolics, total organic carbon (TOC), and TOX.
- Sodium was detected in a field blank at an estimated concentration greater than the MDL, but less than the laboratory's RL, indicating a potential for high bias in the associated samples. Concentrations of sodium in groundwater samples were greater than the RL. The associated samples were qualified (B) to indicate the potential for an indeterminate amount of analytical error associated with the result.
- TOC was detected in a field blank at concentrations between the laboratory's MDL and RL. Sample TOC results greater than the MDL, but less than the RL (B-307-B1 and B-307-B2) were qualified as not detected (U) at the RL. TOC results greater than the RL (B-304-B1 and the duplicate) were qualified (B) to indicate the potential for an indeterminate amount of analytical error associated with the result.
- LCS acceptance criteria were met for metals, inorganics, phenolics, TOC, and TOX.
- MS/MSD acceptance criteria were met for metals, inorganics, phenolics, TOC, and TOX.
- The field duplicate pair for B-304-B1 was within acceptable RPD criterion for metals, inorganics, phenolics, TOC, and TOX.

September 2017

- No analytes were detected in method blanks associated with metals (mercury, iron, manganese, and sodium), inorganics (chloride and sulfate), phenolics, TOC, and TOX.
- Sodium was detected in a field blank at an estimated concentration greater than the MDL, but less than the laboratory's RL, indicating a potential for high bias in the associated samples. Concentrations of sodium in groundwater samples were

greater than the RL. The associated samples were qualified (B) to indicate the potential for an indeterminate amount of analytical error associated with the result.

- Manganese was detected in a field blank at an estimated concentration greater than the MDL, but less than the laboratory's RL, indicating a potential for high bias in the associated samples. Concentrations of manganese in groundwater samples were less than and greater than the RL. Manganese detections less than the RL (B-307-B1 and B-307-B2) were qualified as not detected (U) at RL (0.01 mg/L). Concentrations equal to or exceeding the RL (B-304-B1) were qualified (B) to indicate the potential for an indeterminate amount of analytical error associated with the result.
- Total organic carbon (TOC) was detected in a field blank at concentrations between the laboratory's MDL and RL. Sample results greater than the MDL, but less than the RL (B-307-B1 and B-307-B2) were qualified as not detected (U) at the RL. Groundwater samples with TOC results greater than the RL (B-304-B1) were qualified (B) to indicate the potential for an indeterminate amount of analytical error associated with the result.
- LCS acceptance criteria were met for metals, inorganics, phenolics, TOC, and TOX.
- MS/MSD acceptance criteria were met for metals, inorganics, phenolics, TOC, and TOX.
- The field duplicate pair for B-304-B1 was within acceptable RPD criteria for metals, inorganics, phenolics, TOC, and TOX.

2.6 Groundwater Quality Results

Monitoring wells in the Landfill 5 Detection Monitoring Program were analyzed by ALPHA for metals (mercury, iron, manganese, and sodium), inorganics (sulfate and chloride), phenols, and indicator parameters (TOX, TOC, pH, and specific conductance). Parameter values (dissolved oxygen, turbidity, oxidation-reduction potential and water temperature) were also obtained in the field during low-flow purging when wells were sampled. The field-measured parameters are contained in Appendix A. ALPHA laboratory analytical reports are provided in Appendix B.

Laboratory analytical and field sampling (specific conductance and pH) results for the semiannual Detection Monitoring Program are summarized in Tables 2-4 and 2-5. Groundwater samples were obtained from three detection monitoring wells; i.e., B-304-B1, B-307-B2 and B-307-B2, along with a duplicate and field blank during March and September 2017 sampling rounds. Detection monitoring wells B-304-O1, B-306-B3, and B-307-O1 were either dry or had an insufficient amount of water in the semiannual sampling rounds, which prevented groundwater samples from being obtained.

Groundwater quality results from detection monitoring were compared to the Site's Media Protection Standards (MPS). If there was not an MPS established for an analytical parameter, the Maine Maximum Exposure Guideline (MEG) was referenced. The Maine MEG serves as a guidance level for drinking water and is not regulatory standard. If an analytical parameter did not have an MPS or an MEG, then a Federal Secondary Maximum Contaminant Level (SMCL) was referenced. Like the MEG, the SMCL is not an enforceable standard; rather, it addresses drinking water aesthetics (taste, color, and odor) that apply to a limited group of water quality parameters.

The non-parametric Mann-Kendall trend analysis test was performed to assess if there were statistically significant trends in water quality parameter concentrations over the last five-year period of monitoring (March 2013 through December 2017). A false positive or Type 1 error at $\alpha = 0.05$ was selected (i.e., 95 confidence level) for the Mann-Kendall trend testing. A statistically significant trend (upward or downward) was identified when the Mann-Kendall trend analysis resulted in a Type I error of less than 0.05. A non-parametric Theil-Sen slope line was plotted on the Mann-Kendall trend graphs to provide an estimate of temporal trend over the last five-year period. Mann-Kendall trend graphs are provided in Appendix C.

TABLE 2-4
METALS, INORGANICS AND PHENOL RESULTS
DETECTION MONITORING PROGRAM

| Well | Sample Date | Detection Monitoring Parameters (mg/L) | | | | | | |
|-------------|-------------|--|---------------|----------------------|------------------|----------------------|---------------------|------------------|
| | | Mercury 0.002 MPS | Iron 5 MEG | Manganese 0.5 MPS | Sodium 20 MEG | Chloride 250 SMCL | Sulfate 250 SMCL | Phenols 2 MEG |
| B-304-B1 | 03/21/17 | < 0.0002 | < 0.05 | 0.015 | 76 B | 68 | 17 | 0.013 J |
| | Duplicate | < 0.0002 | < 0.05 | 0.013 | 75 B | 72 | 17 | 0.018 J |
| | 09/11/17 | < 0.0002 | < 0.05 | 0.019 B | 71.7 B | 74 | 19 | < 0.03 |
| B-304-O1 | Duplicate | < 0.0002 | < 0.05 | 0.02 B | 70.1 B | 74 | 19 | < 0.03 |
| | 03/21/17 | I | I | I | I | I | I | I |
| B-306-B3 | 09/11/17 | I | I | I | I | I | I | I |
| | 03/21/17 | I | I | I | I | I | I | I |
| B-307-B1 | 09/11/17 | D | D | D | D | D | D | D |
| | 03/21/17 | < 0.0002 | < 0.05 | < 0.01 | 14 B | 2.6 | 27 | < 0.03 |
| | 09/11/17 | < 0.0002 | < 0.05 | 0.01 U | 12.9 B | 2.6 | 28 | < 0.03 |
| B-307-B2 | 03/21/17 | < 0.0002 | < 0.05 | < 0.005 | 9.2 B | 2.5 | 14 | < 0.03 |
| | 09/11/17 | < 0.0002 | < 0.05 | 0.01 U | 6.79 B | 2.8 | 14 | < 0.03 |
| B-307-O1 | 03/21/17 | I | I | I | I | I | I | I |
| | 09/11/17 | D | D | D | D | D | D | D |
| Field Blank | 03/21/17 | < 0.0002 | < 0.05 | < 0.01 | 0.21 J | < 0.5 | < 1 | < 0.03 |
| | 09/11/17 | < 0.0002 | < 0.05 | 0.002 J | 0.366 J | < 0.5 | < 1 | < 0.03 |

Abbreviations:

B – Sample result greater than the Reporting Limit, parameter detected in an associated blank between the Reporting Limit and the Method Detection Limit indicating an indeterminate amount of error potentially impacting the sample result

D – The sampling location was dry

I – Sampling location yielded insufficient quantity to obtain a sample

J – Estimated value detected at a concentration less than the Reporting Limit, but above the Method Detection Limit

U – Qualified as not detected due to presence of analyte in associated method blank/field blank

< – Not detected above the specified Reporting Limit

mg/L – milligrams per liter

MEG – Maximum Exposure Guideline (Maine)

MPS – Media Protection Standard

SMCL – Secondary Maximum Contaminant Level

TABLE 2-5
SUMMARY OF INDICATOR PARAMETER RESULTS
DETECTION MONITORING PROGRAM

| Well | Replicate No. | Total Organic Halogens (µg/L) | | Total Organic Carbon (mg/L) | | pH (su) | | Specific Conductance (µS/cm) | |
|--------------------|---------------|----------------------------------|-----------------|--------------------------------|-----------------|-----------------|-----------------|---------------------------------|-----------------|
| | | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 |
| B-304-B1 | 1 | 11.4 J | < 30 | 0.63 B | 0.68 B | 7.84 | 7.51 | 598 | 624 |
| | 2 | 10.4 J | 10.8 J | 0.61 B | 0.63 B | 7.75 | 7.43 | 599 | 624 |
| | 3 | 10.6 J | < 30 | 0.62 B | 0.63 B | 7.76 | 7.41 | 598 | 625 |
| | 4 | < 30 | < 30 | 0.63 B | 0.62 B | 7.75 | 7.42 | 600 | 625 |
| B-304-B1 Duplicate | 1 | 13.9 J | < 30 | 0.63 B | 1.10 B | NA | NA | NA | NA |
| | 2 | < 30 | < 30 | 0.60 B | 0.70 B | NA | NA | NA | NA |
| | 3 | < 30 | 12.2 J | 0.60 B | 0.61 B | NA | NA | NA | NA |
| | 4 | Y | < 30 | 0.62 B | 0.60 B | NA | NA | NA | NA |
| B-304-O1 | 1 | I | I | I | I | I | I | I | I |
| | 2 | I | I | I | I | I | I | I | I |
| | 3 | I | I | I | I | I | I | I | I |
| | 4 | I | I | I | I | I | I | I | I |
| B-306-B3 | 1 | I | D | I | D | I | D | I | D |
| | 2 | I | D | I | D | I | D | I | D |
| | 3 | I | D | I | D | I | D | I | D |
| | 4 | I | D | I | D | I | D | I | D |

