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NEW ENGLAND INTERCOLLEGIATE
GEOLOGICAL CONFERENCE

*108th Annual Meeting*

# Guidebook for Field Trips along the Maine Coast from Maquoit Bay to Muscongus Bay

*Edited by*

Henry N. Berry IV and
David P. West, Jr.

*Hosted by*

The Maine Geological Survey and
The Middlebury College Geology Department

October 14-16, 2016

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# WHAT TO DO ABOUT 2,000 GALLONS OF OIL IN A SCHOOL LEACHFIELD: AN ENVIRONMENTAL GEOLOGIST'S PERSPECTIVE

By

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## SITE INFORMATION

### Background

On February 4, 2015, approximately 2,100 gallons of No.2 fuel oil were mistakenly deposited into a pump station associated with an engineered subsurface wastewater disposal system located behind the Medomak Middle School (middle school) in Waldoboro, Maine. It is estimated that approximately 750 gallons of oil were recovered from the pump station and other components of the system, including piping and other underground structures. The remaining oil is migrated to the two leach fields. Maritime Energy immediately accepted responsibility and worked with the Maine Department of Environmental Protection (MEDEP), Maine Drinking Water Program (MEDWP), and school officials from MSAD #40 to remediate the oil, rebuild the leachfields, and conduct a hydrogeologic investigation to assess the long-term effects, if any, of the release. This report documents the remediation and hydrogeologic investigation.

### Site Description

The middle school is located on the west side of Manktown Road in Waldoboro, Maine, about 0.5 miles north of US Route 1 (see **Figure 1, Site Location Map**). Drinking water is provided by a drilled bedrock well and sanitary wastewater is discharged from a holding tank to two septic leachfields (Leach Field #1 to the east and Leach Field #2 to the west), each about 150 feet long and 50 feet wide (see **Figure 2, Site Plan).** This Site Plan also shows the location of 9 monitoring wells that were installed after the replacement of the leachfields.

## REMEDIATION METHODS AND RESULTS

### Objective

The objective of the remediation was to remove all oil-contaminated soil with Extractable Petroleum Hydrocarbon (EPH) concentrations above the MEDEP Remedial Action Guidelines (RAGs) for leaching to groundwater.

### Method

The top 1 to 3 feet of "clean" soils were mechanically excavated from the top of each leach field. These soils were live-loaded into dump trucks for transportation to the nearby George C. Hall & Sons (Hall) gravel pit in Thomaston, Maine. Clean soils were excavated under the direction of the St.Germain Collins, who used visual and olfactory evidence to determine the boundary between clean soils and oil-impacted soils.

Once the clean soil was removed, the oil-impacted soils were mechanically excavated from each leach field and live-loaded into dump trucks. (The leach field piping and other components were also removed and managed separately.) This process continued until the exposed soil across the entire leach field appeared free of impacts, at which time a 10-foot by 10-foot grid was established across and on the walls of each leach field excavation (the wall grid cells were 10 feet long laterally and as high as the excavation wall, typically about 4 feet). Grid cells are labeled based upon an alphabetic and numeric axes that define the gridded area, such as A12, B3, and C5.

A surface soil sample from each grid cell was then collected and tested for oil following the MEDEP oleophilic dye test method. If the test shows "Saturated," "Positive," or "Slightly Positive" results, additional soils were excavated and field samples were collected and tested until "Undetected" results occurred. Ten percent of the field sample locations were laboratory samples. All samples were analyzed for EPH using the Massachusetts Department of Environmental method, and shipped to Alpha Analytical of Westborough, Massachusetts in a chilled cooler under standard chain of custody protocol. The laboratory results were used to confirm that no soil remained with EPH levels above the MEDEP RAG.

