2012 TRIENNIAL SAMPLING AND WELL DECOMMISIONING REPORT

SUBJECT SITE: PORTLAND BANGOR WASTE OIL FACILITY

TENNEY HILL ROAD
CASCO, MAINE

Remediation Site No. 00487

Prepared by:

Bureau of Remediation and Waste Management
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CERTIFICATION STATEMENT

I, Jason S. Langley, C.G. No. GE541, certify that I currently hold an active Certified Geologist license in the State of Maine. I further certify that the August 2013 document titled: "*2012 Triennial Sampling and Well Decommissioning Report, Portland Bangor Waste Oil Facility, Tenney Hill Road, Casco, Maine*" was prepared under my responsible charge.

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1. INTRODUCTION

1.1 Purpose of the Triennial Monitoring Report

This report has been prepared by the Maine Department of Environmental Protection (MEDEP) Technical Services staff to provide a summary of groundwater monitoring and sampling efforts conducted at the former Portland Bangor Waste Oil (PBWO) facility in Casco, Maine (hereafter referred to as Site) since completion of the Remedial Investigation (RI) by Drumlin Environmental, LLC [Drumlin, 2004]. This report presents a narrative discussion of fieldwork and associated observations from the most recent sampling event completed in 2012. This report provides groundwater sampling logs, analytical results from the 2004 RI through 2012, conclusions, and recommendations for future work.

1.3 Background Specific to the Triennial Monitoring Report

PBWO operated a satellite storage facility in a gravel pit on Tenney Hill Road in Casco, Maine from 1969 to 1980 (**Figure 1**). During the late 1980s to early 1990s the USEPA investigated the PBWO facility, and volatile organic compounds (VOCs) and petroleum products were detected in soils and surface water at the gravel pit. MEDEP began investigating the gravel pit area in 1997, which culminated in the aforementioned RI and removal of 6,500 tons of VOC and petroleum impacted soils from the gravel pit site in 2002-2003 [Drumlin, 2004].

Subsequent work by MEDEP after the RI included the installation of bedrock monitoring wells MW-19A, MW-19B, MW-20A, MW-20B, and MW-21, and overburden monitoring wells MW-19C and MW-20C from 2005 to 2006 (**Figure 2**). Boring logs that were available in MEDEP's files for these monitoring wells are included in **Appendix A**. In addition, groundwater sampling of monitoring wells at the Site was completed by MEDEP staff in 2005, 2007, 2008, and 2009. Also, pore water sampling along Decker Brook was conducted by MEDEP staff in 2005 and 2006. Prior to the sampling event in 2012, some Site monitoring wells were apparently abandoned (including MW-20C), however no records of these well abandonments were located in MEDEP files.

2. SITE DESCRIPTION

2.1 Site Location

The Site is comprised of several parcels bounded by Poland Spring Road (Route 11) to the north, Tenney Hill Road to the west, and Decker Brook to the east (**Figures 1,2**). Site access is provided via Tenney Hill Road or from the Hancock Lumber Company's (HLC) sawmill facility located at 1260 Poland Spring Road.

The plume of VOC impacted groundwater is primarily on land owned or maintained by HLC. The Site is generally bounded as follows:

- To the south, forested property owned by HLC.
- To the east, Decker Brook wetland followed by forested property owned by HLC.
- To the north, Decker Brook followed by the Town of Casco salt shed and transfer station/recycling facility located on Leach Hill Road.
- To the west, residential properties along Tenney Hill Road.

2.2 Site History

Please refer to the RI report for a summary of the Site's history [Drumlin, 2004].

2.3 Topography

The USGS's Naples, Maine 7.5-minute topographic quadrangle map shows the Site location and surface features in the area as indicated on **Figure 1**. The Site and its vicinity are hilly with ground elevations ranging from 300 ft along Decker Brook to 420 ft at Tenney Hill above the North American Vertical Datum of 1988 (NAVD). Topographic contours at 10-ft intervals across the Site are also depicted on subsequent figures beginning with **Figure 2**. Locally the Site topography is hummocky with multiple streams and springs flowing down Tenney Hill to Decker Brook.