TABLE 2-5 (cont'd)

| Well | Replicate No. | Total Organic Halogens (µg/L) | | Total Organic Carbon (mg/L) | | pH (su) | | Specific Conductance (µS/cm) | |
|--------------------|---------------|-------------------------------|--------------|-----------------------------|--------------|--------------|--------------|------------------------------|--------------|
| | | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 | Mar 21, 2017 | Sep 11, 2017 |
| B-307-B1 | 1 | < 30 | < 30 | 0.50 U | 0.50 U | 7.87 | 7.77 | 261 | 253 |
| | 2 | < 30 | < 30 | 0.50 U | 0.50 U | 7.93 | 7.63 | 260 | 253 |
| | 3 | < 30 | < 30 | 0.50 U | 0.50 U | 7.95 | 7.60 | 260 | 251 |
| | 4 | < 30 | < 30 | 0.50 U | 0.50 U | 7.98 | 7.61 | 259 | 251 |
| B-307-B2 | 1 | < 30 | < 30 | 0.50 U | 0.50 U | 8.38 | 8.33 | 212 | 185 |
| | 2 | < 30 | < 30 | 0.50 U | 0.50 U | 8.42 | 8.46 | 216 | 186 |
| | 3 | < 30 | < 30 | 0.50 U | 0.50 U | 8.45 | 8.47 | 215 | 186 |
| | 4 | < 30 | < 30 | 0.50 U | 0.50 U | 8.45 | 8.47 | 216 | 186 |
| B-307-O1 | 1 | I | D | I | D | I | D | I | D |
| | 2 | I | D | I | D | I | D | I | D |
| | 3 | I | D | I | D | I | D | I | D |
| | 4 | I | D | I | D | I | D | I | D |
| Field Blank (FB-3) | 1 | < 30 | < 30 | 0.38 J | 0.25 J | NA | NA | NA | NA |
| | 2 | < 30 | < 30 | 0.41 J | 0.26 J | NA | NA | NA | NA |
| | 3 | < 30 | < 30 | 0.46 J | 0.24 J | NA | NA | NA | NA |
| | 4 | Y | < 30 | 0.43 J | 0.23 J | NA | NA | NA | NA |

Abbreviations:

B – Sample result greater than the Reporting Limit, parameter detected in an associated blank
 D – Sampling location was dry
 I – Sampling location yielded insufficient quantity to obtain a sample
 J – Estimated value greater than the Method Detection Limit but less than the Reporting Limit
 U – Qualified as not detected; result less than the reporting limit, parameter detected in associated blank
 Y – Sample bottle broken in transit to laboratory

µg/L - micrograms per liter
 µS/cm – microsiemens per centimeter
 mg/L – milligrams per liter
 NA – Not analyzed
 su – Standard units
 < – Not detected above the specified Reporting Limit

2.6.1 Metals, Inorganics and Phenols. The sampling referenced in 40 CFR § 265.92 that applies to groundwater monitoring at Landfill 5 specifies that sodium, manganese, iron, chloride, sulfate and phenols be analyzed at least annually to evaluate groundwater quality. In addition, groundwater samples from the Landfill 5 wells were also analyzed for mercury, a metal associated with plant operations at the Site until the facility was closed in 2000. These parameter results are summarized in Table 2-4.

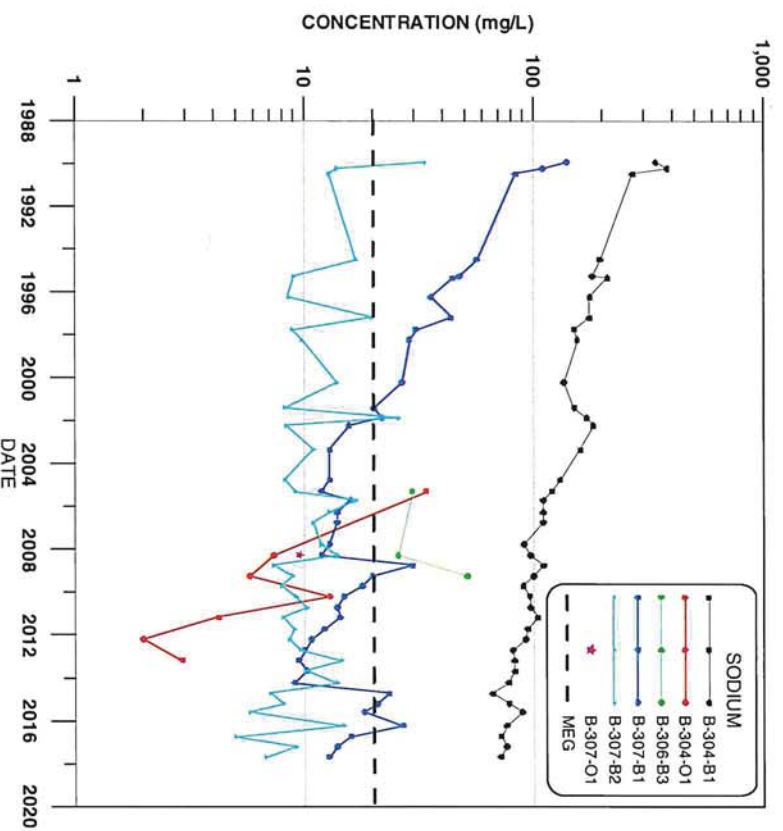
Mercury (RL of 0.0002 milligrams per liter [mg/L]) was not detected in the detection monitoring wells sampled at Landfill 5 during 2017, which was consistent with the groundwater quality results in past years of monitoring. The available historical water quality record dating back to 1995 listed infrequent detections at the limit of quantitation (0.0002 to 0.0004 mg/L) or estimated values near the MDL, which were less than the mercury MPS of 0.002 mg/L.

Sodium concentrations in the three detection monitoring wells sampled ranged between 6.79 to 76 mg/L, values very similar to last year's semiannual results. The Maine MEG for sodium (20 mg/L), an advisory concentration guideline for drinking water, was exceeded in B-304-B1 (72 and 76 mg/L) during both semiannual sampling rounds. Monitoring well B-304-B1 is located between Landfill 4 and Landfill 5 (see Figure 1-3). Although sodium detections in B-304-B1 have exceeded the Maine MEG over the historical sampling record, concentrations have gradually decreased as shown in Figure 2-1. Sodium concentrations in B-307-B1 and B-307-B2 were both less than the Maine MEG during 2017 monitoring. Since 2002, B-307-B1 has experienced occasional sodium concentrations slightly above the Maine MEG, while detections in MW-307-B2 have been less than the Maine MEG over the same period of time. No significant trend in the sodium concentration was identified over the last 5-year period of monitoring in the three wells (see Appendix C).

Manganese detections during 2017 semiannual monitoring were less than the MPS of 0.5 mg/L, and were limited to B304-B1 (0.013 to 0.02 mg/L). Manganese was not detected in B-307-B1 and B-307-B2, with results from the September 2017 round qualified as non-detect because of trace estimated concentrations present in the associated field blank. The historical sampling record indicated that detections of manganese in MW-304-B1, B-307-B1 or B-307-B2 have been significantly less than the Site MPS and Maine's MEG of 0.3 mg/L. There was no

statistical evidence of a significant upward trend in the manganese concentration over the last five years of the sampling record.

FIGURE 2-1
SODIUM CONCENTRATIONS
IN DETECTION MONITORING WELLS



Iron was not detected in monitoring wells MW-304-B1, B-307-B1, or B-307-B2 during the 2017 semiannual sampling rounds. Historically, iron detections among these three wells are relatively low and less than the Maine MEG of 5 mg/L when the parameter was present. There was no statistical evidence of a significant trend in the iron concentration over the last five years of the sampling record. Chloride concentrations in the Landfill 5 detection monitoring wells during 2017 semiannual monitoring ranged from 2.5 to 74 mg/L. Well B-304-B1 contained the highest concentrations (68 to 74 mg/L) of chloride. Less than 3 mg/L of chloride was detected in MW-307-B1 and MW-307-B2, which has been typical over most of the historical record. The concentration of chloride in B-304-B1 and B-307-B2 has gradually increased over the last few

years, which resulted in a statistically significant upward trend over the last five years of monitoring. However, the chloride concentrations in these three wells were considerably lower than the Federal SMCL of 250 mg/L. No Site MPS or Maine MEG exists for chloride.

