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June 1, 2018

Mr. Chris Swain
Maine Department of Environmental Protection
17 State House Station
Augusta, Maine 04333-0017

Subject: 1st Quarter 2018 Short-Term Comprehensive Monitoring Plan Data Report
Orrington Remediation Site, Orrington, Maine

Dear Mr. Swain:

Results from monitoring conducted in the first quarter of 2018 at the Orrington Remediation Site (Site) are provided in this letter report. Samples of groundwater, surface water, and sediment were obtained according to the February 24, 2017 Short-Term Comprehensive Monitoring Plan (CMP). Sampling locations included in the Short-Term CMP are shown on Figure 1.

Sampling in the first quarter 2018 was conducted to satisfy the following monitoring programs:

- Interim Extraction System (IES) Monitoring;
- Landfill 5 Groundwater Monitoring Program;
- Short-Term Remediation Monitoring; and
- Site Perimeter Monitoring.

Sampling was conducted during the weeks of February 19, March 12, and March 19, 2018. Samples were sent via courier to Alpha Analytical Laboratory (Alpha) of Westborourgh, Massachusetts, for analysis of parameters according to the Short-Term CMP and described further in the sections below.

Analytical results were quantified to the laboratory's method detection limit (MDL). Concentrations detected between the MDL and the laboratory's reporting limit (RL) were qualified by Alpha as estimated (J) values. According to the Data Validation Protocol agreed on between Mallinckrodt and MEDEP on January 29, 2018, final laboratory analytical reports and electronic data deliverables (EDDs) containing unvalidated data were submitted to Maine Department of Environmental Protection (MEDEP) on March 3, May 4, May 7, and May 29, 2018.

SME conducted quality control review of the laboratory analytical data. Data review reports are provided in Attachment 1.

IES MONITORING

Operations and Maintenance

Groundwater extraction rates from the five extraction wells that comprise the IES have generally been stable since established at the current nominal extraction rates in June 2015, as reported in monthly and quarterly reports in 2015, 2016, and 2017. The four northern extraction wells each operate at a nominal flow rate of 6 gallons per minute (gpm), and the southernmost extraction well, EW-3, operates at a nominal flow rate of 4 gpm. Flow rates vary based on the pressure in the extraction system, which includes the treatment train in the Groundwater Treatment Plan (GWTP), and are modified as needed on a weekly basis by adjusting the individual potentiometers.

Following pump testing and extraction system performance testing conducted in November and December 2017 (reported to MEDEP on March 28, 2018), the testing pump was removed and the extraction pump was replaced in EW-3, and the system was returned to routine operation on December 13, 2017. As discussed via telephone and email with MEDEP (including email correspondence on March 10, 2018), the in-line flowmeters that had been in operation since the IES was installed experienced intermittent operation issues. Following completion of the pump and performance testing, the five in-line flowmeters were not working and routine maintenance did not resolve the issue. The flowmeters were replaced during the week of February 5, 2018.

Following replacement of the flowmeters, the pump in EW-3 appeared to be working harder than the flow would suggest. After some troubleshooting testing, the pump and potentiometer for EW-3 were replaced on February 9, 2018. An email providing a summary update of the extraction system was sent to MEDEP on March 10, 2018.

Water Level Elevations

Water level elevations at and surrounding the five extraction wells comprising the IES are recorded hourly by data logging pressure transducers. Pressure transducer graphs from individual monitoring points are provided in Attachment 2 and transducer data are provided in Attachment 3. Average groundwater elevations are shown on Figure 2 along with the interpreted groundwater surface in the area immediately surrounding the IES. To remove the effects of tidal variations to groundwater levels, the average water levels recorded over a three-day period between February 17 and 19, 2018 were used to construct the contours shown on Figure 2. Average water level elevations during this period indicate drawdown of up to 0.5 feet at the extraction wells and hydraulic capture of groundwater extending beyond EW-1 and EW-3. Figure 2 illustrates that the IES is successful in capturing mercury in the groundwater emanating from the Landfill 1 area and upgradient.

Laboratory Analytical Data

Quarterly monitoring of IES extraction wells and the Groundwater Treatment Plant (GWTP) Influent was conducted according to the Short-Term CMP on March 12, 2018. Monitoring parameters are provided in Table 1.