3. REGIONAL GEOLOGY

3.1 Overburden Geology

According to the Maine Geological Survey's (MGS) Surficial Geology map for Naples Quadrangle, Maine, surficial deposits at the Site consist of Pleistocene age eolian sands atop Tenney Hill, undifferentiated glacial till to the north and south of the eolian sands deposit, and glacial Sebago Lake bottom and fan-delta deposits along the base of Tenney Hill from the north around to the east. The wetland area of Decker Brook to the east and south is comprised of Holocene age muck, peat, silt, and sand deposits [MGS, 1997].

3.2 Bedrock Geology

The MGS Bedrock Geology of the Naples Quadrangle, Maine map indicates that the Site and surrounding area is underlain by a two-mica granite of the Sebago Lake Pluton [MGS, 1996]. Bedrock monitoring wells installed during the RI and later by MEDEP largely encountered medium-grained granite, with some rock cores revealing geologically younger intrusives such as white coarse-grained pegmatites and fine-grained basalt dikes [Drumlin, 2004].

3.3 Public and Private Water Supply Wells

MEDEP staff contacted the Maine Geological Survey (MGS) to search their Water Well Database for water supply wells in the vicinity of the site. Records provided by MGS are included in **Appendix B**. Some of the residential supply wells identified by MGS were sampled by MEDEP staff during the RI from 2002 to 2004. Samples from these wells were non-detect for COCs associated with the Site [Drumlin, 2004].

The HLC sawmill facility and Bargain Barn located on either side of Poland Spring Road have a total of five supply wells that have been mapped and historically sampled by MEDEP, and are shown on **Figure 2**. The "Hancock PW" well provides process water for lumber manufacturing, wells designated "Hancock WW-1" and "Hancock WW-2" are used for wetting of logs, and domestic water is supplied for the Bargain Barn from "Hancock BB" and to the sawmill office from "Hancock DW". Construction details of the aforementioned wells as reported by MGS are included in **Appendix B**.

4. SITE MONITORING METHODOLOGY

4.1 Overview

As previously referenced in Section 1.3, the extent of VOC and petroleum impacted soil and groundwater was characterized during the RI [Drumlin, 2004]. Concurrent with the RI, MEDEP removed 6,500 tons of VOC and petroleum contaminated soils from the gravel pit area in 2002 and 2003. After completion of the removal action and RI, MEDEP began long term groundwater monitoring of the Site in 2005.

For this triennial sampling report, MEDEP technical services staff mobilized to the Site on September 11-12, 2012 to collect groundwater samples from a subset of existing overburden and bedrock monitoring wells, Hancock Lumber Company supply wells, and to collect a pore water sample along Decker Brook at the inferred terminus of the overburden groundwater VOC plume. Sampling activities were performed in general accordance with MEDEP standard operating procedures (SOPs) DR#001, DR#002, DR#003, and DR#023.

4.2 Monitoring Well Sampling

On September 11-12, 2012 MEDEP technical services staff collected groundwater samples from bedrock monitoring wells MW-13A/Y, MW-16A/B, MW-17A/B, MW-19A/B, MW-20A/B, and HL-1A; and from overburden monitoring wells MW-10B, MW-13B, MW-19C, HL-1B, GP-26, GP-33, and GP-44 as shown on **Figure 2**. Monitoring well sampling was performed in general accordance with MEDEP SOP DR#003 for low-flow sampling. Depth-to-water readings were recorded on August 28-29, 2012 at each well as indicated on **Table 1A**.

Each monitoring well was purged via a peristaltic pump prior to sampling until fine-grained sediment was largely removed, and both pumping drawdown and field-measured parameters had stabilized. Measured parameters included turbidity, dissolved oxygen (DO), specific conductivity, temperature, oxidation reduction potential (ORP), and pH that were recorded with a Hach 2100P turbidity meter and an YSI 556MPS water quality meter connected to a flow-through cell. Low-flow was not achievable in

monitoring well GP-44 due to a low water table and lower transmissivity of overburden materials in the screened interval, therefore a grab sample was collected.
A summary of field-measured parameters for groundwater sampling events from 2002-2012 is included in **Table 1B**. Groundwater sampling field logs from the 2012 event are included in **Appendix C**.