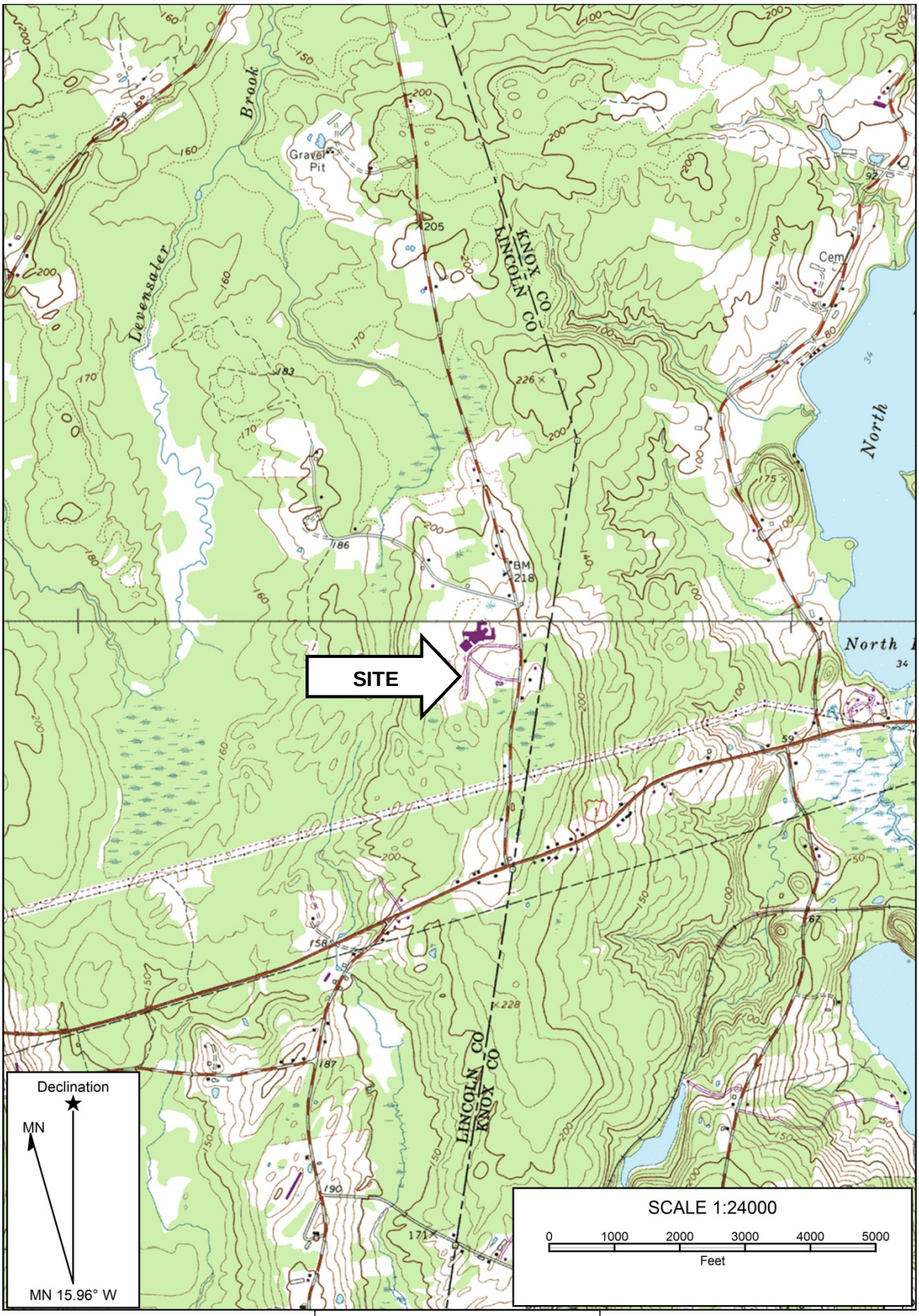


**Figure 1) Site Location Map**

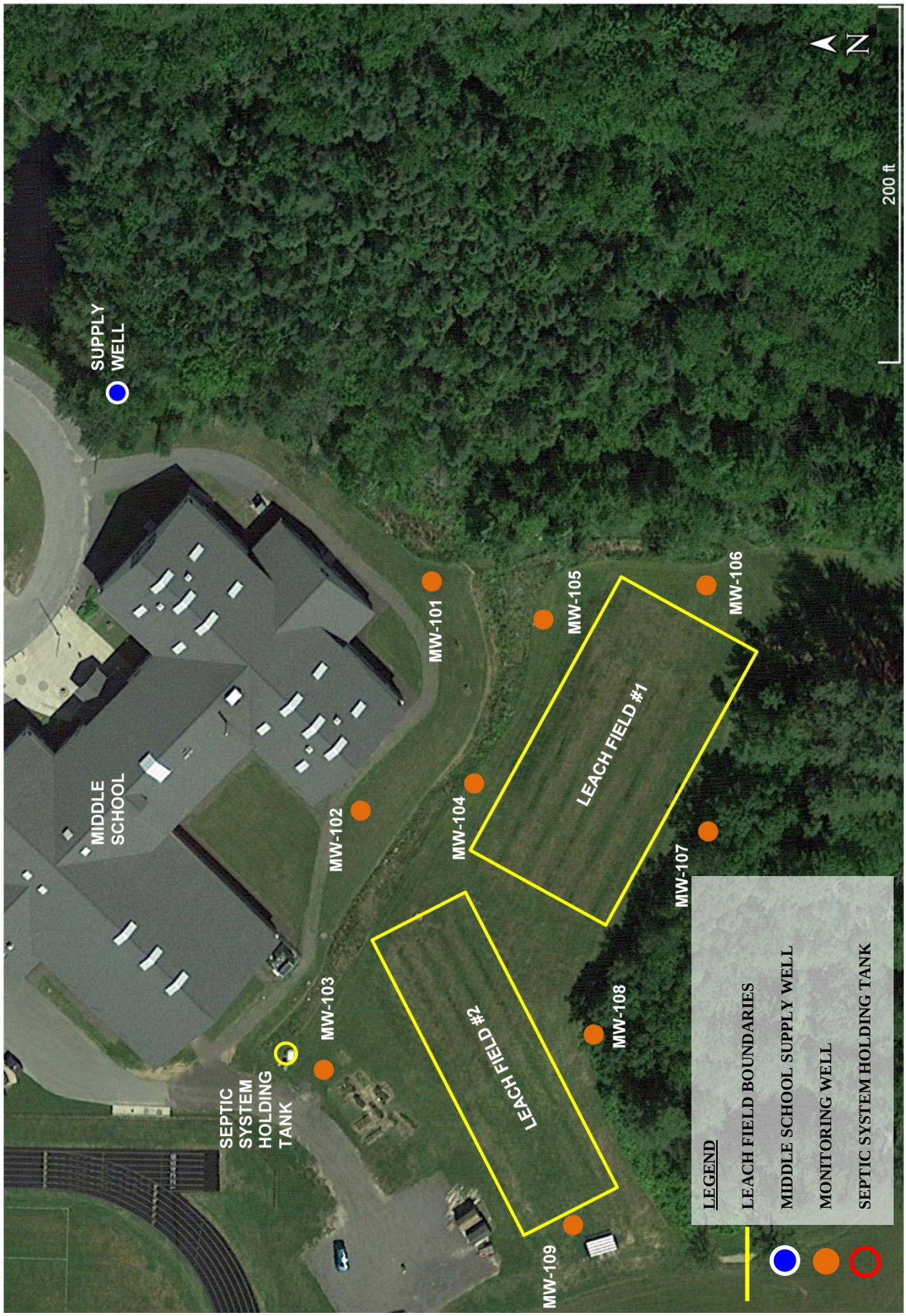


**Figure 2) Site Plan**

**Results**

Each leach field was initially excavated to a depth of about 3 to 4 feet below grade before visual and olfactory evidence of contamination was not present. As shown on **Figure 3, Initial Field Screening Results,** soil from the entire footprint of Leach Field #1 was removed due to contamination, but only about 80% of Leach Field #2 was removed, with the end farthest from the discharge pipe remaining clean. This figure also shows the results of the first round of oleophilic dye tests. Leach Field #1 exhibited dye test results above "Undetected" at 13 locations, while Leach Field #2 had 9 locations above "Undetected". Only one of these initial screening points was along an excavation side wall.

For both leach fields, most of the locations where the field test detected oil required about 2 to 5 feet of further excavation before an "Undetected" result was obtained. However, in the vicinity of cell F6 at Leach Field #1 and C13 at Leach Field #2, further excavation encountered more oil contamination. In some locations the surface soil was not contaminated but oil was found several feet below. Free product was visible in the bottom of some excavations at Leach Field #1. This phenomenon is likely due to the oil moving through fractures in the soil (glacial till as described later) since it otherwise exhibits a low permeability. The excavations in these areas expanded laterally to encompass adjacent grid cells and were terminated with MEDEP approval at about 8 feet where groundwater seepage was encountered.