TABLE 1

INTERIM EXTRACTION SYSTEM MONITORING

Monitoring Locations	Monitoring Frequency	Sample Parameters	Sampling Date
Extraction Wells EW-1, EW-2, EW-3, EW-4, and MW-601	Quarterly	Total mercury, chloropicrin, chloride	March 12, 2018
GWTP Influent	Quarterly	Total mercury, chloropicrin, MPS VOCs, chloride, alkalinity, iron, manganese, and sodium	March 12, 2018

A summary of analytical results is provided in Table 2. Analytical results from March 2018 sampling indicate mercury, chloropicrin, and chloride concentrations are within the range of historical detections, with the exception of chloropicrin in EW-2 and the GWTP Influent. The detected concentration of 20,900 micrograms per liter (µg/L; 23,900 µg/L duplicate) from EW-2 is above the previously-detected maximum concentration of 19,200 µg/L. The detected concentration of chloropicrin from the GWTP Influent is higher than previously detected in quarterly monitoring. VOC concentrations in the GWTP sample are within historical ranges or below MPS. Detected concentrations of mercury and chloropicrin over time in the five IES wells are shown on Figure 3. Summary tables of field parameters and laboratory analytical data are provided in Attachment 4. Field sampling documentation is also provided in Attachment 4.

TABLE 2

LABORATORY ANALYTICAL DATA SUMMARY – MARCH 12, 2018

Parameter	Analytical Method	EW-1	EW-2	EW-3	EW-4	MW-601	GWTP Influent
Mercury (µg/L)	7470	37.1	6.78	5.88	51.6	66.2	30.5
Chloropicrin (µg/L)	8011	35	20,900	10,200	11,400	1,250	10,400
Chloride (mg/L)	E300	200	430	320	440	290	330
Nominal Pumping Rate (gpm)	-	5.5	5	4	5.5	5	25

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LANDFILL 5 MONITORING

Landfill 5 Detection and Assessment monitoring was conducted according to the Short-Term CMP during the week of March 19, 2018. A summary of the Landfill 5 monitoring programs is provided in Table 3. Data have been submitted electronically to MEDEP as noted above. Laboratory analytical results are generally consistent with recent monitoring results with detected concentrations within the historical range of detections. Attachment 5 provides summary data tables of field parameters and laboratory analytical data, and field sampling documentation.

TABLE 3

LANDFILL 5 MONITORING PROGRAMS

Program	Frequency	Monitoring Wells	Sample Parameters
Detection Monitoring	Semiannual (Quarters 1 and 3)(2)	B-304-B1/O1(1) B-306-B3 (1) B-307-B1/B2 B-307-O1 (1)	Total organic halogens, total organic carbon, pH, specific conductance, temperature, iron, manganese, sodium, mercury, chloride, sulfate, phenols
Assessment Monitoring	Quarterly	B-303-B1/B2/B3/O1(1) B-306-B1/B2	VOCs, mercury (unfiltered), pH, specific conductance

Notes:
1. Monitoring wells B-304-O1, B-306-B3, B-307-O1, and B-303-O1 have historically either been dry or yielded an insufficient quantity of groundwater to obtain a groundwater sample.
2. Quarters 1 and 3 are for January through March and July through September, respectively.

REMEDIATION MONITORING

Mallinckrodt began remediation monitoring, according to the Short-Term CMP, in February 2017. Remediation monitoring during the first quarter 2018 included monthly monitoring in the vicinity of the Plant Area, and quarterly monitoring in the vicinity of the Southerly Stream, Landfill 2, and Plant Area remediation areas. A summary of these monitoring programs is provided in Table 4. Summary data tables and field sampling documentation for each remediation area are provided in Attachment 6.

