ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

47 OREAD STREET
PARCEL ID: MAP 06, BLOCK 028, LOT 00015
WORCESTER, MASSACHUSETTS

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CERTIFICATION

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Revision: 0
47 Oread Street
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Worcester, Massachusetts

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The following personnel have prepared and/or reviewed this report for accuracy, content, and quality of presentation.

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1.0 INTRODUCTION

This Analysis of Brownfield Cleanup Alternatives (ABCA) has been prepared on behalf of Regional Environmental Council, Inc. (REC) to evaluate cleanup alternatives for the property located at 47 Oread Street in Worcester, Massachusetts (the property). The City of Worcester, Massachusetts (City), is planning to apply funds from the United States Environmental Protection Agency (EPA) Brownfields Revolving Loan Fund (RLF) to the remediation of soil impacted by a release of oil and/or hazardous materials (OHM). OHM in soil consists of lead, arsenic, polycyclic aromatic hydrocarbons (PAHs), and tetrachloroethylene (PCE). The proposed remediation will support redevelopment of the property for use as an agricultural greenhouse as part of YouthGROW project, which teaches inner city teenagers about urban agriculture.

This report summarizes previous work and presents cleanup alternatives to guide selection of a remedy for the identified hazards. This ABCA was prepared in accordance with relevant federal and state regulatory agency requirements. The recommended cleanup alternative will be implemented following Massachusetts Department of Environmental Protection (MassDEP) and EPA approval of the ABCA. A Quality Assurance Project Plan (QAPP) and Site-specific Health & Safety Plan (HASP) will be submitted to EPA and MassDEP for review and approval prior to the start of cleanup.

2.0 BACKGROUND

2.1 Property Description

The property at 47 Oread Street is a 0.18-acre parcel owned by REC and described by the City of Worcester Assessor's Department as Map 06, Block 028, Lot 00015. The property is currently improved by a shed in the western portion of the property. Remaining portions of the parcel are vacant unimproved land.

The property is located at an elevation of approximately 520 feet above mean sea level. Although heavily modified by human activity, regional topography generally slopes downward to the east and south, toward Southbridge Street.

The property is located in a Residential zone (RG-5) of Worcester. Residential properties along Beacon Street abut the property to the north. A multi-tenant commercial property at 42 Lagrange Street occupied by REC, the REC YouthGROW Farm, and Atlantic Ball Valve Corporation, abuts the property to the east and south. Oread Street abuts the property to the west, beyond which are residential properties. The location of the property is depicted on Figure 1 – *Site Location Map* and property features are depicted on Figure 2 – *Site Plan.*

2.2 Forecasted Climate Conditions

According to the National Oceanic and Atmospheric Administration (NOAA) State Climate Summary for Massachusetts, dated 2022, climate trends for Massachusetts and the northeast region of the United States include increased temperatures, greater precipitation variability, increase in winter and spring precipitation, increase of extreme precipitation events, and a rise of sea level. A summary of forecasted climate conditions from NOAA is included in Appendix A.

According to a United States Federal Emergency Management Agency (FEMA) Flood Zone Map 25027C0618E, which is included in Appendix B, the property is not located within a flood hazard area. Surface water bodies are not located within 500 feet of the property, and nearby surface water bodies are at least 20 feet lower in elevation. Any change in flood zones will not affect the property due to its location and elevation relative to nearby surface water.

2.3 Property Ownership and History

According to the City of Worcester Assessor's Office, the property is currently owned by REC with a purchase date of February 27, 2025. According to information included in an ASTM *Phase I Environmental Site Assessment* (November 2024 Phase I ESA) for the properties at 108 & 112 Beacon Street and 47 Oread Street, which was prepared by Omni Environmental Group and dated November 2024, and updated information from REC, the land use history is summarized as follows:

- 1892 to 1993: The property was improved by a three-story residential apartment building in the western, northern, and central portions of the property. A four-car auto garage was constructed circa 1936.
- 1993 to 2003: One or more fires destroyed the residential building and garage in the early 1990s. According to REC, the current property owner, the building was demolished, the foundation was buried, and the remainder of the materials were hauled off-site for disposal.
- Mid-1990s to Early 2000s: According to REC, unpermitted dumping activities occurred on 47 Oread Street and the eastern abutting property. The waste included general litter, old appliances, tires, and construction materials.
- 2016 to Present: Following the installation of a soil cap, which reportedly includes a demarcation barrier and soil and crushed stone, a hoop greenhouse was constructed, and the property was utilized as part of the YouthGROW farm for urban agriculture activities. The soil cap was reportedly placed based on prior testing data indicating the presence of lead at elevated concentrations. The property was purchased by REC on February 27, 2025, and the greenhouse was removed from the property and relocated off-site.