As shown on **Figure 4, Final Excavation Boundaries**, the lateral expansion at the southeast corner of Leach Field #1 extended up to 15 feet beyond the original grid boundaries. Although oleophilic dye tests showed the presence of oil along the excavation boundaries here, MEDEP approved terminating the excavation due to the presence of a forested wetland to the south and the unpredictable nature of the contamination distribution. Leach Field #2 had two smaller areas where the excavation extended beyond the original grid boundaries. Figure 4 also shows the location of confirmatory samples that were collected from the excavation bottom or side walls. Fifteen samples were collected from Leach Field #1 while 9 samples were collected from Leach Field #2.

**Table 1a&b, Confirmatory Soil Sample Results**, present the results of confirmatory sampling. All of the samples were reported with EPH below the RAGs except one from Leach Field #1 (sample LS-E-0-F), located on the eastern wall of cell F0. This sample was reported with naphthalene and 2-methylnaphthalene slightly above the RAG. Because of the low concentrations and the sample being collected from the southeast corner of the leach field as discussed above, MEDEP approved cessation of soil removal.

Approximately 4,640 tons of oil-contaminated soil were removed from the two leach fields and temporarily stockpiled at the Hall pit. After MEDEP approval, the soil was shipped to the Rockland municipal landfill to be used as daily cover.

**Leachfield Replacement**

The leachfields were replaced immediately after the soil removal and final confirmatory sampling.

## HYDROGEOLOGIC INVESTIGATION

**Objectives**

The objectives of the investigation were as follows:

1. Determine if overburden groundwater in the vicinity of the leach fields has been contaminated with oil.

2. Calculate groundwater flow direction in the vicinity of the leach fields and with respect to the middle school supply well.