Samples were collected using a peristaltic pump as described previously. The samples were collected in pre-cleaned sample bottles, kept on ice, and shipped with Chain of Custody documentation to Katahdin Analytical Services (Katahdin) in Westbrook, Maine for analysis. Samples collected from the aforementioned monitoring wells were analyzed for VOCs via EPA Method 8260B, plus duplicate samples for VOCs were collected from MW-19B and MW-19C for quality control purposes. Samples from MW-10B, MW-13A/B, MW-17B, and MW-19B/C were also analyzed for 1,4-dioxane via EPA Method 8270C. Finally, samples from MW-10B, MW-13A/B, MW-17B, MW-19B/C, GP-26, and GP-33 were tested for total extractable petroleum hydrocarbons (TEPH) as per the MassDEP method.

4.3 Supply Well Sampling

On September 11, 2012 MEDEP technical services staff collected groundwater samples from supply wells Hancock-DW and Hancock-PW from the kitchen sink tap and inside the pump house, respectively (**Figure 2**). Each tap was allowed to run for at least 10 minutes prior to sample collection per MEDEP SOP DR#001. The Hancock DW sample was submitted to Katahdin for analysis of VOCs (8260B), 1,4-dioxane (8270C), and TEPH (MassDEP), and the Hancock PW sample was tested for VOCs (8260B) only.

4.4 Pore Water Sampling

On September 11, 2012 a pore-water sample designated PW-5 was collected along Decker Brook adjacent to a wooden bridge for ATVs on the Hancock Lumber property. A pre-cleaned stainless steel pore-water sampler tube was inserted into the bank of Decker Brook approximately 2-feet below ground surface, and then attached to a peristaltic pump with disposable polyethylene tubing. The sample was submitted to Katahdin for analysis of VOCs via 8260B. The locations of PW-5 and previous pore-water samples from 2005 and 2006 are shown on **Figure 2**.

4.5 Evaluation of Groundwater Flow Direction

Depth-to-water measurements were recorded in all Site monitoring wells on August 28-29, 2012 and prior to sampling on September 11-12, 2012. These measurements were subtracted from existing TOC elevation data. Site-specific groundwater flow is discussed further in Section 5.2.

5. SITE HYDROGEOLOGIC CHARACTERIZATION

5.1 Site Geology

For a thorough discussion of Site specific geology the reader should refer to the RI report [Drumlin, 2004]. In general, overburden deposits are thickest at the top of Tenney Hill, on the order of 25 to 30 feet thick consisting of primarily eolian sand over undifferentiated glacial till. Excellent exposures of the eolian sands are found in Hancock Lumber's gravel pit just north of the monitoring well network. These deposits thin downslope to Decker Brook, with the eolian sands pinching out at the base of Tenney Hill. Boring logs from MW-20A/B show sandy to silty till with boulders and cobbles on the east side of Decker Brook on the order of 15 to 17 feet thick (**Appendix A**).

As noted earlier bedrock at the Site is comprised of medium-grained granite with secondary intrusives such as basalt dikes and coarse-grained pegmatites. There are no bedrock outcrops at the Site. Monitoring well screens were placed in sections of high fracture density, with fractures having subvertical to vertical orientations [Drumlin, 2004]. Boring logs from MW-20A/B noted significant loss of circulation during drilling suggesting the presence of large voids/fractures in the granite bedrock on the east side of Decker Brook (**Appendix A**).

5.2 Site Hydrogeology

Groundwater elevations were calculated using top-of-casing (TOC) survey data from the RI report [Drumlin, 2004] and depth-to-water measurements collected on August 28-29, 2012. This data is summarized on **Table 1A** and depicted on **Figures 3A and 3B**. Unfortunately, groundwater elevations could not be determined for source area overburden wells MW-10B and MW-13B. It appears that groundwater in these wells had conductivity lower than the detection limit of the depth-to-water meter probe (**Table 1B and Appendix C**).

