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March 26, 2018

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

Subject: 4th Quarter 2017 Short-Term Comprehensive Monitoring Plan Data Report
Orrington Remediation Site, Orrington, Maine

Dear Mr. Swain:

Results from monitoring conducted in the fourth quarter of 2017 at the Orrington Remediation Site (Site) are provided in this letter report. Samples of groundwater, domestic water, 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 fourth quarter 2017 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 October 23, November 27, and December 11, 2017. 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. Data were validated according to procedures outlined in the Short-Term CMP. Final laboratory analytical reports and electronic data deliverables (EDDs) containing validated data were submitted to Maine Department of Environmental Protection (MEDEP) on December 14, 2017, January 18, 2018, and January 25, 2018.

All laboratory analytical data are considered usable for project objectives. Data validation reports are provided in Attachment 1.

IES MONITORING

Operations and Maintenance

Groundwater extraction rates from the five extraction wells that comprise the IES have 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 to date. 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. Operation of the IES continued at the long-term pumping rates through late November 2017.

On November 22, 2017, SME personnel began preparations for a pump test at EW-3 and performance testing at EW-3 and EW-5 (newly-installed extraction well). Pumping was stopped at EW-3 and the pump removed so that a testing pump could be installed, and pumping from the other four extraction wells was stopped on Monday, November 27. Pump testing at EW-3 was conducted during the week of November 27, 2017, and performance testing at EW-3 and EW-5 was performed during the week of December 4, 2017. Pumping was resumed at all IES wells except EW-3 on Monday, December 11. The IES pump was re-installed at EW-3, and pumping was resumed in the morning of December 13. Details of the hydraulic testing will be provided in a forthcoming data transmittal report.

Following re-start of the IES, the in-line flowmeters for all five extraction wells were not operating, presumably due to the presence of turbidity in extracted groundwater (following the testing and rebound period) blocking the impellers. Given this operational issue and the chronic operational trouble of the flowmeter at EW-1, the Treatment Plant Operator suggested an alternative model for replacement of the in-line flowmeters and totalizers. The meters were replaced on February 5 and 6, 2018. Additional operational details will be provided in the first quarter 2018 data transmittal report.

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 through November 22 (i.e., prior to the pump test preparations) 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 four-day period between October 11 and 14, 2017 were used to construct the contours shown on Figure 2. Average water level elevations during this period indicate drawdown of about 0.5 to 1.5 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, thereby protecting water quality of the Penobscot River.

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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 December 13, 2017. 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	December 13, 2017
GWTP Influent	Quarterly	Total mercury, chloropicrin, MPS VOCs, chloride, alkalinity, iron, manganese, and sodium	December 13, 2017

A summary of analytical results is provided in Table 2. Analytical results from December 2017 sampling indicate mercury, chloropicrin, and chloride concentrations are generally consistent with past monitoring results, with a few exceptions: relative to previously-detected maximum concentrations, elevated mercury concentrations were detected in EW-1 and the Treatment Plant Influent, elevated chloropicrin was detected in EW-2 and MW-601, and slightly elevated chloride was detected in EW-2. This groundwater is all captured and treated in the on-Site GWTP. Detected concentrations of mercury and chloropicrin over time 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 – DECEMBER 13, 2017

Parameter	Analytical Method	EW-1	EW-2	EW-3	EW-4	MW-601	GWTP Influent
Mercury (µg/L)	7470	152	10.4	10.1	62.6	185	107
Chloropicrin (µg/L)	8011	4.81	19,200	6,280	15,000	3,660	5,720
Chloride (mg/L)	E300	420	560	480	560	570	530
Average Pumping Rate (gpm)	-	5	6	3	6	6	26

Notes:
1. Average extraction well flow rates are assumed, based on measured GWTP Influent flow rate and recent IES operations data. In-line flowmeters were not operating at the time of sampling.