3. Create a network of monitoring wells that can be used for additional monitoring, as appropriate.

**Methods**

On May 1 and 4, 2015, St.Germain Collins supervised the advancement of soil borings and construction of monitoring wells using a geoprobe operated by Environmental Projects, Inc. of Auburn, Maine. Each boring was advanced with continual soil sampling and classification to 16 feet, and the borings were completed with a 1-inch

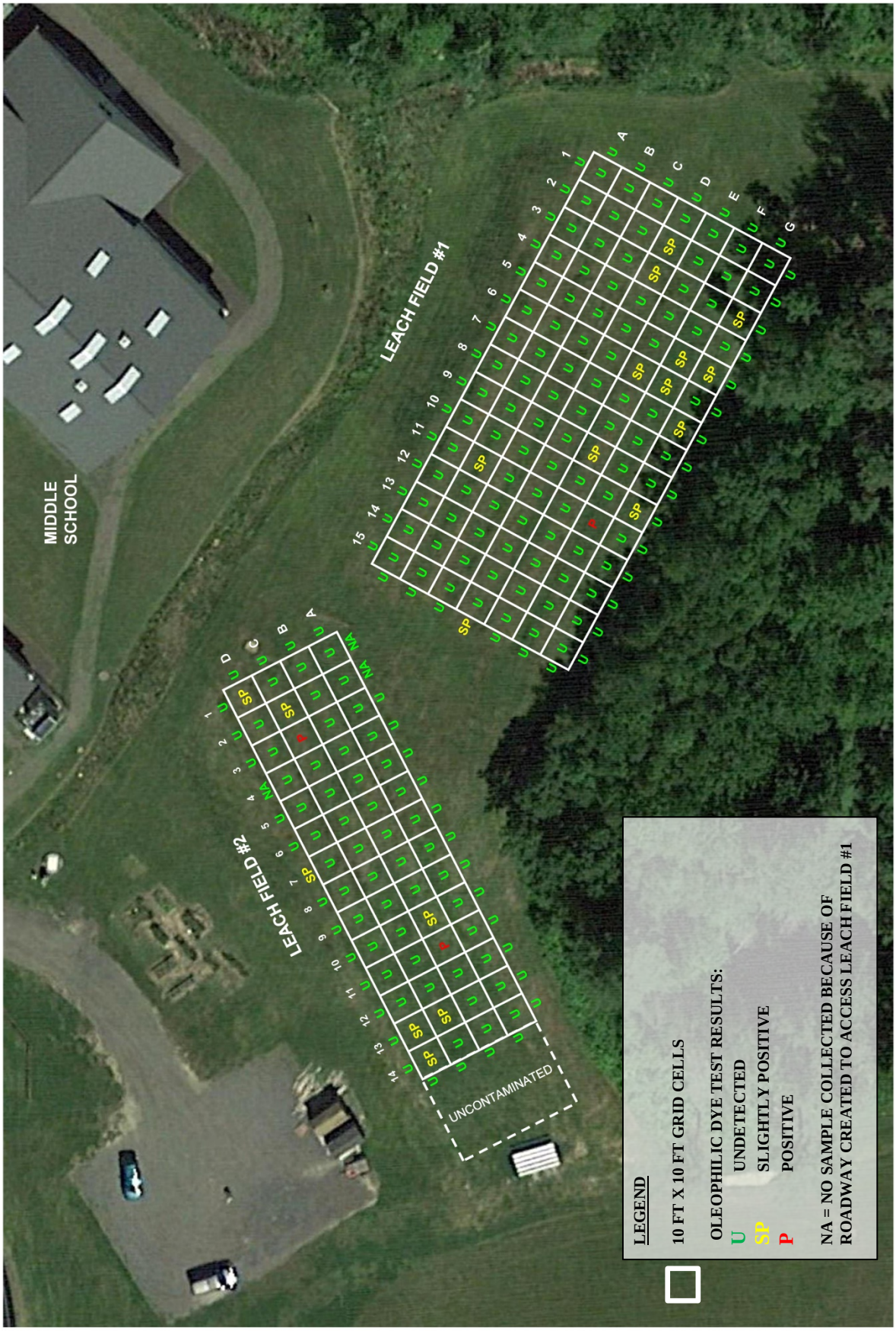


**Figure 3) Initial Field Screening Results**

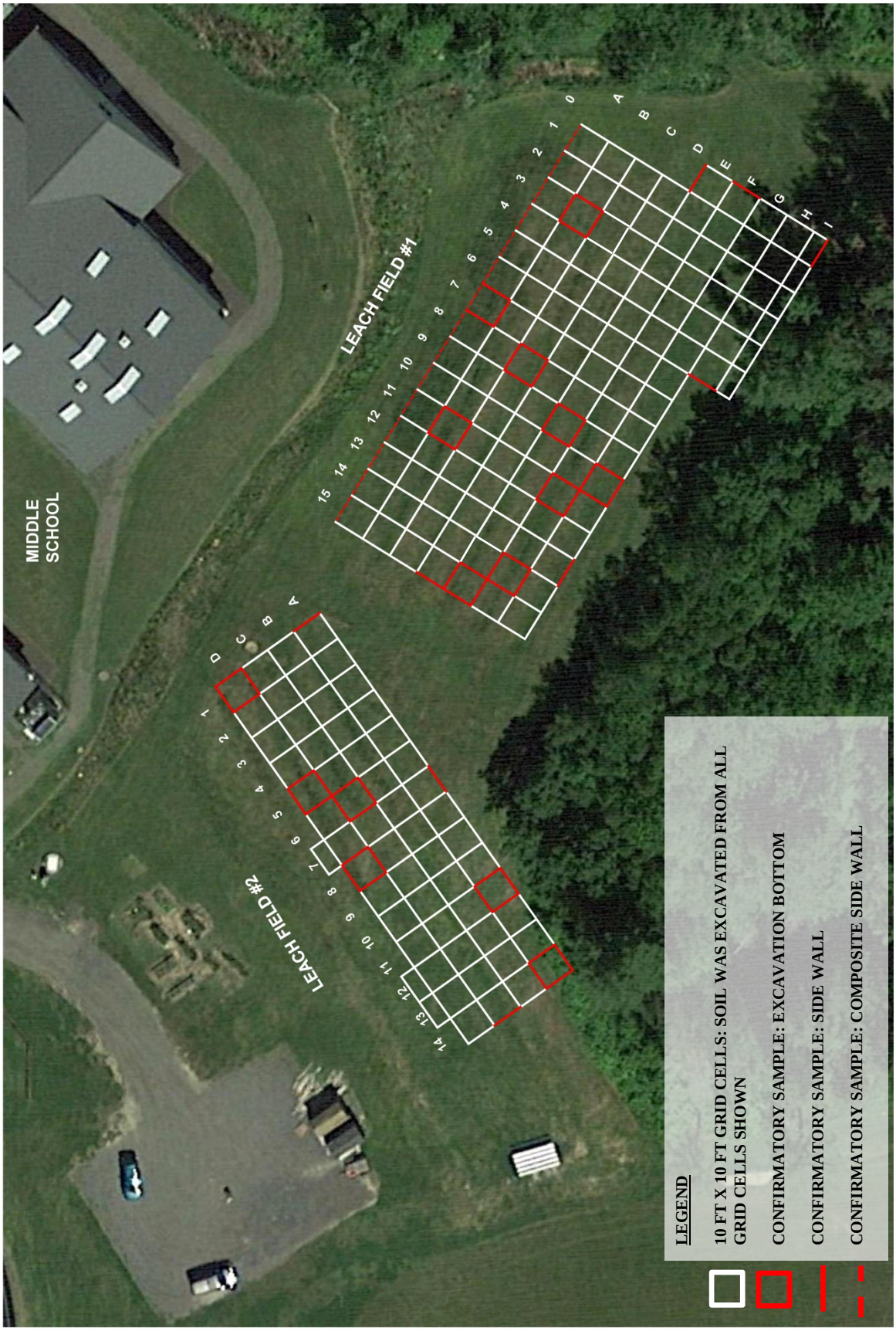


**Figure 4) Confirmatory Sample Locations**

**Table 1a: Leach Field #1**
**Confirmatory Soil Sample Results**
**Medomak Middle School**
**Waldoboro, Maine**

| LOCATION | NSW-1 (FIELD #1)* | NSW-2 (FIELD #1)* | NSW-3 (FIELD #1)* | LS-8-C | LS-9-E | LS-11-B | LS-11-F | LS-14-F |
|---|---|---|---|---|---|---|---|---|
| SAMPLE DATE | 3/6/2015 | 3/6/2015 | 3/6/2015 | 3/13/2015 | 3/13/2015 | 3/13/2015 | 3/13/2015 | 3/13/2015 |
| C9-C18 Aliphatics | **26.7** | **136** | 6.99 U | 7.56 U | 6.78 U | **30.3** | 7.98 U | 9.98 U |
| C19-C36 Aliphatics | **18.8** | **46.9** | 6.99 U | 7.56 U | 6.78 U | **12.3** | 7.98 U | 9.98 U |
| C11-C22 Aromatics, Adjusted | **37** | **93.8** | **7.2** | 7.56 U | 6.78 U | **41.8** | 7.98 U | 9.98 U |
| Naphthalene | 0.052 | **0.201** | 0.028 U | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| 2-Methylnaphthalene | 0.095 | **0.7** | 0.028 U | 0.03 U | 0.027 U | **0.235** | 0.032 U | **0.05** |