Figure 3A shows groundwater elevations for overburden and shallow bedrock wells, and overburden groundwater elevation contours inferred from the 2004 RI dataset for comparison to the August 2012 dataset. Shallow bedrock wells are included on Figure 3A due to the limited number of overburden monitoring wells with groundwater elevation data. Figure 3B compares the shallow and deep bedrock well groundwater elevations with the 2004 RI groundwater elevation contours. In general, the 2012 data fits well with the inferred 2004 groundwater contours. Groundwater flow in the overburden, shallow and deep bedrock wells all appear to follow topography going east to northeast around Tenney Hill towards Decker Brook. Please note however that the practice of contouring groundwater elevation data in fractured bedrock is not representative of actual groundwater flow. For the purposes of this report it is helpful to illustrate that groundwater flow has remained relatively consistent since the RI.

It is suspected that shallow and deep bedrock groundwater flow continues northeastward under Decker Brook, but this assumption is solely based on detections of VOCs in MW-20B, and not groundwater elevation measurements in wells north and east of Decker Brook.

A summary of vertical gradient calculations between nested or adjacent shallow and deep bedrock wells is provided in **Table 2**. These calculations assume hydraulic connectivity between fractures in the shallow and deep bedrock wells. Based on historical detections of VOCs, this seems plausible with respect to monitoring wells MW-13A/Y, MW-16A/B, MW-17A/B, and MW-19A/B both in the vertical and horizontal dimensions. The vertical gradients shown herein are fairly weak, and do not indicate a systematic flow regime in the bedrock fractures. The RI report noted that weak downward gradients were observed from the overburden to shallow bedrock, and the opposite was found in deep vs. shallow bedrock wells [Drumlin, 2004].

Horizontal gradients for overburden and shallow bedrock were calculated using historical water elevation data from monitoring wells MW-10B/13B (overburden in source area), MW-10A/13A (shallow bedrock in source area), and MW-13A/17B (shallow bedrock along slope of Tenney Hill). The average horizontal gradient between MW-10B/13B was 0.027 ft/ft (source area overburden); 0.035 ft/ft between MW-10A/13A (source area shallow bedrock); and 0.067 ft/ft between MW-13A/17B (shallow bedrock slope).

6. ANALYTICAL RESULTS

6.1 Groundwater and Pore-Water Analytical Results

Analytical results of groundwater samples continued to indicate the presence of VOCs and TEPH in several overburden and bedrock monitoring wells in excess of the USEPA Maximum Contaminant Levels (MCLs) and current Maine Exposure Guidelines (MEG) [Maine CDC, 2012]. **Table 3** presents a complete summary of analytical results from 2002 to 2012 for trichloroethylene (TCE), tetrachloroethylene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), cis-1,2 dichloroethylene (cis-1,2 DCE) and diesel range organics (DRO) analysis or TEPH. **Table 4** shows results for 1,4-dioxane as compared to 1,1,1-TCA in a subset of monitoring wells at the Site. **Table 5** summarizes pore water sampling results from 2005, 2006, and 2012. Laboratory data prepared by Katahdin for the 2012 sampling event was uploaded into MEDEP's Environmental and Geographic Analysis Database (EGAD) under Site number 28461.

Pore Water Sampling

Samples collected along Decker Brook in 2005-06 (PW-1A and PW-1 through PW-4) and 2012 (PW-5) revealed no detections of the primary chlorinated solvent COCs. Trace detections of toluene and naphthalene were noted at location PW-1A (resample of PW-1) in 2006. Likely laboratory-related contaminants were noted in PW-1 (chloroform) from 2005 and PW-5 (acetone) from 2012. These results indicate that Site-related COCs do not appear to be discharging into Decker Brook.

Overburden Monitoring Wells

Source area monitoring well MW-13B has shown a significant reduction in VOCs (roughly two orders of magnitude) since completion of the removal action in 2003. This trend illustrates the success of the source removal, and the dispersion of DNAPL via groundwater flow to a dissolved phase VOC plume. TCE, PCE, and daughter product cis-1,2 DCE continue to persist at levels exceeding the respective MCL or MEG. An encouraging trend is the increasing proportion of cis-1,2 DCE to its parent chlorinated solvents, suggesting that the breakdown of TCE and PCE is occurring naturally. However, other daughter products such as vinyl chloride have not been detected at MW-13B or any other wells at the Site. A chart of VOC concentrations vs. time for MW-13B is included in **Appendix E**. An exponential best fit curve was applied to the TCE data. Based on this best fit trend, TCE is projected to equal the 2012 MEG of 4.0 ppb in roughly 112 years. Also note that petroleum in the form of DRO or TEPH continues to persist in MW-13B.