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LANDFILL 5 MONITORING

Landfill 5 Assessment monitoring was conducted according to the Short-Term CMP during the week of December 11, 2017. A summary of the Landfill 5 monitoring programs is provided in Table 3. Data have been submitted electronically to MEDEP as noted above, and were provided in an annual report in the first quarter of 2018, according to the usual schedule of reporting. 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 fourth quarter 2017 included monthly and quarterly monitoring in the vicinity of the Scrap Metal Yard, Southerly Stream, and Landfill 2 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
Scrap Metal Yard and Southerly Stream (middle)	Groundwater	MW-405-O1, Chlorate Building MH	Total Mercury	Quarterly	December 2017
	Surface Water	SW15-5A		Monthly	
	Sediment	SD15-5 (no longer present), SD15-6A		Monthly	
	Water Level	MW-405-O1/B1, MW-706-O1/B1, PZ-3	N/A	Quarterly	
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
	Surface Water	SW17-1	Total Mercury	Monthly	November 2017
	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-704-O1/O2	Total Mercury, Carbon Tetrachloride	Monthly	November 2017
	Groundwater	MW-409-O1/B1, MW-704-O1/O2, MW-705-O1, MW-706-O1/B1		Quarterly	September 2018
	Surface Water	SW15-1, SW15-1A, SW15-5A	Total Mercury	Monthly	December 2017
	Sediment	SD15-1, SD15-6A		Monthly	December 2017
	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

Notes:
1. Red text indicates sampling that was completed (final samples obtained) according to the Short-Term CMP in the fourth quarter of 2017.
2. Monthly sampling of MW-704-O1/O2 as part of the Landfill 2 program has been completed, but sampling of these locations will continue on a quarterly basis, as indicated above.

Scrap Metal Yard

Sampling in the vicinity of the Scrap Metal Yard remediation area was conducted on October 24, November 29, and December 12 and 13, 2017, in general accordance with the Short-Term CMP. As noted in the third quarter 2017 data transmittal report, no samples were collected at SD15-5 since there is no longer a drainage swale and therefore no sediment accumulation in that area due to re-grading associated with remediation activities. All other monitoring locations were accessible and samples were obtained according to the plan.

Surface water from SW15-5A had a mercury concentration of 0.97 micrograms per liter (µg/L) in October 2017, above the MPS of 0.91 µg/L for surface water. Surface water at this location has not had mercury detected above laboratory reporting limits in previous sampling. Samples collected in November and December were non-detect, consistent with the sampling history at this location. The final sample at this location was scheduled for November 2017 based on the

remediation calendar; however, an additional sample was obtained in December in order to show two months of below-MPS concentrations following the single exceedance.

Groundwater from the Chlorate Building underdrain (Chlorate Building MH) had a mercury concentration above the MPS but within the historical range of detections. Groundwater from MW-405-O1 had mercury concentrations (in both sample and duplicate) below MPS and within the historical range of detections.

As noted above, location SD15-5 is no longer present and therefore no sediment samples were obtained during fourth quarter monitoring. Samples obtained from location SD15-6A in October had mercury concentrations above MPS and above baseline sampling conducted in 2015[1]. Some erosion control maintenance was conducted in the vicinity of SD15-6A prior to sampling in November[2]. The sediment samples obtained from SD15-6A in November and December were below MPS. As with surface water discussed above, the final sampling was originally scheduled for November, and an additional sampling event was added to show two months of below-MPS concentrations following the exceedances at this location. Sampling according to the Short-Term CMP is completed at this location.

Southerly Stream

Sampling in the vicinity of the Southerly Stream remediation area was conducted on October 24, November 27, and December 11 through 13, 2017, in accordance with the Short-Term CMP. All monitoring locations were accessible and samples were obtained according to the plan. Mercury analytical results are generally consistent with recent monitoring. Where mercury was detected above laboratory reporting limits, the concentrations are within the range of recent detections and all are below the MPS. The final sample was obtained from SW17-1 in November 2017, and sampling according to the Short-Term CMP is completed at this location.