| Acenaphthylene | 0.036 | 0.137 U | 0.028 U | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Acenaphthene | 0.029 U | 0.137 U | 0.028 U | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Fluorene | 0.049 | 0.137 U | 0.028 U | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Phenanthrene | **0.862** | **0.182** | **0.06** | 0.03 U | 0.027 U | **0.183** | 0.032 U | 0.04 U |
| Anthracene | 0.052 | 0.137 U | 0.028 U | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Fluoranthene | **1.22** | **0.144** | **0.425** | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Pyrene | **1.08** | **0.166** | **0.45** | 0.03 U | 0.027 U | **0.038** | 0.032 U | 0.04 U |
| Benzo(a)anthracene | 0.354 | 0.137 U | 0.225 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Chrysene | **0.504** | 0.137 U | 0.256 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Benzo(b)fluoranthene | **0.521** | 0.137 U | 0.328 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Benzo(k)fluoranthene | 0.208 | 0.137 U | 0.134 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Benzo(a)pyrene | 0.324 | 0.137 U | 0.228 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Indeno(1,2,3-cd)Pyrene | 0.236 | 0.137 U | 0.173 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Dibenzo(a,h)anthracene | 0.051 | 0.137 U | 0.038 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |
| Benzo(ghi)perylene | 0.229 | 0.137 U | 0.166 | 0.03 U | 0.027 U | 0.03 U | 0.032 U | 0.04 U |