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TABLE 4

REMEDIATION MONITORING PROGRAMS

Area	Media	Locations	Parameters	Frequency	Final Sample Date
Southerly Stream (southern)	Groundwater	B-321-B2, B327-O1, MW-504-O1/B1, MW-511-B2/B1, MW-702-O1/B2	Total Mercury	Quarterly	June 2018
	Water Level	B-321-O1/B1/B2, B-327-O1, MW-504-O1/B1, MW-505-B1/B2, MW-509-B1, MW-511-B1/B2, MW-702-O1/B1/B2, MW-703-B1/B2	N/A	Quarterly	June 2018
Landfill 2 and Southerly Stream (northern)	Groundwater	MW-409-O1/B1, MW-704-O1/O2, MW-705-O1, MW-706-O1/B1	Total Mercury, Carbon Tetrachloride	Quarterly	September 2018
	Water Level	B-301-O1/O2/B1, MW-409-O1/B1, MW-704-O1/O2, MW-705-O1, MW-706-O1/B1	N/A	Quarterly	September 2018
Plant Area	Groundwater	B-315-O1/O2/B1, B-316-O1/B1, B-327-O1, MW-403-O1/O2/B1, MW-509-B1, MW-701-O1/B1/B2	Total Mercury, Chloropicrin, MPS VOCs, MPS SVOCs	Quarterly	TBD
	Groundwater	Chlorate Building MH	Total Mercury, MPS VOCs	Monthly	
	Surface Water	SW15-6, SW15-7, SW15-10R		Monthly	
	Sediment	SD15-7, SD15-8, SD18-1	Total Mercury, Chloropicrin	Monthly	
	Water Level	B-315-O1/O2/B1, B-316-O1/B1, B-327-O1, MW-403-O1/O2/B1, MW-503-O1/B1, MW-509-B1, MW-701-O1/O2/B1/B2, MW-702-O1/B1/B2	N/A	Quarterly	

Southerly Stream

Groundwater sampling in the vicinity of the Southerly Stream remediation area was conducted during the week of March 12, 2018, in accordance with the Short-Term CMP. All analytical results are within the historical range of detections, and below MPS.

Surface water monitoring for the Southerly Stream area was completed during the fourth quarter of 2017. Quarterly monitoring of groundwater in the vicinity of the Southerly Stream will conclude in June 2018.

Landfill 2

Remediation monitoring in the vicinity of the Landfill 2 remediation area was conducted during the week of March 12, 2018, in accordance with the Short-Term CMP. First quarter 2018 groundwater analytical results are consistent with recent monitoring and below MPS.

Surface water, sediment, and monthly groundwater sampling for the Landfill 2 area was completed during the fourth quarter of 2017. Quarterly groundwater monitoring according to the Short-Term CMP will continue through September 2018.

Plant Area

Remediation monitoring in the vicinity of the Plant Area remediation area began in February 2018. The first surface water samples were collected on February 20, 2018. Monthly and quarterly sampling of groundwater, surface water, and sediment was conducted during the week of March 12, 2018, in general accordance with the Short-Term CMP. Exceptions to the Short-Term CMP are:

- Surface water monitoring location SW15-10 is no longer accessible, since surface water is piped from the containment area to a location approximately 240 feet southwest. The replacement sampling location SW15-10R is shown on Figure 1.
- Monitoring location MW-701-O1 was inaccessible due to a snow pile, so no sample was obtained in the first quarter 2018.
- SME did not obtain a sample from B-316-B1 in March due to an equipment issue; however, a replacement sample was obtained in April 2018.
- Monitoring locations MW-502-O1 and MW-510-O1 were permanently abandoned in early April (as previously approved by MEDEP and reported on May 21, 2018), and have been removed from the Plant Area monitoring program.

Where parameters were detected in groundwater above laboratory reporting limits, they were generally below MPS and within the historical range of detections, with the following exceptions:

- B-316-O1: Chloropicrin, mercury, and hexachloroethane were detected at concentrations above MPS, and mercury and hexachloroethane concentrations were consistent with previous detections. Groundwater from this area is captured by the groundwater extraction system in the Landfill 1 Area.
- B-316-B1: Chloropicrin and 1,1-dichloroethene were detected at concentrations above MPS, and concentrations were within the range of historical detections. Groundwater from this area is captured by the groundwater extraction system in the Landfill 1 Area.
- Chlorate Building MH: Mercury and trichloroethene (TCE) were detected at concentrations above MPS, with the TCE concentration above the previous range of detections. Water from the manhole is pumped to the GWTP for treatment prior to discharge under the Site MEPDES Permit.

Mercury was not detected above the MPS in any surface water locations sampled this quarter. No MPS VOCs were detected above laboratory reporting limits in Plant Area surface water samples during first quarter monitoring.