Sulfate detections in B-304-B1, MW-307-B1 and MW-307-B2 have generally varied within a relatively narrow range of concentration over the Site history of monitoring at Landfill 5. Concentrations of sulfate among these three wells in 2017 were detected between 14 to 28 mg/L, compared to the Federal SMCL of 250 mg/L. Although sulfate concentrations have been relatively stable, a statistically significant downward trend was identified in B-307-B2 in the last 5-year period of monitoring.

Detected or estimated concentrations of total recoverable phenolics were limited to monitoring well B-304-B1 in the March 2017 semiannual sampling round, where an estimated concentration (0.013 and 0.018 mg/L [duplicate]) less than the RL (0.03 mg/L) was detected. The concentration of total recoverable phenolics was less than the Maine MEG of 2 mg/L. An evaluation of trend in the total recoverable phenolic results can lead to erroneous conclusions because of multiple FLS provided by different laboratories. Laboratory FLS of 0.005 mg/L (2013 to March 2015) and 0.03 mg/L (August 2015 through 2017) were reported over the last 5-year period used for the Mann-Kendall trend testing. Except for one detection of phenol (0.005 mg/L) in B-304-B1 during March 2015, the subsequent detections after March 2015 occurred as estimated values between ALPHA's RL 0.03 mg/L and the MDL of 0.01 mg/L. To evaluate total recoverable phenolics by the Mann-Kendall test, all non-detect values were replaced with ALPHA's MDL (0.01 mg/L). No statistically significant trend in the total recoverable phenolics was indicated. Another method to handle multiple FLS is to set all non-detects to a common value less than the lowest detection.⁵

2.6.2 Indicator Parameters. Replicate samples (four per well location) for analysis of TOX, TOC, pH and specific conductance were obtained during the March and September 2017 detection monitoring rounds (see Table 2-5). These parameter concentrations were used in the

⁵ U.S.EPA, 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance)*, Office of Resource Conservation and Recovery Implementation and Information Division, EPA/530/R-09-007, March 2009.

Mann-Kendall trend test to evaluate whether statistically significant differences existed between the upgradient background wells (B-303-series) and groundwater in the downgradient detection monitoring wells (B-304-B1, B-307-B1 and B-307-B2). Detection monitoring wells B-304-O1, B-306-B3, and B-307-B3 were either dry or had an insufficient amount of groundwater during March and September 2017 to obtain representative samples for the statistical testing.

TOX replicate results comprised estimated detections between the MDL and RL, as well as non-detects less than the RL (30 µg/L) in the downgradient well B-304-B1 sample and its duplicate during the 2017 semiannual sampling rounds. A non-detect at the RL was replaced with the MDL concentration of 10 µg/L and the replicates averaged to determine the TOX concentration for the sample location. The estimated TOX concentration over the semiannual sampling rounds ranged between 10.2 to 11.3 µg/L. TOX was not detected in B-307-B1 and B-307-B2 during either of the semiannual sampling rounds in 2017. The statistical evidence was not sufficient to conclude if a significant trend in TOX concentration occurred over the last five-year period of detection monitoring.

Downgradient detection monitoring wells contained detectable TOC at concentrations greater than the RL (0.5 mg/L) in B-304-B1 and between the RL and the MDL in B-307-B1 and B-307-B2. The TOC data were qualified due to its presence in the associated field blanks in March and September 2017. The averaged replicate concentrations of TOC in B-304-B1 varied between 0.61 and 0.75 mg/L over the semiannual sampling rounds, but were qualified (B) to indicate an indeterminate amount of potential sampling or laboratory error associated with the result. The averaged replicate concentrations in B-307-B1 and B-307-B2 were qualified as non-detects at the RL in both semiannual sampling rounds. As observed in previous years, TOC has typically been reported as not detected to trace concentrations near or less than the laboratory RL. TOC concentrations in the downgradient detection monitoring wells did not exhibit a statistically significant upward trend over the last five years.

Field personnel obtained replicate readings of pH and specific conductance from detection monitoring wells around Landfill 5. The pH in B-304-B1 over the two semiannual sampling rounds averaged approximately 7.6. Groundwater in monitoring wells B-307-B1 and B-307-B2 averaged a pH of about 7.8 and 8.4 over both rounds of sampling, respectively. The pH in

B-307-B1 has exhibited a consistent gradual decrease in the pH since September 2014, and sufficient evidence to support a statistically significant decreasing trend. No significant trends in pH were found in B-304-B1 or B-307-B2.

The average specific conductance over the semiannual sampling rounds in B-304-B1 (612 microsiemens per centimeter [$\mu\text{S}/\text{cm}$]) was typical to the values measured since 2010. The average specific conductance in B-307-B1 (256 $\mu\text{S}/\text{cm}$) and B-307-B2 (200 $\mu\text{S}/\text{cm}$) did not vary far from the mean value calculated over the historical record for these two wells. No statistically significant trend in specific conductance was identified in B-304-B1, B-307-B1 and B-307-B2 over the last 5-year period.

2.7 Statistical Analyses

Regulations for evaluating groundwater in background and downgradient wells in detection monitoring are discussed in 40 CFR § 265.93(b). Guidance for the statistical evaluation is contained in U.S.EPA's *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document*.⁶ Additional information is also available in U.S.EPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (Unified Guidance).⁵ These documents were referenced for the statistical methods used to assess the groundwater quality at Landfill 5. A group of indicator parameters was evaluated using the averaged replicate t-Test to determine if the groundwater quality downgradient of Landfill 5 differed significantly (at an overall significance level at one percent) from the background values associated with upgradient groundwater. The critical value for the t-Test statistic for both the 2017 March and September semiannual sampling rounds was derived from a Bonferroni adjustment based on twelve comparisons (three detection monitoring wells tested for four indicator parameters: TOC, TOX, pH, and specific conductance) to control the overall site-wide false positive rate at a one percent level of significance.

⁶ U.S.EPA, 1986. *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document*, Office of Solid Waste and Emergency Response, EPA/530/SW-86/055; September 1986.

2.7.1 Background Groundwater Quality Characterization. Background indicator parameters were obtained for the upgradient-to-downgradient interwell statistical comparisons of groundwater quality in the Detection Monitoring Program at Landfill 5. The original Acheron (1991) backwater indicator parameters statistics were re-evaluated by SME and updated in 2013 to reflect the recent natural groundwater condition after statistically significant differences were identified. Summary statistics calculated from the updated background characterization were used to generate the background statistics for the averaged replicate t-T test. The statistics from the 2013 update of the background groundwater indicator parameters are shown in Table 2-6.

TABLE 2-6
SUMMARY OF BACKGROUND STATISTICS – INDICATOR PARAMETERS
DETECTION MONITORING PROGRAM

| Summary Statistic | TOC (mg/L) | TOX (µg/L) | pH (su) | Specific Conductance (µS/cm) |
|--|------------|------------|---------|------------------------------|
| Mean | 0.89 | 9.88 | 6.85 | 165 |
| Variance | 0.35 | 26.2 | 0.16 | 716 |
| Standard Deviation | 0.59 | 5.1 | 0.40 | 26.8 |
| Coefficient of Variation | 0.66 | 0.52 | 0.06 | 0.16 |
| Abbreviations: µg/L - micrograms per liter µS/cm - microsiemens per centimeter mg/L - milligrams per liter su - standard units TOC - total organic carbon TOX - total organic halogens | | | | |

2.7.2 Statistical Evaluation of the March 2017 Data. Groundwater samples were obtained from three downgradient detection monitoring wells located beyond the footprint of Landfill 5: B-304-B1, B-307-B1, and B-307-B2. The remaining three detection monitoring wells were either dry or did not have a sufficient amount of groundwater in the well to obtain a representative sample. Summary statistics calculated from the averaged indicator parameter replicate samples were compiled in Table 2-7.

TABLE 2-7
SUMMARY STATISTICS
MARCH 2017
DETECTION MONITORING PROGRAM

| Well | Location | Indicator Parameter | Number of Replicates | Proportion < DL | Mean | Variance | Standard Deviation | Coefficient of Variation |
|-------------------------|--------------|---------------------|----------------------|-----------------|-------|----------|--------------------|--------------------------|
| B-304-B1 | Downgradient | TOX | 4 | 1.0 | 10.6 | 0.35 | 0.59 | 5.6 |
| | | TOC | 4 | 0 | 0.62 | 0.0001 | 0.03 | 1.5 |
| | | pH | 4 | 0 | 7.78 | 0.002 | 0.04 | 0.01 |
| | | SC | 4 | 0 | 599 | 0.9 | 1.0 | 0.002 |
| B-304-O1 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |
| B-306-B3 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |
| B-307-B1 | Downgradient | TOX | 4 | 1.0 | < 10 | 0 | 0 | 0 |
| | | TOC | 4 | 1.0 | < 0.5 | 0 | 0 | 0 |
| | | pH | 4 | 0 | 7.93 | 0.002 | 0.05 | 0.01 |
| | | SC | 4 | 0 | 260 | 0.7 | 0.8 | 0.003 |
| B-307-B2 | Downgradient | TOX | 4 | 1.0 | < 10 | 0 | 0 | 0 |
| | | TOC | 4 | 1.0 | < 0.5 | 0 | 0 | 0 |
| | | pH | 4 | 0 | 8.43 | 0.001 | 0.03 | 0.004 |
| | | SC | 4 | 0 | 215 | 3.6 | 1.9 | 0.009 |
| B-307-O1 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |

Note:
1. The well was dry or yielded insufficient quantity to obtain a groundwater sample.