**Table 1b: Leach Field #1**
**Confirmatory Soil Sample Results**
**Medomak Middle School**
**Waldoboro, Maine**

| LOCATION | LSS-D-8 (FIELD #2) | LSS-C-6 (FIELD #2) | LSS-D-5 (FIELD #2) | LSS-D-1 (FIELD #2) | LSS-A-11 (FIELD #2) | LSS-A-14 (FIELD #2) | LSS-E-C-14 (FIELD #2) | LSS-S-A-7 (FIELD #2) | LSS-W-A-1 (FIELD #2) | MEDEP LG RAGs |
|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATE | 3/24/2015 | | | | | | | | | |
| C9-C18 Aliphatics | 7.46 U | 7.84 U | 7.4 U | 8.14 U | 7.46 U | 7.45 U | 7.37 U | 6.51 U | 6.73 U | 10,000 |
| C19-C36 Aliphatics | 7.46 U | 7.84 U | 7.4 U | 8.14 U | 7.46 U | 7.45 U | 7.37 U | 6.51 U | **15.5** | 10,000 |
| C11-C22 Aromatics, Adjusted | 7.46 U | 7.84 U | 7.4 U | 8.14 U | 7.46 U | 7.45 U | 7.37 U | 6.51 U | 6.73 U | 460 |
| Naphthalene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 1.7 |
| 2-Methylnaphthalene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 3.6 |
| Acenaphthylene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 68 |
| Acenaphthene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 170 |
| Fluorene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 120 |
| Phenanthrene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 97 |
| Anthracene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 2,400 |
| Fluoranthene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Pyrene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Benzo(a)anthracene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Chrysene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Benzo(b)fluoranthene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Benzo(k)fluoranthene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Benzo(a)pyrene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Indeno(1,2,3-cd)Pyrene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Dibenzo(a,h)anthracene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |
| Benzo(ghi)perylene | 0.03 U | 0.031 U | 0.03 U | 0.033 U | 0.03 U | 0.03 U | 0.03 U | 0.026 U | 0.027 U | 10,000 |

Data in mg/kg
U= not detected above listed limit
MEDEP LG RAGS= Maine Department of Environmental Protection Leaching to Groundwater Remedial Action Guidelines, 2013.
Shading indicates exceedence of Remedial Action Guideline.

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File No.: 3687
7/16/2015

diameter PVC well with a 10-foot screen and a filter sand pack around the screen. The two wells closest to the middle school (see Figure 2) were completed with the screen interval from 4 to 14 feet below grade since the water table was suspected to be shallower in this area, while the remainder of the wells were constructed with the screen interval from 5 to 15 feet below grade. The wells were completed with a flush-mount road box, and then surveyed for location and relative elevation so a groundwater contour map could be prepared.

On May 19, 2015, St.Germain Collins collected groundwater samples from the 9 wells for analysis of EPH. The samples were collected using MEDEP Standard Operating Procedure DR#002 (*Groundwater Collection for Site Investigation and Assessment Monitoring*).

**Hydrogeology**

Site geology consists of brown gray, dense glacial till with sandy, silty, or clayey silt matrices depending on location and depth. Gravel, cobbles, and boulders were variably present. No refusal was encountered at the boring termination depth of 16 feet except at well MW-105 where refusal occurred at a depth of 9 feet.

Water levels in the wells ranged from about 1 to 5 feet below grade, as summarized on **Table 2, Well Construction Data**. **Figure 5, Groundwater Contour Map**, shows water table contours from data collected on May 19, 2015. Groundwater flow is generally southwest to northeast but shows a more easterly trend at east side of the leachfields. The forested area immediately to the east is a wetland as mapped by the Turner Group who designed the school. This area has a ground surface elevation of about 215 to 216 feet msl, which is about 4 to 5 feet lower than the surrounding area, and in turn likely represents a discharge area for overburden groundwater from the leachfields, the land surrounding the middle school itself, and the higher land along Manktown Road.

**Soil Quality**

St.Germain Collins was prepared to collect soil samples from the borings for field and/or laboratory analysis if visual or olfactory evidence of contamination was observed, but no such evidence was identified.

**Water Quality**

Analytical results from the groundwater sampling are summarized on **Table 3, Groundwater Sampling Results**. Five wells (MW-2 through MW-5, and MW-7) were reported with detectable levels of EPH, with well MW-103 reported with one parameter (C9-C18 Aliphatics at 1,250 ug/l) above the Maine CDC Maximum Exposure Guideline (MEG) of 700 ug/l. With the exception of MW-107, all of these wells are hydraulically downgradient from the leachfields. Well MW-107 is in the general vicinity of a zone of concentrated oil contamination in soil that extended into the woods (see description in Section 2.3), which may be the explanation for groundwater contamination in an apparently upgradient location.