Landfill 2

Remediation monitoring in the vicinity of the Landfill 2 remediation area was conducted on October 23 and 24, November 27 to 29, and December 12 and 13, 2017, in general accordance with the Short-Term CMP. As discussed in the third quarter data transmittal report, groundwater monitoring at five monitoring wells was left out of the September due to a planning oversight. An extra round of samples was therefore obtained from these five monitoring points in November in order to complete the intended number of sampling rounds at these locations.

Fourth quarter groundwater and surface water analytical results are consistent with recent monitoring and below MPS where parameters were detected above laboratory reporting limits, with the exception of surface water from SW15-5A in October (as discussed above). Samples obtained from this location in November and December were non-detect for mercury.

[1] Sevee & Maher Engineers, Inc., March 25, 2016. Current Conditions Monitoring Data Transmittal, Orrington Remediation Site, Orrington, Maine.

[2] Email communication between Chris Greene (Geosyntec) and Kyle Jellison (MEDEP), November 16 and 17, 2017.

As noted above, sediments from location SD15-6A had mercury concentrations above the MPS of 2.2 milligrams per kilogram (mg/Kg) in samples obtained in October, and mercury concentrations below MPS in samples obtained in November and December, following erosion control maintenance in the vicinity of the sampling location. Other sediments obtained in fourth quarter monitoring had mercury concentrations below the MPS.

Surface water, sediment, and monthly groundwater sampling for the Landfill 2 area is completed. Quarterly groundwater monitoring according to the Short-Term CMP will continue through June 2018.

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 December 11, 2017. Sampling was conducted according to the Short-Term CMP. 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
Haseltine and Safian residences	Ferry Road	Total mercury, chloride
B-320-O1/B1	Landfill 1	Total mercury, chloropicrin, chloride, MPS SVOCs

In addition to the regularly-scheduled fourth quarter Short-Term CMP monitoring, samples were obtained from P-13-B1 and -B2 on October 23, 2017. As discussed in the third quarter data transmittal report, this sampling round was intended to follow up on results from September monitoring results, which included observations from P-13-B1 of increased mercury, chloropicrin, and carbon tetrachloride concentrations from June second quarter monitoring, and MPS exceedances of those parameters.