Sediment sampling results from SD15-7 and SD15-8 were consistent with previous sampling results. Sediments from the deeper sample at SD15-7 exceeded the MPS; however, this sampling location was in an area that was excavated in April, from which mercury-containing

sediments were removed. The first sediment samples were obtained from SD18-1 in March. Mercury was detected above the MPS in the deeper sample; however, maintenance was done on the paved sump (the location of SD18-1) on May 25, 2018, which included removing accumulated sediments.

SITE PERIMETER MONITORING

A summary of the Site Perimeter monitoring program is provided in Table 5. Site Perimeter monitoring was conducted during the week of March 12, 2018. Sampling was conducted according to the Short-Term CMP, with the following exception: Following discussion between Mallinckrodt and MEDEP regarding the accepted results and conclusions from the Ferry Road Current Conditions Study[1], MEDEP approved removing the Haseltine and Safian monitoring points from the sampling program. Approval for this change to the monitoring program was provided in a letter from Chris Swain to Kathryn Zeigler on March 15, 2018. No samples were obtained from the residential wells in March, and no further monitoring of these wells will be conducted. A summary of Site Perimeter monitoring is provided in Table 5.

TABLE 5

SITE PERIMETER MONITORING PROGRAM

Monitoring Locations	Site Area	Sample Parameters
P-13-B1, P-13-B2	Landfill 3	Total mercury, chloropicrin, MPS VOCs, chloride
MW-704-O1/O2	Landfill 2	Total mercury, chloride
MW-511-B1/B2	Ferry Road	Total mercury, chloride
B-321-B1/B2	Ferry Road	Total mercury, chloride
B-320-O1/B1	Landfill 1	Total mercury, chloropicrin, chloride, MPS SVOCs

As discussed in an email (from Lisa Jacob to Chris Swain) on May 29, 2018, additional samples were collected from P-13-B1 and -B2 on April 12, 2018 to follow up on an elevated concentration of chloropicrin in P-13-B1 reported by Alpha Analytical Laboratory from the March sampling round. As discussed in our email transmittal, we do not have confidence in the March analytical result for chloropicrin from P-13-B1, given a laboratory analytical error, and an order of magnitude difference in concentration from previous and subsequent samples. We therefore consider the P-13-B1 April result (1,580 µg/L) as the first quarter monitoring result. Both the March and April data for P-13-B2 were consistent with historical monitoring; therefore, the March data for P-13-B2 represents the first quarter monitoring results. The April data for both monitoring points are included in the summary tables in Attachment 7.

First quarter laboratory analytical results for the Site Perimeter monitoring program are generally consistent with recent monitoring results. Detected concentrations were below MPS, with the exception of P-13-B1: In addition to the chloropicrin described above, concentrations of carbon

[1] SME, February 24, 2017. Ferry Road Area Current Conditions Assessment Report, Orrington Remediation Site, Orrington, Maine.

tetrachloride, 11-dichloroethene, and total mercury were above MPS. Hydrogeology and groundwater geochemistry of this area of the Site will be the subject of additional investigations and testing, intended for summer and fall of 2018.

Summary data tables and field sheets are provided in Attachment 7. Please note that there is some overlap between the Site Perimeter and Remediation monitoring programs, and therefore field documentation for some Site Perimeter monitoring points is provided in Attachment 6.

CLOSING

The second quarter 2018 sampling and water level monitoring event is scheduled for the week of June 11, 2018 and MEDEP has been informed of that sampling schedule. If you have any questions concerning the monitoring programs conducted as part of the Short-Term CMP, please do not hesitate to contact Kathryn Zeigler or me.

Very truly yours,

SEVEE & MAHER ENGINEERS, INC.

Lisa J. Jacob, C.G.
Senior Geologist

Attachments:

- Figure 1 – Short-Term CMP Monitoring Locations
- Figure 2 – Interpreted Groundwater Phreatic Surface
- Figure 3 – Mercury and Chloropicrin Concentration Plots
- Attachment 1 – Data Review Reports
- Attachment 2 – Transducer Graphs
- Attachment 3 – Transducer Data (Excel Format)
- Attachment 4 – Interim Extraction System Data Summary Tables and Field Sheets
- Attachment 5 – Landfill 5 Data Summary Tables and Field Sheets
- Attachment 6 – Remediation Monitoring Data Summary Tables and Field Sheets
- Attachment 7 – Site Perimeter Data Summary Tables and Field Sheets

cc: Kathryn Zeigler, Mallinckrodt US LLC (email only)
Chris Evans, Maine DEP (email only)
Chris Greene, Geosyntec (email only)
Orrington Public Library (hard copy only)