**Table 2**
**Well Construction Data**
**Medomak Middle School**
**Waldoboro, Maine**

| Well | Well Screen Interval | Top of Well Elevation | DTW 5/19/15 | WL Elevation 5/19/15 |
|---|---|---|---|---|
| MW-101 | 4-14 | 93.05 | 3.87 | 89.18 |
| MW-102 | 4-14 | 94.03 | 2.92 | 91.11 |
| MW-103 | 5-15 | 95.80 | 2.94 | 92.86 |
| MW-104 | 5-15 | 93.15 | 0.71 | 92.44 |
| MW-105 | 5-15 | 92.57 | 1.74 | 90.83 |
| MW-106 | 5-15 | 94.80 | 4.44 | 90.36 |
| MW-107 | 5-15 | 96.57 | 3.16 | 93.41 |
| MW-108 | 5-15 | 95.10 | 1.56 | 93.54 |
| MW-109 | 5-15 | 96.95 | 3.10 | 93.85 |

Notes:
Data in feet.
DTW = depth to water.
WL = water level.
Elevations relative to arbitrary site datum.

It is unclear why the highest EPH concentrations were reported for well MW-103, which is somewhat distant from the western leachfield. This well is relatively close to the septic system holding tank where it is possible that some oil leaked out of the tank or piping during the release. However, this source is not supported by the groundwater flow direction here and the absence of naphthalene and 2-methylnaphthalene, which are the two primary compounds making up fuel oil.