Fourth quarter laboratory analytical results are generally consistent with recent monitoring results with detected concentrations below MPS, with the exception of P-13-B1. Samples collected from P-13-B1 in the October and December had concentrations of total mercury, chloropicrin, carbon tetrachloride, and 11-dichloroethene (December samples) above MPS. Monitoring of these points will be conducted on a quarterly basis as established in the Short-Term CMP. Hydrogeology and groundwater geochemistry of this area of the Site will be the subject of additional investigations and testing, intended for 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 first quarter 2018 sampling and water level monitoring event was completed the week of March 12, 2018 and MEDEP was 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 Validation 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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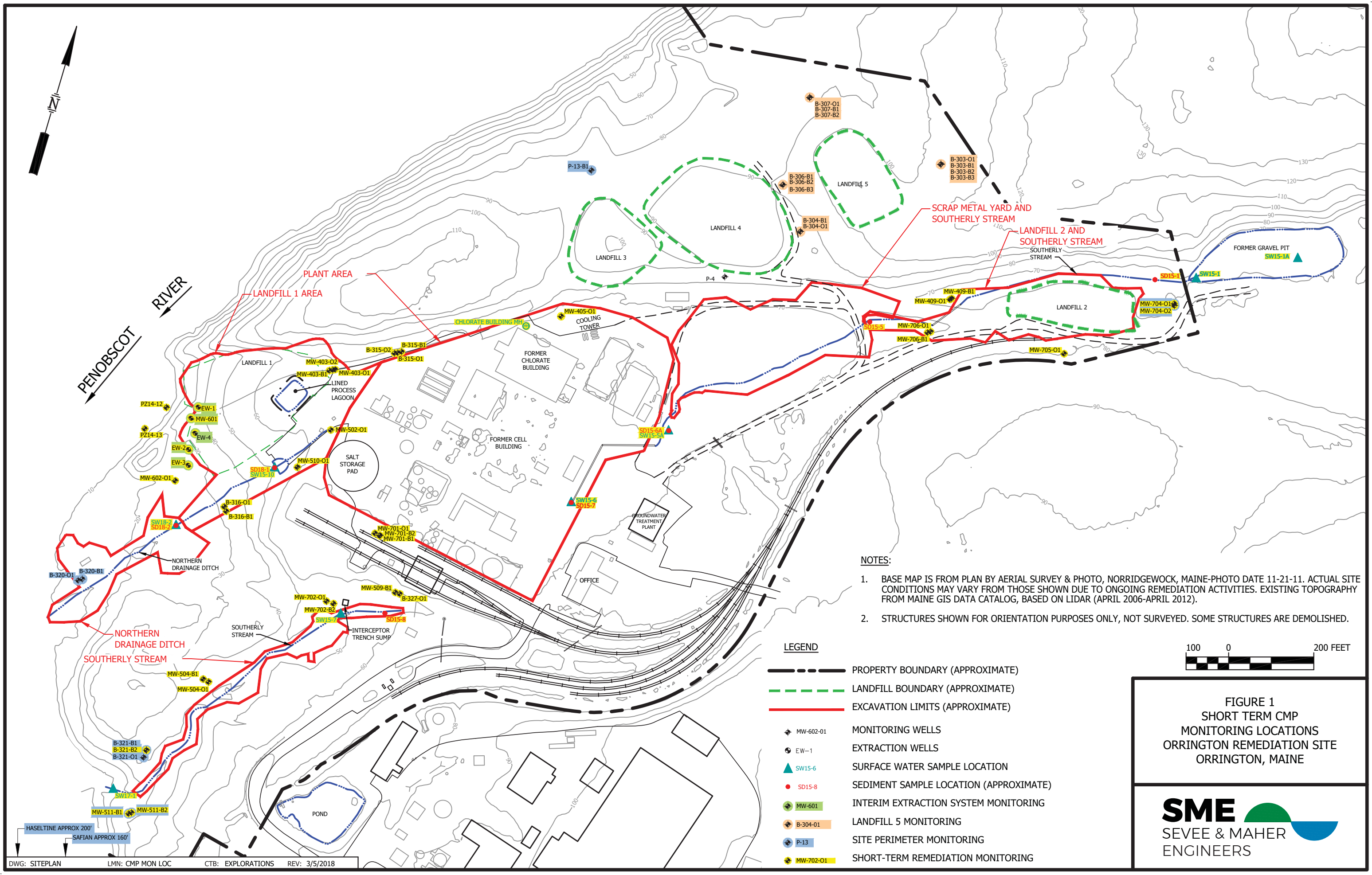

PENOBSCOT RIVER
LANDFILL 1 AREA
PLANT AREA
SCRAP METAL YARD AND SOUTHERLY STREAM
LANDFILL 2 AND SOUTHERLY STREAM
NORTHERN DRAINAGE DITCH
SOUTHERLY STREAM
LANDFILL 1
LANDFILL 2
LANDFILL 3
LANDFILL 4
LANDFILL 5
LINED PROCESS LAGOON
FORMER CHLORATE BUILDING
CHLORATE BUILDING MH
COOLING TOWER
FORMER CELL BUILDING
SALT STORAGE PAD
GROUNDWATER TREATMENT PLANT
OFFICE
INTERCEPTOR TRENCH SUMP
POND
FORMER GRAVEL PIT
HASELTINE APPROX 200'
SAFIAN APPROX 160'
P-13-B1
P-4
B-307-O1
B-307-B1
B-307-B2
B-306-B1
B-306-B2
B-306-B3
B-303-O1
B-303-B1
B-303-B2
B-303-B3
B-304-B1
B-304-O1
MW-409-B1
MW-409-O1
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PZ14-12
PZ14-13
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EW-4
EW-2
EW-3
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B-321-B2
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MW-511-B1
MW-511-B2
SW15-1
SD15-1
SW15-1A
SD15-5
SD15-6A
SW15-6A
SW15-6
SD15-7
SD16-3
SW15-10
SW16-2
SD16-2
SW15-7
SD15-8
SW17-1
100 0 200 FEET

DWG: SITEPLAN LMN: CMP MON LOC CTB: EXPLORATIONS REV: 3/5/2018

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. STRUCTURES SHOWN FOR ORIENTATION PURPOSES ONLY, NOT SURVEYED. SOME STRUCTURES ARE DEMOLISHED.