Abbreviations:
SC - specific conductance (microsiemens per centimeter)
TOC - total organic carbon (milligrams per liter)
TOX - total organic halogens (micrograms per liter)
< DL - less than detection limit

Summary statistics were calculated for the statistical testing to determine if there were significant differences between the indicator parameter concentrations in the background groundwater upgradient of Landfill 5 compared to the groundwater along the downgradient margin of Landfill 5. The laboratory RL for the original 1991 and 2013 updated background statistic for TOX was 10 µg/L. However, laboratories certified by Maine for TOX analysis have provided RLs of 30 and 100 µg/L since the August 2015 semiannual detection monitoring round. To minimize the potential of falsely identifying a significant TOX concentration difference between the upgradient background wells and a downgradient detection monitoring well having an elevated RL compared to the background TOX statistic, the MDL value was substituted for a non-detect concentration consistent with the approach for 2015 Landfill 5 annual reporting. The laboratory's MDL for TOX in the March and September 2017 semiannual detection sampling rounds was 10 µg/L.

The averaged replicate t-Test results from the March 2017 sampling round are provided in Table 2-8. A statistically higher specific conductance that was significantly different from the background value was identified in downgradient monitoring wells B-304-B1 and B-307-B1. The specific conductance in B-304-B1 in the March 2017 semiannual sampling round averaged 599 µS/cm compared to the background concentration of 165 µS/cm. Monitoring well B-304-B1 has consistently had a higher specific conductance than the upgradient background wells based on the results from previous years of monitoring. The specific conductance in B-307-B1 typically has not been significantly different than the background value of 165 µS/cm. However, its averaged concentration of 260 µS/cm in the March 2017 semiannual sampling round was just high enough for the specific conductance in B-307-B1 to be statistically different from the background value. There was no statistical significant difference between the specific conductance in B-307-B2 and the upgradient background location. A graph of specific conductance over the historical water quality record for the downgradient wells monitored under the Detection Monitoring Program is shown in Figure 2-2. Historical specific conductance results from B-304-O1, B-306-B3 and B-307-O1 are included in Figure 2-2 for reference; however, the water quality data record for these three detection monitoring wells is sparse.

TABLE 2-8
AVERAGED REPLICATE t-TEST RESULTS
MARCH 2017 SAMPLING ROUND
DETECTION MONITORING PROGRAM

| Downgradient Well | Total Organic Halogens (µg/L) | | | | Total Organic Carbon (mg/L) | | | | pH (su) | | | | Specific Conductance (µS/cm) | | | |
|-----------------------------|-------------------------------|-------------------------|-------|-------------|-----------------------------|-------------------------|-------|-------------|-------------|-------------------------|-----------|-------------------|------------------------------|-------------------------|-------|-------------------|
| | \bar{X}_m | $\bar{X}_m - \bar{X}_b$ | t^* | $t^* - t_c$ | \bar{X}_m | $\bar{X}_m - \bar{X}_b$ | t^* | $t^* - t_c$ | \bar{X}_m | $\bar{X}_m - \bar{X}_b$ | $t^{(3)}$ | $t^* - t_c^{(4)}$ | \bar{X}_m | $\bar{X}_m - \bar{X}_b$ | t^* | $t^* - t_c^{(4)}$ |
| B-304-B1 | 10.6 | 0.72 | 0.14 | -3.34 | 0.62 | -0.27 | -0.44 | -4.27 | 7.78 | 0.93 | 2.23 | -1.93 | 599 | 434 | 15.9 | 12.5 |
| B-304-O1 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| B-306-B3 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| B-307-B1 | 10 | 0.12 | 0.02 | -3.46 | 0.5 | -0.39 | -0.65 | -4.47 | 7.93 | 1.08 | 2.61 | -1.55 | 260 | 95 | 3.5 | 0.03 |
| B-307-B2 | 10 | 0.12 | 0.02 | -3.46 | 0.5 | -0.39 | -0.65 | -4.47 | 8.43 | 1.58 | 3.80 | -0.4 | 215 | 50 | 1.8 | -1.6 |
| B-307-O1 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| $\bar{X}_b^{(2)}$ | 9.88 | | | | 0.89 | | | | 6.85 | | | | 165 | | | |
| $S_b^* [1 + (1/n_b)]^{1/2}$ | 5.21 | | | | 0.61 | | | | 0.42 | | | | 27.2 | | | |
| t_c | 3.479 | | | | 3.822 | | | | 4.163 | | | | 3.466 | | | |

Notes:

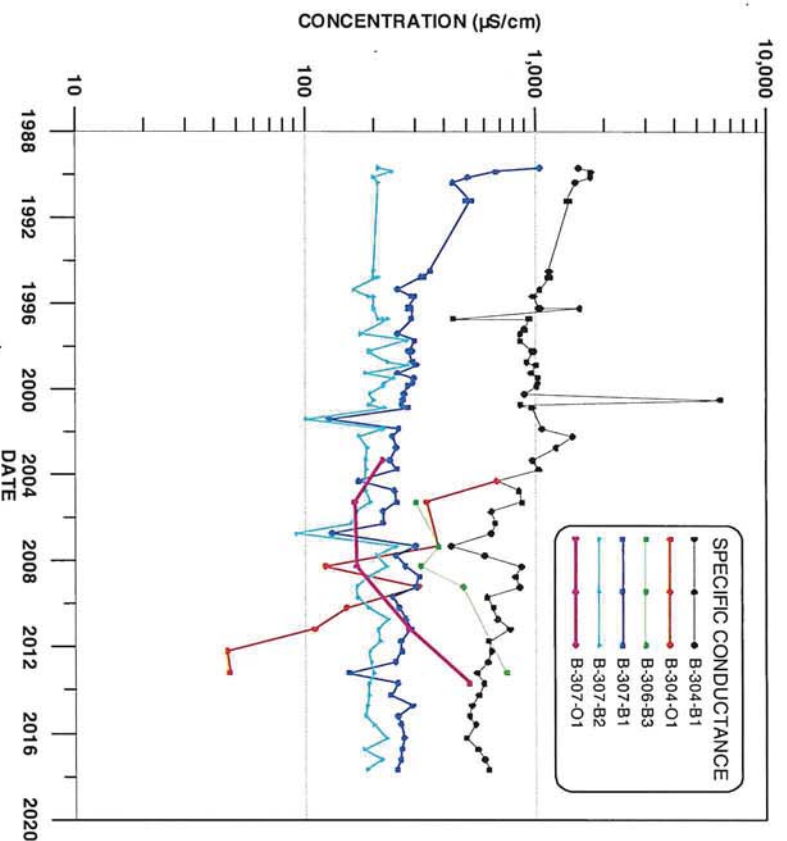
1. The well was dry or yielded insufficient quantity to obtain a sample.
2. Background well statistics for hypothesis testing updated in 2013.
3. Absolute value of t^* used to calculate $t^* - t_c$ for two-tailed hypothesis testing.
4. Bold red value for $t^* - t_c$ is a statistical exceedance for parameter at a downgradient well compared to background.

Abbreviations:

\bar{X}_m - mean of replicate samples
 \bar{X}_b - background mean
 t^* - averaged replicate test statistic for data ($t^* = \bar{X}_m - \bar{X}_b / S_b^* [1 + (1/n_b)]^{1/2}$)
 t_c - critical value based on 99% confidence, single tail for TOX, TOC, specific conductance;
two tail for pH
 S_b^* - background standard deviation

nb - number of averaged replicates in the background data set
µg/L – micrograms per liter
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
su - standard units

FIGURE 2-2
SPECIFIC CONDUCTANCE
IN DETECTION MONITORING WELLS



The averaged pH replicates among the three detection monitoring wells were not statistically different from the background value during the March 2017 semiannual round. Groundwater in wells B-304-B1, B-307-B1, and B-307-B2 had pH values of 7.78, 7.93, and 8.43, respectively, compared to the background pH of 6.85. The pH B-307-B1 continued its 3.5-year decreasing trend after an anomalous pH of 10 occurred in March of 2014 (see Mann-Kendall plots in Appendix C).

TOX and TOC were detected in the averaged replicates from B-304-B1 at concentrations that were not statistically different from their respective upgradient background values. TOX was not detected in B-307-B1 and in B-307-B2. TOC replicate samples in B-307-B1 and B-307-B2 were qualified as non-detected at the RL because of field blank contamination. The lack of TOX and

TOC detections around Landfill 5 is consistent with the detection monitoring history in past years.