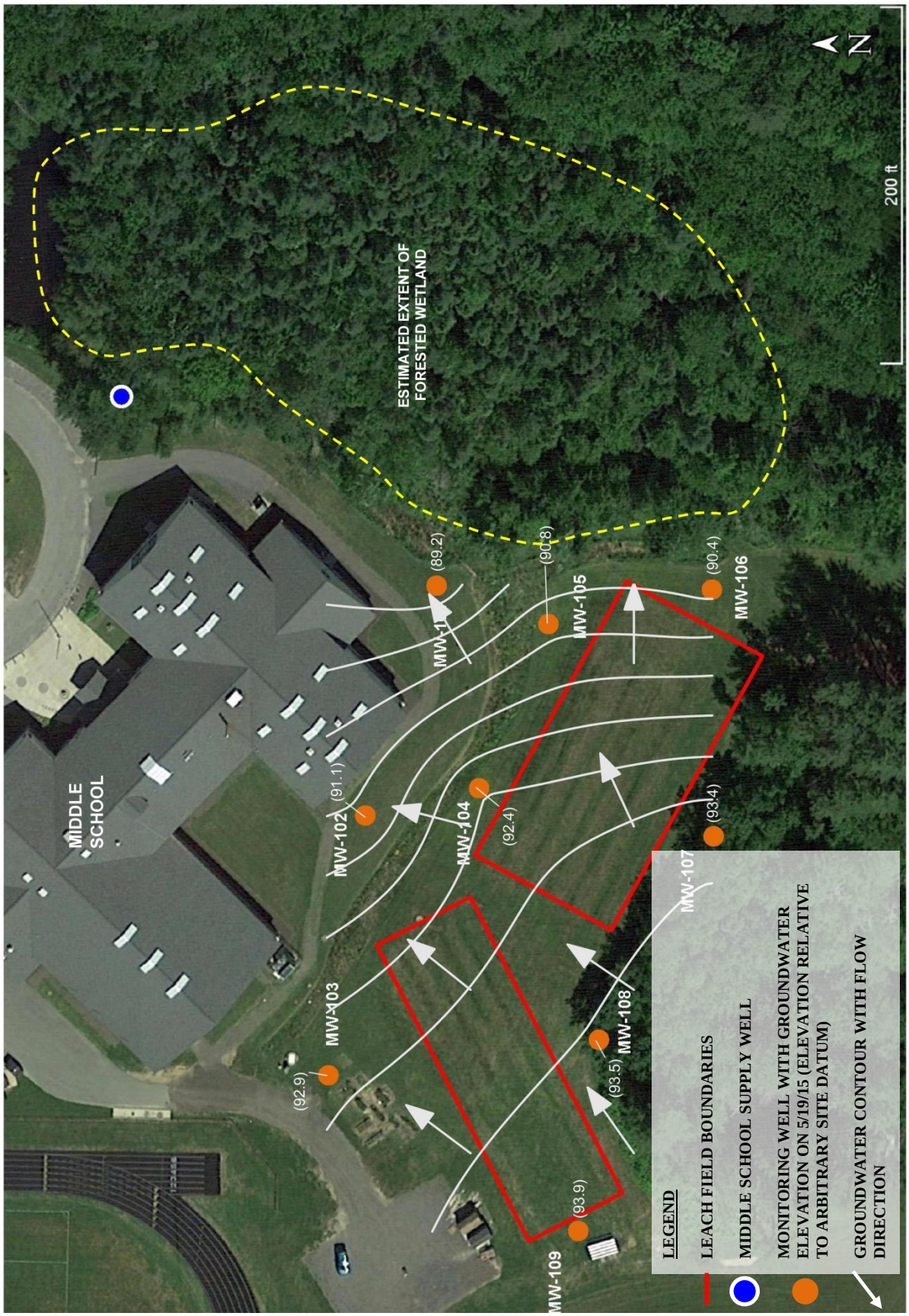


**Figure 5) Groundwater Contour Map**

**Table 3**
**Groundwater Sampling Results**
**Medomak Middle School Leachfields**
**Waldoboro, Maine**

| Parameters | MEGs | MW-101 | MW-102 | MW-103 | MW-104 | MW-105 | MW-106 | DUP* | MW-107 | MW-108 | MW-109 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C9-C18 Aliphatics | 700 | 100 U | 100 U | **1,250** | 100 U | 100 U | 100 U | 100 U | 100 U | 100 U | 100 U |
| C19-C36 Aliphatics | 10,000 | 100 U | 100 U | **1,960** | 100 U | 100 U | 100 U | 100 U | **102** | 100 U | 100 U |
| C11-C22 Aromatics, Adjusted | 200 | 100 U | 100 U | 500 U | 100 U | 100 U | 100 U | 100 U | 100 U | 100 U | 100 U |
| Naphthalene | 10 | 0.4 U | **0.539** | 2 U | **1.72** | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| 2-Methylnaphthalene | 30 | 0.4 U | **1.11** | 2 U | **4.65** | **0.414** | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Acenaphthylene | NA | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Acenaphthene | 400 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Fluorene | 300 | 0.4 U | 0.4 U | 2 U | **0.647** | **0.496** | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Phenanthrene | NA | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Anthracene | 2,000 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Fluoranthene | 300 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Pyrene | 200 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Benzo(a)anthracene | 0.5 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Chrysene | 50 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Benzo(b)fluoranthene | 0.5 | 0.4 U | 0.4 U | **2** | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Benzo(k)fluoranthene | 5 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Benzo(a)pyrene | 0.05 | 0.2 U | 0.2 U | 1 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U |
| Indeno(1,2,3-cd)Pyrene | 0.5 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Dibenzo(a,h)anthracene | 0.05 | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |
| Benzo(ghi)perylene | NA | 0.4 U | 0.4 U | 2 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U | 0.4 U |

Notes:
Samples collected 5/19/15.
Data in ug/l.
MEGs = Maine CDC 2012 Maximum Exposure Guideline.
NA = not applicable.
Underline indicates detection limit greater than MEG.
Shading indicates exceedence of MEG.
* = duplicate of MW-106.

St.Germain Collins
File No.: 3687
7/16/2015

**Risk to Middle School Supply Well**

One concern after the oil release was that the middle school supply well could become contaminated (see Figure 2 for location). This well was constructed in 2008 with the following specifications as provided by the Maine Drinking Water Program:

- 300 feet total depth
- 40 feet to bedrock
- 50 feet 6-inch diameter steel casing
- Jaswell seal with 4–inch diameter PVC casing to 80 feet below ground surface
- Yield 12 gpm

The supply well is unlikely to become contamination for the following reasons:

- Oil contamination would have to travel through 40 feet of overburden and then 40 feet of bedrock before reaching the bedrock borehole, despite oil being less dense than water.

- Overburden groundwater contours suggest the overburden groundwater from the area of the leachfield will flow toward and discharge into the wooded wetland to the east.

- The glacial till is dense and mostly fine-grained, which would result in a low permeability and in turn a slow contaminant migration velocity, allowing dispersion and degradation to attenuate the contaminants.

Furthermore, the middle school well has been sampled on a monthly basis by Water Quality and Compliance for EPH, Volatile Petroleum Hydrocarbons (VPH) and Volatile Organic Compounds (VOCs) since March 2015 and no EPH, VPH or VOC compounds have been detected with the exception of a trace level (0.526 ug/l) of naphthalene in June 2015. Naphthalene was not detected in the July Sample. The Medomak High School well, located about 1,000 feet north of the middle school, has also been sampled twice since the release and no EPH, VPH, or VOC compounds have been detected.

## CONCLUSIONS

St.Germain Collins supervised the excavation of approximately 5,000 cubic yards of soil contaminated with #2 fuel oil from two leach fields that serve the Medomak Middle School in Waldoboro, Maine. Twenty-four confirmatory samples were collected from the two excavations for EPH analysis and all but one sample were reported with EPH levels below the MEDEP Leaching to Groundwater RAG. The sample that did exceed the RAG was reported with two compounds only slightly above guidelines. MEDEP did not require further excavation where this sample was collected due to the low EPH levels, and the unpredictable and limited nature of the contamination distribution.

The leach fields were subsequently rebuilt and 9 monitoring wells were installed and sampled. The geologic materials consist of dense glacial till at all locations with groundwater between 1 and 5 feet below grade. Groundwater flow is to the northeast and east and is interpreted to ultimately discharge to a wooded wetland next to the school. No soil contamination was encountered but several wells showed low levels of EPH compounds.

The bedrock well serving the school is not considered under threat from the residual groundwater contamination because of geologic conditions and the well construction, which make migration to the well unlikely.

As proposed in the investigation work plan, the monitoring wells will be sampled quarterly for two years (through June 2017), unless the results warrant a reduction in frequency and number of samples.