Monitoring well MW-10B was sampled during the 2012 event to obtain current data on any residual VOCs in shallow groundwater near the former removal action area. VOCs were not detected in this well. However, low-level TEPH of 140 ppb was detected in the 2012 sample.

Monitoring well MW-19C at the base of Tenney Hill continues to have TCE above the MEG/MCL, however the overall trend shows a decline in VOC concentrations since 2005. A chart of VOC concentrations vs. time for MW-19C is included in **Appendix E**. Based on the best fit exponential curve, TCE is projected to equal the 2012 MEG in approximately 123 years. Geoprobe wells and the Hancock Lumber well HL-1B in the Decker Brook basin indicate trace to no VOC detections, and low-level TEPH persistence in GP-33 and HL-1B.

Figure 4A provides a map view of 2012 TCE concentrations compared to the overburden VOC plume presented in the RI report [Drumlin, 2004]. The 2012 inferred extent of VOCs in overburden is based partially on a limited extent of overburden monitoring well locations, and detections of VOCs in shallow bedrock wells on Tenney Hill where it seems reasonable to assume that VOCs are also present in the overburden at these locations. Based on the available data it appears that the VOC plume in overburden has narrowed and no longer crosses Decker Brook.

Shallow Bedrock Monitoring Wells

The trend of VOC concentrations in source area shallow bedrock well MW-13A is similar to that of MW-13B in the source overburden, in that the bulk of dissolved phase VOCs passed through bedrock fractures after completion of the removal action in 2003. Since 2005, TCE concentrations have remained an order of magnitude lower than what was observed prior to the removal action, but are still above the MEG/MCL. PCE and daughter product cis-1,2 DCE have declined below their respective MEG/MCLs, but low-level DRO/TEPH continues to persist in this well. Refer to **Appendix E** for a chart of VOC concentrations vs. time. Interestingly, the best fit exponential to TCE predicts attenuation to the MEG in the same time frame as MW-13B, or roughly 112 years.

Downgradient shallow bedrock wells MW-17B, MW-16B, and MW-19B show a continued persistence of VOCs. Of these MW-19B appears to be the primary recipient of upgradient VOCs that migrate down Tenney Hill through the overburden and along bedrock fractures. Of the wells sampled for 1,4-dioxane during the 2012 event, MW-19B reported a trace level of 1,4-dioxane significantly below the MEG of 4 ppb as shown on **Table 4**. The trend in MW-16B shows a decline in VOCs below their respective MEGs/MCLs, suggesting that the VOC plume has narrowed laterally over time. Shallow bedrock well MW-18B to the south has consistently reported non-detect for VOCs, which provides at least one spatial point bounding the VOC plume in bedrock to the south. HL-1A was non-detect in 2007 and 2012, which bounds the VOC plume to the north at this location. Across Decker Brook, MW-20B appears to define the furthest downgradient extent of VOCs in shallow bedrock, with levels of TCE consistently above the MEG/MCL since 2005.

Deep Bedrock Monitoring Wells

Of the deep monitoring wells sampled since 2003, only MW-19A has consistently reported levels of TCE above the MEG/MCL while other wells at the Site have been non-detect or naturally attenuated to trace levels over time (**Table 3**). Given the tendency of chlorinated solvents to sink, these results are encouraging and indicate that VOCs have not extensively migrated into deeper bedrock fractures. Based on these trends it appears that groundwater flow is dominated by shallow horizontal fractures or fracture sets that are hydraulically connected near the bedrock/overburden interface.