FIGURES

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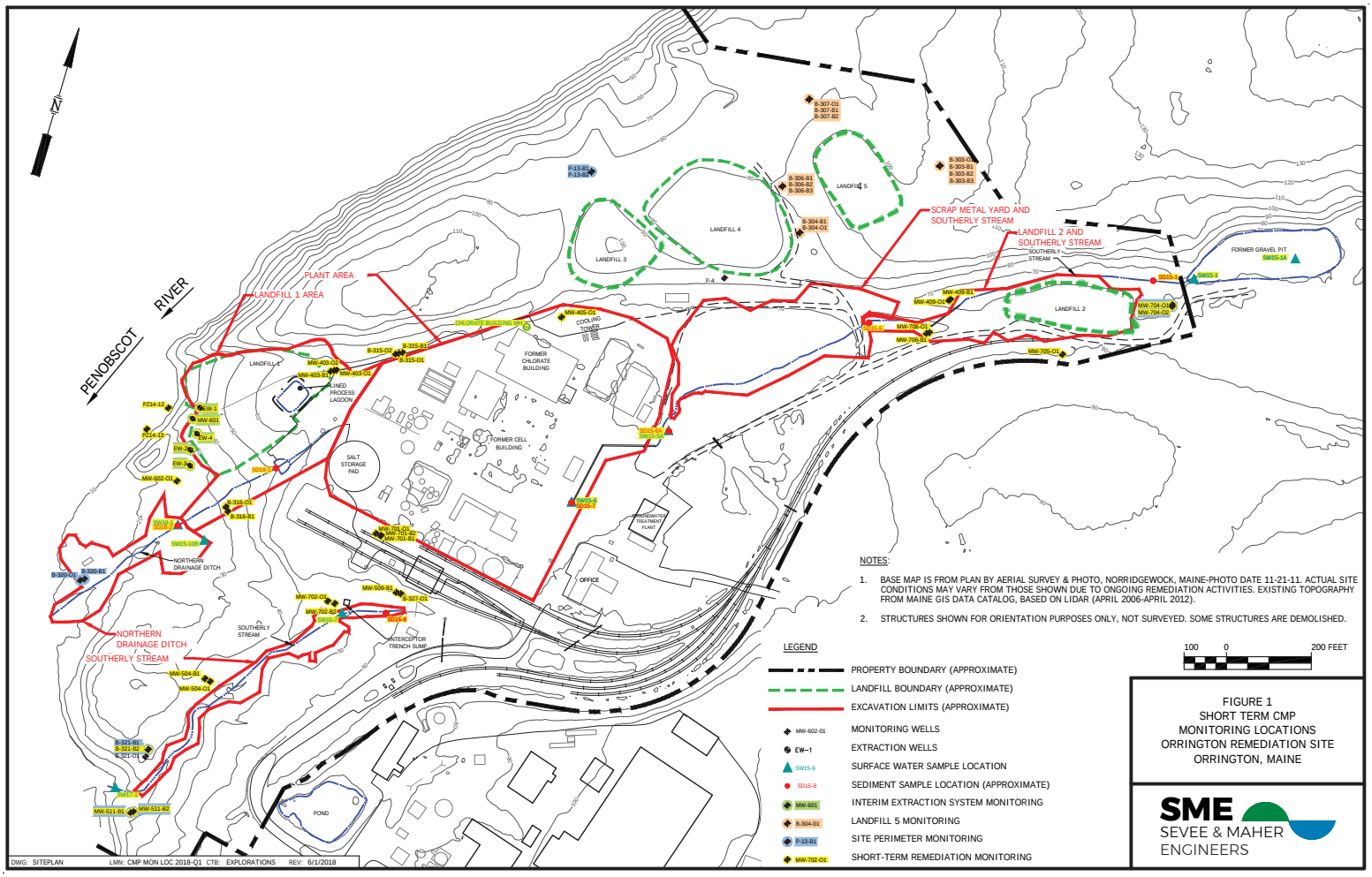