LEGEND

Symbol	Description
	PROPERTY BOUNDARY (APPROXIMATE)
	LANDFILL BOUNDARY (APPROXIMATE)
	EXCAVATION LIMITS (APPROXIMATE)
MW-602-01	MONITORING WELLS
EW-1	EXTRACTION WELLS
SW15-6	SURFACE WATER SAMPLE LOCATION
SD15-8	SEDIMENT SAMPLE LOCATION (APPROXIMATE)
MW-601	INTERIM EXTRACTION SYSTEM MONITORING
B-304-01	LANDFILL 5 MONITORING
P-13	SITE PERIMETER MONITORING
MW-702-01	SHORT-TERM REMEDIATION MONITORING

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

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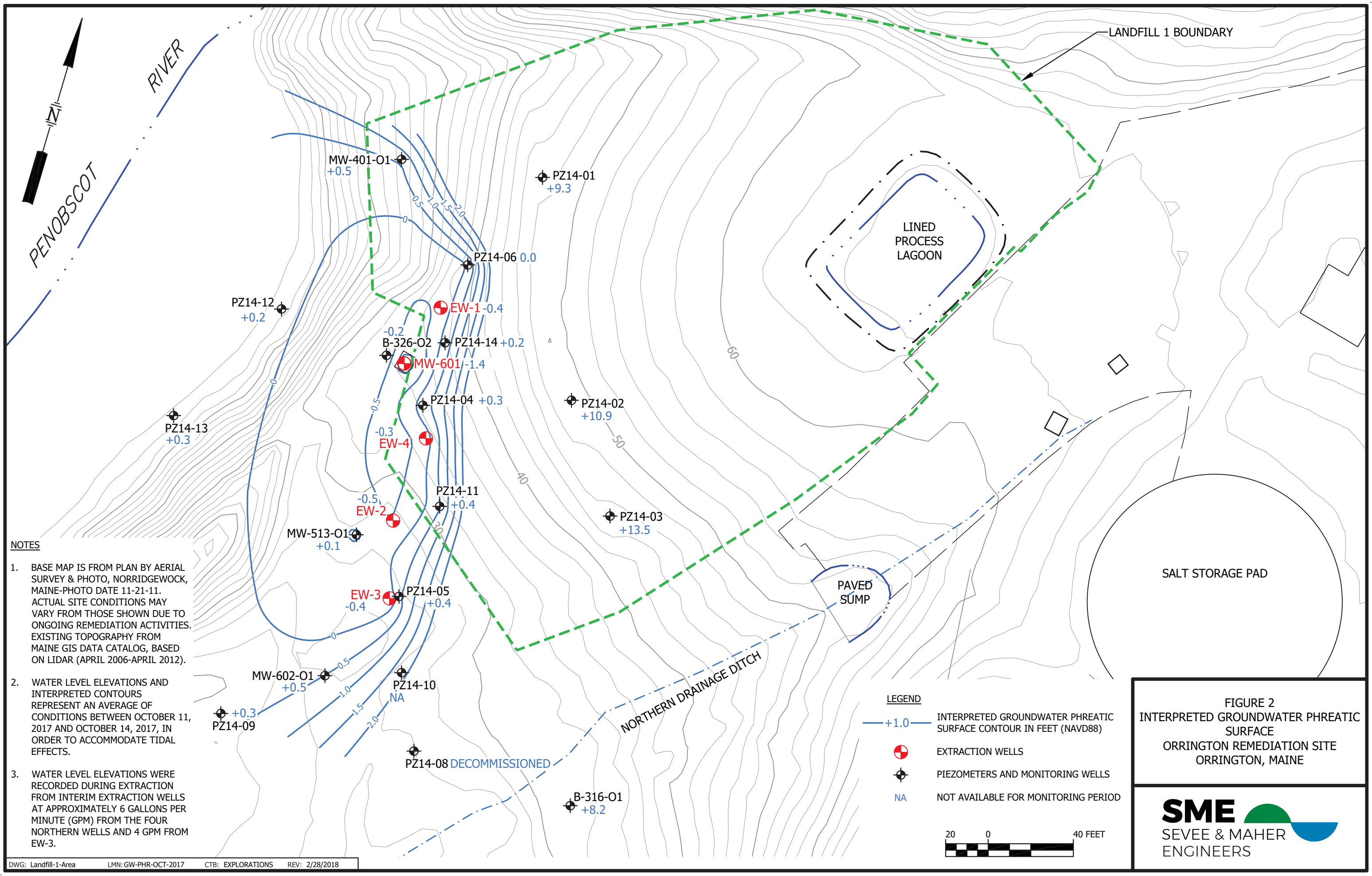