2.7.3 Statistical Evaluation of the September 2017 Data. Three wells were sampled for the Detection Monitoring Program in September 2017: B-304-B1, B-307-B1, and B-307-B2. Shallow wells B-304-O1, B-306-B3, and B-307-B1 were dry during the September 2017 semiannual sampling round, which precluded groundwater samples from being obtained from these locations. Summary statistics for the September 2017 semiannual groundwater sampling round are compiled in Table 2-9. The results of the averaged replicate t-Test are summarized in Table 2-10.

The September 2017 statistical t-Testing indicated that the specific conductance in B-304-B1 was significantly greater than the upgradient background mean (165 µS/cm) as it has been in past sampling rounds. The specific conductance in B-304-B1 (625 µS/cm) had increased during the 6-month interval between the semiannual sampling rounds. The specific conductance in B-307-B1 was slightly lower (252 µS/cm) compared to the March 2017 sampling round (260 µS/cm), which was enough of a decrease so that the groundwater in B-307-B1 was statistically no different than the background value. The specific conductance in monitoring well B-307-B2 (186 µS/cm) was not significantly different from the background groundwater, consistent with the March 2017 statistical testing.

The statistical t-Testing for pH in the downgradient Landfill 5 wells yielded the same conclusion as in the March 2017 semiannual sampling round; i.e., no significant difference between the pH in B-304-B1 (7.44), B-307-B1 (7.65), and B-307-B2 (8.43) and the background pH. The pH in B-304-B1 and B-307-B decreased between the 2017 semiannual sampling rounds, while the pH in B-307-B2 was essentially the same in both rounds.

The TOX and TOC groundwater data and t-Testing for the 2017 September semiannual round mirrored the results and statistical conclusions from the 2017 March sampling round. Estimated detections of TOX (10.2 µg/L) and TOC (0.64 mg/L) in the averaged replicates from B-304-B1 were not statistically different from their background values. No TOX was detected in B-307-B1 and in B-307-B2 and TOC replicate samples were qualified as non-detected at the RL because

TABLE 2-9
SUMMARY STATISTICS
SEPTEMBER 2017
DETECTION MONITORING PROGRAM

| Well | Location | Parameter | Number of Replicates | Proportion < DL | Mean | Variance | Standard Deviation | Coefficient of Variation |
|-------------------------|--------------|-----------|----------------------|-----------------|-------|----------|--------------------|--------------------------|
| B-304-B1 | Downgradient | TOX | 4 | 1.0 | 10.2 | 0.16 | 0.40 | 3.9 |
| | | TOC | 4 | 0 | 0.64 | 0.001 | 0.027 | 4.2 |
| | | pH | 4 | 0 | 7.44 | 0.002 | 0.046 | 0.61 |
| | | SC | 4 | 0 | 625 | 0.3 | 0.6 | 0.1 |
| B-304-O1 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |
| B-306-B3 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |
| B-307-B1 | Downgradient | TOX | 4 | 1.0 | < 10 | 0 | 0 | 0 |
| | | TOC | 4 | 1.0 | < 0.5 | 0 | 0 | 0 |
| | | pH | 4 | 0 | 7.65 | 0.0063 | 0.079 | 1.04 |
| | | SC | 4 | 0 | 252 | 1.3 | 1.2 | 0.5 |
| B-307-B2 | Downgradient | TOX | 4 | 1.0 | < 10 | 0 | 0 | 0 |
| | | TOC | 4 | 1.0 | < 0.5 | 0 | 0 | 0 |
| | | pH | 4 | 0 | 8.43 | 0.005 | 0.068 | 0.81 |
| | | SC | 4 | 0 | 186 | 0.25 | 0.5 | 0.3 |
| B-307-O1 ⁽¹⁾ | Downgradient | TOX | 0 | -- | -- | -- | -- | -- |
| | | TOC | 0 | -- | -- | -- | -- | -- |
| | | pH | 0 | -- | -- | -- | -- | -- |
| | | SC | 0 | -- | -- | -- | -- | -- |

Notes:
1. The well was dry or yielded insufficient quantity to obtain a groundwater sample.

Abbreviations:
SC - specific conductance (microsiemens per centimeter)
TOC - total organic carbon (milligrams per liter)
TOX - total organic halogens (micrograms per liter)
< DL - less than detection limit

TABLE 2-10
AVERAGED REPLICATE t-TEST RESULTS
SEPTEMBER 2017 SAMPLING ROUND
DETECTION MONITORING PROGRAM

| Well | Total Organic Halogens (mg/L) | | | | Total Organic Carbon (mg/L) | | | | pH (su) | | | | Specific Conductance (µS/cm) | | | |
|-----------------------------|-------------------------------|-------------|-------|-------------|-----------------------------|-------------|-------|-------------|---------|-------------|-----------|-------------|------------------------------|-------------|-------|-------------------|
| | X_m | $X_m - X_b$ | t^* | $t^* - t_c$ | X_m | $X_m - X_b$ | t^* | $t^* - t_c$ | X_m | $X_m - X_b$ | $t^{(b)}$ | $t^* - t_c$ | X_m | $X_m - X_b$ | t^* | $t^* - t_c^{(a)}$ |
| B-304-B1 | 10.2 | 0.32 | 0.06 | -3.42 | 0.64 | -0.25 | -0.42 | -4.24 | 7.44 | 0.59 | 1.43 | -2.74 | 625 | 460 | 16.9 | 13.4 |
| B-304-O1 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| B-306-B3 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| B-307-B1 | 10 | 0.12 | 0.02 | -3.46 | 0.5 | -0.39 | -0.65 | -4.47 | 7.65 | 0.80 | 1.93 | -2.23 | 252 | 87 | 3.2 | -0.3 |
| B-307-B2 | 10 | 0.12 | 0.02 | -3.46 | 0.5 | -0.39 | -0.65 | -4.47 | 8.43 | 1.58 | 3.81 | -0.35 | 186 | 21 | 0.8 | -2.7 |
| B-307-O1 ⁽¹⁾ | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| $X_b^{(2)}$ | 9.88 | | | | 0.89 | 0.86 | | | 6.85 | | | | 165 | | | |
| $S_b^* [1 + (1/n_b)]^{1/2}$ | 5.21 | | | | 0.608 | 0.567 | | | 0.415 | | | | 27.2 | | | |
| t_c | 3.479 | | | | 3.822 | 3.963 | | | 4.163 | | | | 3.466 | | | |

Notes:

1. The well was dry or yielded insufficient quantity to obtain a sample.
2. Background well statistics for hypothesis testing updated in 2013.
3. Absolute value of t^* used to calculate $t^* - t_c$ for two-tailed hypothesis testing.
4. Bold red value for $t^* - t_c$ is a statistical exceedance for parameter at a downgradient well compared to background.

Abbreviations:

X_m - mean of replicate samples
 X_b - background mean
 t^* - averaged replicate test statistic for data ($t^* = X_m - X_b / S_b^* [1 + (1/n_b)]^{1/2}$)
 t_c - critical value based on 99% confidence, single tail for TOX, TOC, specific conductance;
two tail for pH
 S_b^* - background standard deviation

nb - number of averaged replicates in the background data set
µg/L - micrograms per liter
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
su - standard units

of field blank contamination. TOX and TOC have been relatively stable over several years of monitoring with no indication of upward trend in concentration.

2.8 Piezometric Data Analysis

Groundwater level measurements were obtained on a quarterly frequency (March, June, September, and December) in 2017 from the detection and assessment monitoring wells around Landfill 5 to fulfill requirements in 40 CFR § 265.93(f). Groundwater elevations calculated from these measurements are summarized in Table 2-11. The four background wells (B-303-series) had higher static heads and were hydraulically upgradient of Landfill 5 compared to the downgradient wells located near the margin of the landfill. Artesian flow existed in upgradient background wells B-303-B1 and B-303-B2 during the March and June 2017 quarterly sampling rounds. The artesian conditions confirmed an upward vertical hydraulic gradient from the bedrock flow system in proximity to Landfill 5.

The seasonal groundwater high around Landfill 5 was measured during the March sampling round in 2017. Occasionally, the seasonal high groundwater has occurred during the December sampling quarter in previous years. The seasonal groundwater low for most of the Landfill 5 area wells was recorded in the September sampling round. The groundwater elevation fluctuated approximately 2 to 7.5 feet among the wells between the seasonal groundwater high and low. The maximum static head difference in the water table between upgradient well B-303-O1 and the downgradient well locations during the seasonal groundwater high was 21.7 feet in B-304-O1, resulting in a horizontal hydraulic gradient in the order of 0.06 sloping in a westerly direction across Landfill 5. The slope of the horizontal hydraulic gradient decreased to a value of approximately 0.05 during the seasonal groundwater low period.