FIGURE 1
SHORT TERM CMP
MONITORING LOCATIONS
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE

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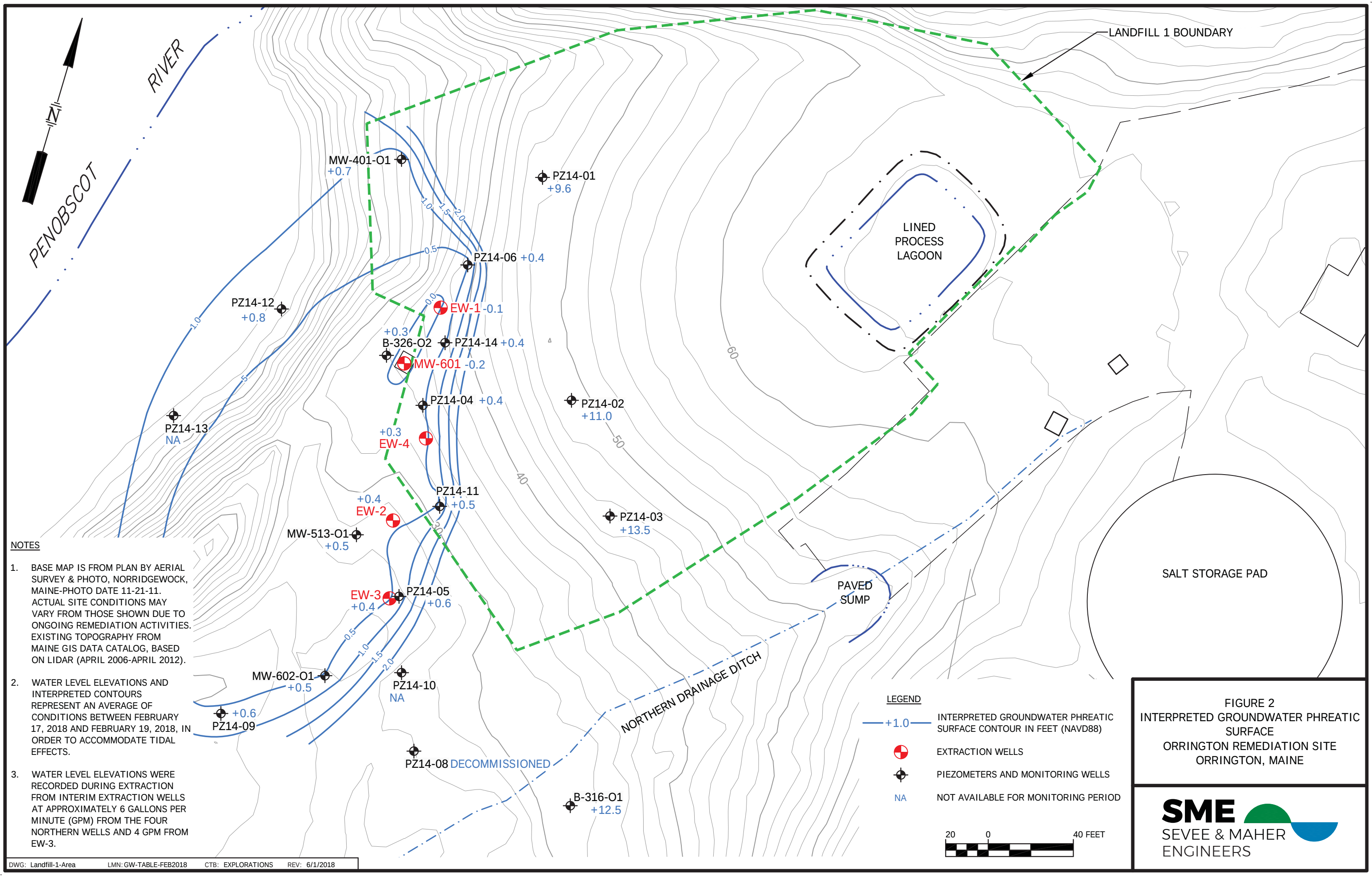