NOTES

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 OCTOBER 11, 2017 AND OCTOBER 14, 2017, 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-PHR-OCT-2017 CTB: EXPLORATIONS REV: 2/28/2018

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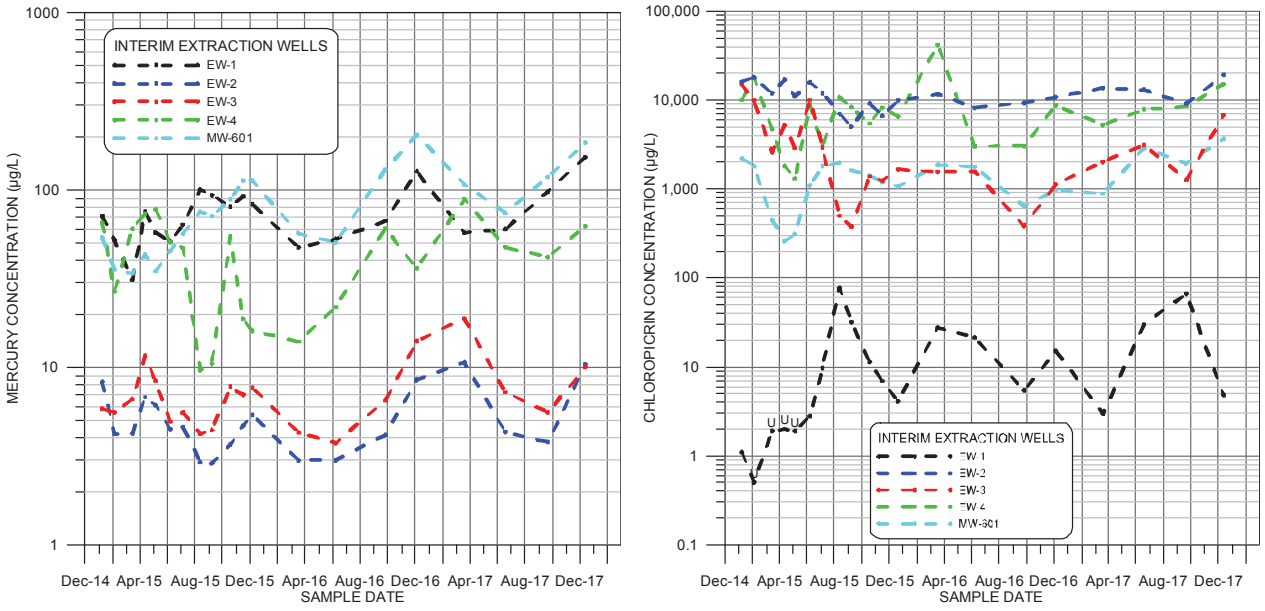
FIGURE 3

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



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March 26, 2018