TABLE 2-11
GROUNDWATER ELEVATIONS
LANDFILL 5 MONITORING WELLS

| Hydraulic Location | Well | Monitoring Point Elevation ⁽¹⁾ (ft NAVD) | Depth to Groundwater (ft btmp) ⁽²⁾ | | | | Groundwater Elevation (ft NAVD) | | | |
|--------------------|----------|--|--|-----------------|-----------------|-----------------|------------------------------------|-----------------|-----------------|-----------------|
| | | | Mar 20-21 2017 | Jun 19, 2017 | Sep 11, 2017 | Dec 11, 2017 | Mar 20-21 2017 | Jun 19, 2017 | Sep 11, 2017 | Dec 11, 2017 |
| Upgradient | B-303-B1 | 106.48 | -2.76 | -2.20 | 1.71 | 4.50 | 109.24 | 108.68 | 104.77 | 101.98 |
| | B-303-B2 | 106.28 | 2.62 | 2.72 | 3.01 | 4.56 | 103.66 | 103.56 | 103.27 | 101.72 |
| | B-303-B3 | 106.21 | 7.51 | 8.85 | 12.08 | 10.22 | 98.70 | 97.36 | 94.13 | 95.99 |
| | B-303-O1 | 106.35 | 5.71 | 7.80 | D | D | 100.64 | 98.55 | < 98.55 | < 98.55 |
| Downgradient | B-304-B1 | 88.64 | 7.70 | 8.32 | 10.81 | 9.65 | 81.22 | 80.60 | 78.11 | 79.27 |
| | B-304-O1 | 88.48 | 9.48 | 9.47 | 9.51 | 9.57 | 78.94 | 78.95 | 78.91 | 78.85 |
| | B-306-B1 | 94.84 | 15.80 | 16.85 | 20.10 | 18.83 | 79.04 | 77.99 | 74.74 | 76.01 |
| | B-306-B2 | 94.83 | 13.16 | 15.26 | 16.90 | 16.75 | 81.67 | 79.57 | 77.93 | 78.08 |
| | B-306-B3 | 94.86 | 13.16 | D | D | D | 81.70 | < 81.2 | < 81.2 | < 81.2 |
| | B-307-B1 | 91.62 | 9.55 | 12.05 | 17.05 | 15.19 | 82.07 | 79.57 | 74.57 | 76.43 |
| | B-307-B2 | 91.62 | 9.85 | 11.95 | 16.90 | 14.97 | 81.77 | 79.67 | 74.72 | 76.65 |
| | B-307-O1 | 91.69 | 8.75 | D | D | 9.04 | 82.94 | < 82.67 | < 82.67 | 82.65 |

Notes:

1. Monitoring point elevations based upon a field survey completed on October 19 and 20, 2010. Elevations referenced to M.D.O.T. Benchmark BOB-15-V published elevation of 132.615 (NAVD 1988).
2. Depth to water measurement in B-303-B1 and B-303-B2 is feet above the top of monitoring point when value is preceded with a minus sign.

Abbreviations:

- D - The sampling location was dry
ft btmp - feet below top of monitoring point elevation (well riser or casing)
ft NAVD - feet North American Vertical Datum

3.0 ASSESSMENT MONITORING PROGRAM

The 2017 quarterly Assessment Monitoring Program referenced in 40 CFR § 265.93(d) is discussed in this section of the Landfill 5 annual report.

3.1 2017 Sampling Program

Monitoring wells B-303-B1, B-303-B2, B-303-B3, B-303-O1 (collectively B-303-series), B-306-B1, and B-306-B2 shown in Figure 1-3 comprised the Assessment Monitoring Program. The B-303-series of background wells is located to the east upgradient of Landfill 5. With the exception of the first quarterly sampling round in March 2017, B-303-O1 was not sampled because the well was either dry or lacked a sufficient amount of groundwater to obtain a representative sample. The B-306 wells are positioned just beyond the western downgradient margin of Landfill 5 in the area near to Landfill 4. Quarterly assessment monitoring was conducted during March, June, September, and December of 2017. Groundwater samples obtained for the Landfill 5 Assessment Monitoring Program were analyzed for mercury and VOCs, and indicator parameters for pH and specific conductance. The Assessment Monitoring Program is summarized in Table 3-1, and the analytical methods provided in Table 3-2.

3.2 Sampling Procedures and Documentation

Sampling, sample handling, and documentation were conducted consistent with U.S.EPA and MEDEP-approved protocols. Refer to Section 2.2 through 2.4 for a summary of the groundwater sampling procedures and documentation. The field documentation for the quarterly sampling rounds is provided in Appendix A.

TABLE 3-1
ASSESSMENT MONITORING PROGRAM

| Date | Event | Monitoring Wells | Sample Parameters |
|--------------------|---------------------------------|---|---|
| March 20, 2017 | Quarterly assessment monitoring | B-303-B1/B2/B3/O1 B-306-B1/B2 | VOCs, mercury (unfiltered), pH, specific conductance |
| June 19, 2017 | Quarterly assessment monitoring | B-303-B1/B2/B3/O1 ⁽¹⁾ B-306-B1/B2 | VOCs, mercury(unfiltered), pH, specific conductance |
| September 11, 2017 | Quarterly assessment monitoring | B-303-B1/B2/B3/O1 ⁽¹⁾ B-306-B1/B2 | VOCs, mercury (unfiltered), pH, specific conductance |
| December 11, 2017 | Quarterly assessment monitoring | B-303-B1/B2/B3/O1 ⁽¹⁾ B-306-B1/B2 | VOCs, mercury (unfiltered), pH, specific conductance |

Note:
1. Monitoring well B-303-O1 was either dry or yielded an insufficient quantity of groundwater to obtain a sample during June, September and December of 2017.

3.3 Data Evaluation Review

Laboratory and field QC data from the Assessment Monitoring Program were evaluated as described in Section 2.5 to ensure the results were representative of the Site groundwater quality. Results not considered representative of Site groundwater quality were qualified on the data summary tables. A review of the data quality for the 2017 assessment monitoring yielded the following results by quarterly round:

March 2017

- Bromomethane was detected at an estimated concentration less than the laboratory's RL in a VOC method blank, trip blank, and field blank. The concentrations of bromomethane in the trip blank and field blank were qualified as not detected (U) at the RL (1 µg/L). Mercury was not detected in the method blank.

TABLE 3-2
PARAMETERS AND ANALYTICAL METHODS
ASSESSMENT MONITORING PROGRAM

| Date | Parameter ⁽¹⁾ | Analytical Method ⁽²⁾ | Method Detection Limits |
|--------------------|--------------------------|----------------------------------|---------------------------------|
| March 20, 2017 | VOCs | Method 8260C | 0.07 to 1.9 µg/L ⁽³⁾ |
| | Mercury | Method 7470A | 0.00006 mg/L |
| | pH | Method 9040 | --- |
| | Specific conductance | Method 9050 | --- |
| June 19, 2017 | VOCs | Method 8260C | 0.07 to 1.9 µg/L ⁽³⁾ |
| | Mercury | Method 7470A | 0.00006 mg/L |
| | pH | Method 9040 | --- |
| | Specific conductance | Method 9050 | --- |
| September 11, 2017 | VOCs | Method 8260C | 0.07 to 1.9 µg/L ⁽³⁾ |
| | Mercury | Method 7470A | 0.00006 mg/L |
| | pH | Method 9040 | --- |
| | Specific conductance | Method 9050 | --- |
| December 11, 2017 | VOCs | Method 8260C | 0.07 to 1.9 µg/L ⁽³⁾ |
| | Mercury | Method 7470A | 0.00006 mg/L |
| | pH | Method 9040 | --- |
| | Specific conductance | Method 9050 | --- |

Notes:

1. Specific conductance and pH were measured in the field.
2. *Test Methods of Evaluating Solid Wastes*. EPA Publication SW-846, July 1986, 3rd Edition, Updates I-V, 2007.
3. *Methods for Chemical Analysis of Water and Wastes*. EPA 600/4-79-020, revised March 1983. *Standard Methods for the Examination of Water and Wastewater*. APHA-AWWA-WPCF, 18 Edition, 1992.
4. *Methods for the Determination of Inorganic Substances in Environmental Samples*. EPA/600/R-93/100, August 1993.

Abbreviations:

µg/L - microgram per liter
mg/L – milligrams per liter
VOCs - volatile organic compounds

- Bromomethane was also detected at an estimated concentration less than the laboratory's RL in samples obtained from B-303-B1 and a duplicate from B-306-B1. These two results were qualified as not detected (U) at the RL (1 µg/L) based on the bromomethane in the associated method blank.
- LCS/LCSD acceptance criteria were met for mercury and VOCs, with the exception of trans-1,2-dichloroethene (trans-1,2-DCE), which exceeded the RPD

limit of 20%. Trans-1,2-DCE was not detected in the associated sample batch; therefore, the trans-1,2-DCE result was qualified as an estimated value (UJ) at the RL.

- MS/MSD acceptance criteria were met for mercury.
- Surrogate recoveries for VOC analysis were within the acceptance criteria.
- The field duplicate pair for B-306-B1 was within acceptable RPD criteria for mercury and VOCs.

June 2017

- Analytes were not detected in the method blanks (mercury and VOCs), trip blank or field blank.
- Bromomethane and chloroethane in the LCS/LCSDs were outside the laboratory's acceptance criteria for percent recovery indicating a potential for high bias. These two analytes were not detected in the associated SDG, and therefore no data qualification was required. LCS acceptance criteria were met for mercury.
- MS/MSD acceptance criteria were attained for mercury. Percent recoveries in the MS and/or MSD for carbon tetrachloride, bromomethane and chloroethane exceeded the laboratory's acceptance criteria indicating a potential for high bias. These three compounds were not detected in the native sample, and therefore no data qualification was required.
- An MS percent recovery of naphthalene less than the lower acceptance limit, indicating a potential low bias, was qualified as an estimated (UJ) result in the native sample.
- Surrogate recoveries for VOC analysis were within the acceptance criteria.
- Field duplicate acceptance criteria in B-303-B1 for mercury and VOCs were achieved.