NOTES

1. BASE MAP IS FROM PLAN BY AERIAL SURVEY & PHOTO, NORRIDGEWOCK, MAINE-PHOTO DATE 11-21-11. ACTUAL SITE CONDITIONS MAY VARY FROM THOSE SHOWN DUE TO ONGOING REMEDIATION ACTIVITIES. EXISTING TOPOGRAPHY FROM MAINE GIS DATA CATALOG, BASED ON LIDAR (APRIL 2006-APRIL 2012).
2. WATER LEVEL ELEVATIONS AND INTERPRETED CONTOURS REPRESENT AN AVERAGE OF CONDITIONS BETWEEN FEBRUARY 17, 2018 AND FEBRUARY 19, 2018, IN ORDER TO ACCOMMODATE TIDAL EFFECTS.
3. WATER LEVEL ELEVATIONS WERE RECORDED DURING EXTRACTION FROM INTERIM EXTRACTION WELLS AT APPROXIMATELY 6 GALLONS PER MINUTE (GPM) FROM THE FOUR NORTHERN WELLS AND 4 GPM FROM EW-3.

LEGEND

+1.0 INTERPRETED GROUNDWATER PHREATIC SURFACE CONTOUR IN FEET (NAVD88)
EXTRACTION WELLS
PIEZOMETERS AND MONITORING WELLS
NA NOT AVAILABLE FOR MONITORING PERIOD

20 0 40 FEET

FIGURE 2
INTERPRETED GROUNDWATER PHREATIC SURFACE
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE

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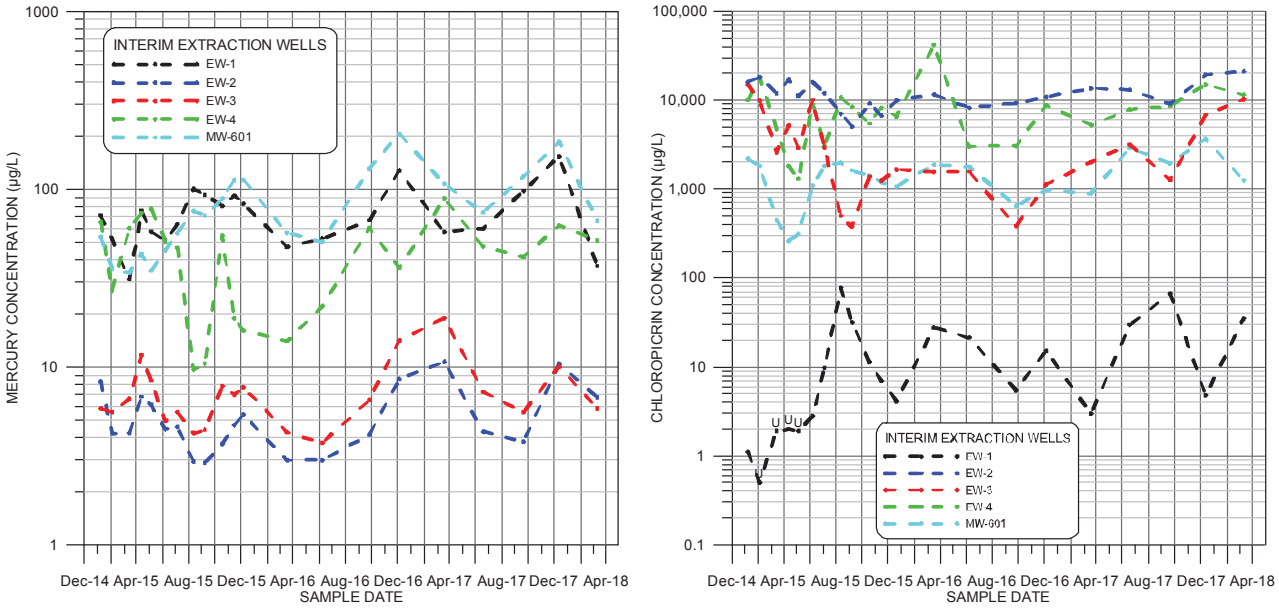
DWG: Landfill-1-Area LMN: GW-TABLE-FEB2018 CTB: EXPLORATIONS REV: 6/1/2018

FIGURE 3

MERCURY AND CHLOROPICRIN CONCENTRATION PLOTS
INTERIM EXTRACTION SYSTEM
ORRINGTON REMEDIATION SITE
ORRINGTON, MAINE



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May 30, 2018