Figure 4B provides a map view of 2012 TCE concentrations compared to the bedrock VOC plume presented in the RI report [Drumlin, 2004]. Similar to the overburden plume in **Figure 4A**, the results suggest a narrowing of the VOC plume and downgradient elongation based on consistent detections of TCE in MW-20B across Decker Brook. It should be noted that monitoring wells MW-19A/B and MW-20A/B were installed after the RI, and that VOCs may have been present in bedrock on the east side of Decker Brook prior to 2005. **Appendix F** includes a series of geologic cross sections with total VOC concentrations for each period of groundwater monitoring. The cross sections illustrate a consistent trend that VOCs remain elevated in the overburden near the source area, and migrate down to shallow bedrock with the highest downgradient concentrations at MW-19B at the base of Tenney Hill.

6.2 Supply Well Analytical Results

Table 6 provides a summary of analytical results for supply wells sampled on the HLC property since 2003 (**Figure 2**). No COCs have been detected in these wells since

2005, and 1,4-dioxane was not detected in the 2012 sample collected from Hancock DW as reported in **Table 4**.

7. MONITORING WELL ABANDONMENTS

In early 2013 several monitoring wells at the Site were selected for abandonment based on historical groundwater data collected to date. On April 16 and 17, 2013 Northern Test Borings (NTB) of Gorham, Maine mobilized to the Site with a track-mounted drill rig and support truck to abandon monitoring wells GP-26, GP-30, GP-44, MW-13Y/Z, MW-18A/B, MW-20A, and MW-21 as shown on **Figure 5**. A MEDEP staff geologist provided oversight of monitoring well abandonments that were performed by NTB. MEDEP well abandonment records completed by MEDEP staff and NTB are included in **Appendix G**.

8. CONCLUSIONS AND RECOMMENDATIONS

Groundwater sampling results collected from the 2012 event and previous MEDEP sampling events since 2005 indicate that VOC contaminated groundwater at the Site has naturally attenuated from one to two orders of magnitude since the source removal action of 2003. Chlorinated solvents such as TCE, PCE, and cis-1,2 DCE continue to persist in both overburden and bedrock groundwater above their respective MEGs/MCLs, and will likely continue to do so for at least 120 years based on trend analyses presented herein. However, routine sampling of supply and drinking water wells at the HLC sawmill facility immediately north of the VOC impacted area has shown consistent non-detections of Site COCs since 2005, despite continued and regular pumping from bedrock supply wells over the time period discussed here. Therefore, risks to human health from ingestion of VOC impacted water at the HLC sawmill facility appears to be practically negligible.

MEDEP Technical Services recommends completing the following tasks in advance of the next triennial sampling event scheduled for September 2015:

1. Perform a top of casing elevation survey of the remaining monitoring wells at the Site, including monitoring wells MW-19A/B/C and MW-20B which were not surveyed after their installation sometime in 2006. This survey information will help improve the determination of groundwater flow in the subsurface at the

Site.

2. Collect a drinking water sample from the Hancock DW well for analysis of VOCs via EPA 524.2 on an annual basis, beginning on September 2013. This well represents the most likely risk pathway to receptors at the Site, and as such could be treated as a "sentry" sample point. An annual sampling frequency will allow MEDEP to more quickly re-evaluate the long term monitoring plan in the event COCs are detected, and would also be more protective of human health. The data collected to date indicates the risk to human health is negligible, however groundwater usage by HLC at the Site may vary more frequently than what could be determined on a triennial basis.

MEDEP Technical Services proposes the following option for future work at the Site:

1. Install transducers in selected Site monitoring wells and Hancock Lumber production wells to help assess whether these wells are hydraulically connected, and could potentially draw VOCs from the plume towards the Hancock Lumber bedrock wells. Analytical data collected so far seems to indicate that these wells are weakly connected, and that the VOC plume does not appear to be migrating northward towards the Hancock Lumber facility.

9. REFERENCES

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Maine CDC drinking water maximum exposure guidelines, 2012.

TABLES

FIGURES

APPENDIX A

MONITORING WELL BORING LOGS

APPENDIX B

MGS WATER WELL RECORDS

APPENDIX C

GROUNDWATER SAMPLING FIELD LOGS

APPENDIX D

VOC CONCENTRATION TREND CHARTS

APPENDIX E

GEOLOGIC CROSS SECTIONS WITH VOC RESULTS

APPENDIX F

MONITORING WELL ABANONDMENT RECORDS