September 2017

- Analytes were not detected in method blanks (mercury and VOCs), trip blank or in the associated field blank.
- An RPD limit (20%) in an LCS/LCSD exceeded the laboratory's acceptance criteria for 1,2,3-trichlorobenzene, indicating a potential non-directional bias in the associated sample group. 1,2,3-trichlorobenzene was not detected in the associated samples; therefore, results affected by the non-compliant LCS/LCSD were qualified as estimated (UJ). LCS acceptance criteria were met for mercury.
- Acceptance criteria for the B-303-B1 field duplicate were satisfied.
- Surrogate recoveries for VOC analyses were within the acceptance criteria.

December 2017

- Method blanks (mercury and VOCs), except for bromomethane at an estimated concentration (0.26 J µg/L), did not contain detectable analytes. Bromomethane was not detected in the associated samples so no data qualification was necessary. The trip blank and the field blank did not contain detectable analytes.
- LCS/LCSD recoveries associated with the SDG exceeded the upper acceptance criteria for acetone, 2-butanone, tetrahydrofuran and tert-butyl alcohol indicating a potential high bias. There were no detections of these four compounds in the SDG; therefore, no qualification of the sample results was necessary.
- MS/MSD recoveries and/or RPDs associated with native sample B-303-B1 exceeded the upper acceptance criteria for acetone, bromomethane, 2-butanone, chloromethane, tetrahydrofuran and tert-butyl alcohol indicating a potential high bias. None of these compounds were detected in B-303-B1; therefore, results for the native sample did not need to be qualified.
- Acceptance criteria for the B-303-B1 field duplicate were satisfied.
- Surrogate recoveries for VOC analysis were within the acceptance criteria.

3.4 Discussion of Results

Laboratory results from the quarterly sampling rounds are summarized in Tables 3-3 and 3-4 in the following subsections. The analytical laboratory reports are included in Appendix B.

3.4.1 Mercury and Field-Measured Parameters. Mercury was not detected in the upgradient Landfill 5 background wells (B-303-series) or in the downgradient assessment monitoring wells B-306-B1 and B-306-B2 during any of the quarterly sampling rounds in 2017. Historically, infrequent detections of mercury near or at the limit of quantitation (e.g., 0.0002 to 0.0004 mg/L), or estimated concentrations approaching the MDL, characterized the water quality around Landfill 5. The last known exceedance of the mercury MPS around Landfill 5 occurred in upgradient background well B-303-B1 over 16 years ago.

Specific conductance in the B-303 upgradient background wells averaged from 155 to 165 $\mu\text{S/cm}$ over the quarterly sampling rounds in 2017. Well B-303-O1 could only be sampled during the March 2017 round, and had a specific conductance of 157 $\mu\text{S/cm}$. An insufficient water level (June 2017) or lack of water in the well (September and December 2017) prevented B-303-O1 from being sampled during three of the sampling quarters. The specific conductance values were not that different than the historical means for the B-303-series wells going back nearly 20 years. There was no statistical evidence of a significant trend in specific conductance in the background wells over the last 5-year period of groundwater monitoring.

Downgradient monitoring wells B-306-B1 and in B-306-B2 are positioned between the western margin of Landfill 5 and the eastern boundary of Landfill 4 and are likely influenced by groundwater flow emanating from Landfill 4. The specific conductance in wells B-306-B1 and B-306-B2 averaged 1,943 and 1,542 $\mu\text{S/cm}$ over the four quarters of 2017, respectively, in contrast to the upgradient background of 165 $\mu\text{S/cm}$. There was no statistical evidence of a significant trend in the specific conductance in wells B-306-B1 and B-306-B2 over the last five-year period of monitoring.

TABLE 3-3
MERCURY AND FIELD PARAMETER RESULTS
ASSESSMENT MONITORING PROGRAM

| Monitoring Well | March 20, 2017 | | | | June 19, 2017 | | | |
|-----------------|----------------------------------|------------|---------------|---------------|----------------------------------|------------|---------------|---------------|
| | Mercury ⁽¹⁾ (mg/L) | pH (su) | SC (µS/cm) | Temp. (°C) | Mercury ⁽¹⁾ (mg/L) | pH (su) | SC (µS/cm) | Temp. (°C) |
| B-303-B1 | < 0.0002 | 7.82 | 160 | 7.9 | < 0.0002 | 7.27 | 146 | 12.7 |
| B-303-B1 DUP | NS | NS | NS | NS | < 0.0002 | NS | NS | NS |
| B-303-B2 | < 0.0002 | 8.02 | 172 | 7.9 | < 0.0002 | 8.04 | 154 | 13.0 |
| B-303-B3 | < 0.0002 | 7.89 | 146 | 6.1 | < 0.0002 | 7.52 | 143 | 13.8 |
| B-303-O1 | < 0.0002 | 8.18 | 157 | 7.2 | I | I | I | I |
| B-306-B1 | < 0.0002 | 7.68 | 1,943 | 7.9 | < 0.0002 | 8.52 | 1,801 | 15.9 |
| B-306-B1 DUP | < 0.0002 | NS | NS | NS | NS | NS | NS | NS |
| B-306-B2 | < 0.0002 | 7.86 | 1,463 | 6.8 | < 0.0002 | 7.16 | 1,076 | 12.2 |
| Field Blank | < 0.0002 | NA | NA | NA | < 0.0002 | NA | NA | NA |
| Monitoring Well | September 11, 2017 | | | | December 11, 2017 | | | |
| | Mercury ⁽¹⁾ (mg/L) | pH (su) | SC (µS/cm) | Temp. (°C) | Mercury ⁽¹⁾ (mg/L) | pH (su) | SC (µS/cm) | Temp. (°C) |
| B-303-B1 | < 0.0002 | 7.69 | 147 | 13.0 | < 0.0002 | 7.83 | 175 | 7.3 |
| B-303-B1 DUP | NS | NS | NS | NS | < 0.0002 | NS | NS | NS |
| B-303-B2 | < 0.0002 | 8.15 | 152 | 13.2 | < 0.0002 | 8.08 | 168 | 7.7 |
| B-303-B3 | < 0.0002 | 7.84 | 150 | 13.9 | < 0.0002 | 8.05 | 211 | 7.3 |
| B-303-O1 | D | D | D | D | D | D | D | D |
| B-306-B1 | < 0.0002 | 8.35 | 2,046 | 14.8 | < 0.0002 | 8.14 | 1,980 | 9.0 |
| B-306-B1 DUP | < 0.0002 | NS | NS | NS | NS | NS | NS | NS |
| B-306-B2 | < 0.0002 | 6.97 | 1,794 | 15.1 | < 0.0002 | 7.04 | 1,836 | 8.3 |
| Field Blank | < 0.0002 | NA | NA | NA | < 0.0002 | NA | NA | NA |

Note:

1. Unfiltered sample for mercury analysis.

Abbreviations:

D - The sampling location was dry
I - Sampling location yielded insufficient quantity to obtain a sample
mg/L - milligrams per liter
µS/cm - microsiemens per centimeter
NA - not analyzed
NS – not sampled
SC - specific conductance
su - standard units
Temp (C) – water temperature in degrees Celsius

TABLE 3-4
VOLATILE ORGANIC COMPOUND DETECTIONS
ASSESSMENT MONITORING PROGRAM

| Well | March 20, 2017 | | June 19, 2017 | | September 11, 2017 | | December 11, 2017 | |
|----------------|----------------------|-----------------------------------|----------------------|-----------------------------------|----------------------|-----------------------------------|----------------------|-----------------------------------|
| | Chloroform (µg/L) | Carbon Tetrachloride (µg/L) | Chloroform (µg/L) | Carbon Tetrachloride (µg/L) | Chloroform (µg/L) | Carbon Tetrachloride (µg/L) | Chloroform (µg/L) | Carbon Tetrachloride (µg/L) |
| | 57 ⁽¹⁾ | 3 ⁽¹⁾ | 57 ⁽¹⁾ | 3 ⁽¹⁾ | 57 ⁽¹⁾ | 3 ⁽¹⁾ | 57 ⁽¹⁾ | 3 ⁽¹⁾ |
| B-303-B1 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 |
| B-303-B1(Dup) | NS | NS | < 0.75 | < 0.5 | NS | NS | < 0.75 | < 0.5 |
| B-303-B2 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 |
| B-303-B3 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 |
| B-303-O1 | < 0.75 | < 0.5 | I | I | D | D | D | D |
| B-306-B1 | 0.86 | < 0.5 | 0.83 | < 0.5 | 1.1 | < 0.5 | 1.2 | < 0.5 |
| B-306-B1 (Dup) | 0.89 | < 0.5 | NS | NS | 1.2 | < 0.5 | NS | NS |
| B-306-B2 | 0.67 J | < 0.5 | 0.68 J | < 0.5 | 0.65 J | < 0.5 | 0.69 J | < 0.5 |
| Field Blank | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 |
| Trip Blank | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 | < 0.75 | < 0.5 |

Note:

1. Media Protection Standard

Abbreviations:

D – The sampling location was dry

I - Sampling location yielded insufficient quantity to obtain a sample

J – Estimated value; parameter detected at a concentration less than the Reporting Limit, but greater than the Method Detection Limit.

µg/L - micrograms per liter

< - not detected above the specified Reporting Limit

The pH in upgradient background wells B-303-B1, B-303-B2 and B-303-B3 averaged from 7.65 to 8.1 over the quarterly sampling rounds in 2017. Well B-303-O1 could only be sampled during the March 2017 round, with the groundwater having a pH of 8.18. The pH in background wells B-303-B2 and B-303-B3 exhibited a statistically significant upward trend in 2017, which extended the upward trend observed in 2016. Downgradient wells B-306-B1 and B-306-B2 averaged pHs of 8.17 and 7.26, respectively. The pH of the deeper groundwater in downgradient well B-306-B1 was more alkaline than the shallower groundwater in B-306-B2, consistent with previous years of monitoring. A statistically significant downward trend in pH over the last five-year period of monitoring was associated with B-306-B1.

3.4.2 Volatile Organic Compounds. Groundwater samples obtained from the Assessment Monitoring Program were analyzed for VOCs. VOCs were not detected with Method 8260C in the upgradient background B-303 well cluster during the quarterly groundwater sampling in 2017. A detection of bromomethane in B-303-B1 at a concentration between the MDL and RL was reported by the analytical laboratory in the March 2017 sampling round. Bromomethane was also detected in the associated method blank, trip blank and field blank. Therefore, the bromomethane detection in B-303-B1 was qualified as not detected.

Chloroform was detected in each of the 2017 quarterly sampling rounds in monitoring wells B-306-B1 and B-306-B2. Concentrations ranged between estimated values of 0.65 µg/L to 1.2 µg/L. The Site MPS for chloroform is 57 µg/L, which has never been exceeded in B-306-B1 or B-306-B2. Sporadic detections of carbon tetrachloride have occurred in the past at concentrations usually less than the RL in these two wells; however, carbon tetrachloride was not detected in either monitoring well during 2017. It has been more than 15 years since the MPS for carbon tetrachloride (3 µg/L) has been exceeded in B-306-B1 or B-306-B2. Graphs of the carbon tetrachloride and chloroform concentrations in B-306-B1 and B-306-B2 over time are shown in Figures 3-1 and 3-2, respectively.

FIGURE 3-1

CARBON TETRACHLORIDE AND CHLOROFORM TRENDS
IN WELL B-306-B1

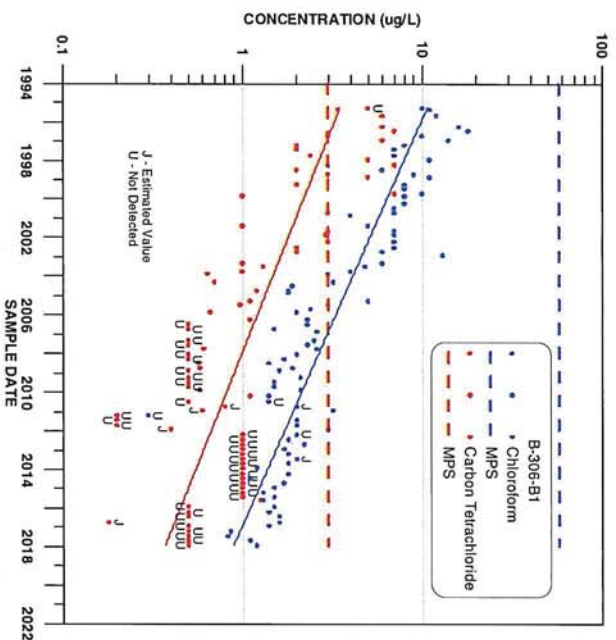
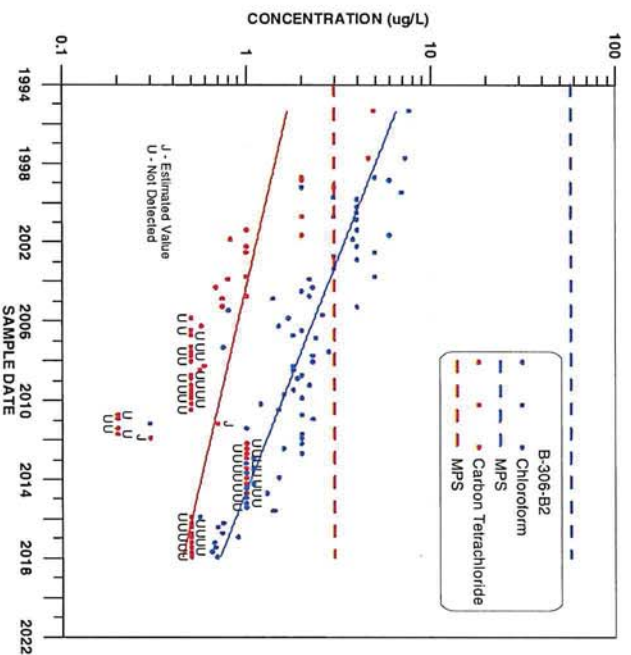


FIGURE 3-2

CARBON TETRACHLORIDE AND CHLOROFORM TRENDS
IN WELL B-306-B2



4.0 SUMMARY

Semiannual detection monitoring and quarterly assessment monitoring programs, as referenced in 40 CFR § 265.90 through 94, were conducted during 2017 at Landfill 5 at the Orrington Remediation Site, a regulated unit under RCRA. The group of wells monitored under these programs was evaluated to determine if there was statistical evidence of significant differences (99 percent confidence level) between groundwater quality downgradient of Landfill 5 compared to the upgradient background condition. A trend analysis was also conducted to evaluate potential changes in detection and assessment monitoring parameter concentrations over the last five years of groundwater sampling around Landfill 5.

The averaged replicate t-Test statistical analysis of the indicator parameters (specific conductance, pH, TOX, and TOC) from the 2017 semiannual detection monitoring yielded the following conclusions about the groundwater quality around Landfill 5:

- Statistically higher specific conductance in downgradient well B-304-B1 (March and September 2017) compared to the upgradient background wells; although, no statistical evidence of an increasing trend in specific conductance.
- Statistically higher specific conductance in downgradient well B-307-B1 (March 2017) compared to the upgradient background wells; although, no statistical evidence of an increasing trend in specific conductance.
- No significant difference between the pH in groundwater from the downgradient detection monitoring wells and the upgradient background wells.
- No significant difference between the TOX concentration in groundwater from the downgradient detection monitoring wells and the upgradient background wells.
- No significant difference between the TOC concentration in groundwater from the downgradient detection monitoring wells and the upgradient background wells.

Groundwater samples were obtained semiannually from downgradient Landfill 5 detection monitoring wells for analysis of seven water quality parameters in 2017. Mercury was not detected (i.e., less than 0.0002 mg/L) in the groundwater around Landfill 5. Sodium concentrations exceeded the Maine MEG drinking water guidance level of 20 mg/L in B-304-B1

(70 to 76 mg/L), values similar to the historical sampling record. Manganese detections in B-304-B1 were less than the Site's MPS of 0.5 mg/L. Concentrations of chloride (2.5 to 74 mg/L) and sulfate (14 to 28 mg/L) in groundwater were less than the Federal SMCL guideline of 250 mg/L. Estimated detections of iron (0.013 J to 0.018 J mg/L) less than the RL were present in B-304-B1. Total recoverable phenolics were not detected (i.e., less than 0.03 mg/L) in the detection monitoring wells.

The Landfill 5 Assessment Monitoring Program comprised quarterly groundwater sampling for mercury and VOCs. Mercury was not detected (i.e., less than 0.0002 mg/L) in the assessment monitoring wells. Chloroform was detected in B-306-B1 and B-306-B2 at concentrations less than 2 µg/L that were less than the Site MPS of 57 µg/L. No other VOCs were detected in the assessment monitoring wells during 2017.

Mann-Kendall trend testing (95 percent confidence interval) of Detection and Assessment Monitoring Program parameter concentrations over the last five years (2013 through 2017) of groundwater sampling identified statistical evidence of trends in groundwater quality:

- A statistically significant increasing trend in the pH in upgradient background wells B-303-B2 and B-303-B3, and a decreasing trend in downgradient wells B-306-B1 and B-307- B1. The pH was within the Federal SMCL guidelines.
- A statistically significant increasing trend in the concentration of chloride in downgradient wells B-304-B1, and B-307-B2; however, concentrations remain well below the Federal SMCL.
- A statistically significant decreasing trend in the sulfate concentration in downgradient well B-307-B2; with concentrations remaining well below the Federal SMCL.

The Landfill 5 detection and assessment monitoring of groundwater will continue as required in 2018 at semiannual and quarterly sampling frequencies, respectively.