2.4 Previous Environmental Assessments

Environmental investigations, including a due diligence environmental assessment and subsurface investigations, were conducted at the property between October 2024 and May 2025. Investigations have consisted of property inspection, advancement of soil borings, installation of groundwater monitoring wells, excavation of test pits, hand auger soil sampling, and the collection of soil and groundwater samples for laboratory analysis. Soil sampling locations and groundwater monitoring wells are depicted in Figure 2. Findings from these assessments are summarized below.

2.4.1 November 2024 Phase I Environmental Site Assessment

According to the November 2024 Phase I ESA, three potential recognized environmental concern were identified at the property:

1. Building fire(s) in the early 1990s resulted in the demolition and reported burying of the former residential building in its foundation, which may have resulted in releases of OHM at the property;
2. According to REC, soil sampling was performed between 2003 and 2016 in relation to the operation of the property for agriculture. REC stated that soil data indicated that lead may have been present at elevated concentrations in soil; however, laboratory results were not available; and
3. Unpermitted dumping activities reportedly took place on the subject and abutting southern property in the mid-1990s and early 2000s. The quantities and types of materials dumped are unknown.

2.4.2 January 2025 Limited Subsurface Investigation

According to a *Limited Subsurface Investigation* report prepared by CMG Environmental, Inc. (CMG) and dated February 13, 2025, subsurface investigation was performed to investigate the recognized environmental concern from the November 2024 Phase I ESA. CMG identified the potential use of per- and polyfluoroalkylated substances (PFAS) in aqueous film-forming foam (AFFF) used to extinguish the fire at the property as an additional recognized environmental concern.

On December 11 and 12, 2024, CMG oversaw the advancement of soil borings MW-5, MW-6, MW-7, and SB-3 to depths of 20 to 25 feet below ground surface (bgs) and screened soil for total organic vapors (TOVs) using a photoionization detector (PID). With the exception of a reading of 33.5 parts per million by volume (ppmv) in soil between 0 to 5 feet bgs in boring MW-7, no elevated TOV concentrations were identified. CMG collected two discrete soil samples from each boring and submitted the samples to Phoenix Environmental Laboratories, Inc. for analysis of volatile organic compounds (VOCs), volatile petroleum hydrocarbons (VPH), extractable petroleum hydrocarbons (EPH) with target PAHs, and total metals. Two soil samples were submitted for analysis of PFAS and three soil samples were submitted for analysis of asbestos.

Lead was detected in the sample collected from 2 to 4 feet in soil boring MW-6 at a concentration exceeding the applicable Massachusetts Contingency Plan (MCP) Reportable Concentration for S-1 Soil (RCS-1). Arsenic was detected in the soil samples collected from 19 to 20 feet bgs at MW-6 and 9 to 10 feet bgs at SB-3 at concentrations exceeding the RCS-1 threshold. CMG opined that arsenic concentrations in soil were naturally occurring and were exempt from MassDEP notification in accordance with 310 CMR 40.0317(22). Various analytes were detected at concentrations above laboratory reporting limits but below the RCS-1 thresholds, as shown in Appendix C in Table 1: Soil Quality Data. No PFAS were identified at concentrations above the laboratory reporting limit and asbestos was not identified in the submitted samples. Soil sample locations are depicted on Figure 2.

Groundwater samples were collected from monitoring wells MW-5, MW-6, and MW-7 in January 2025 for laboratory analysis of VOCs, VPH, EPH, and dissolved Resource Conservation and Recovery Act (RCRA8) metals. The samples from MW-6 and MW-7 were submitted for analysis of PFAS. No analytes were detected at concentrations exceeding the applicable MCP Reportable Concentrations for GW-2 (RCGW-2) groundwater. Various analytes were detected at concentrations above laboratory reporting limits but below the RCGW-2 thresholds, as shown in Appendix C on Table 2: Groundwater Quality Data and Table 3: PFAS in Groundwater.

CMG recommended notification to MassDEP of the exceedance of the RCS-1 threshold for lead in the soil sample from MW-6 by the 120-day notification deadline of June 13, 2025.

2.4.3 April 2025 Test Pit Investigation

According to a *Release Abatement Measure (RAM) Plan* prepared by Mark Germano, LSP, and dated July 23, 2025, JTS Group, Inc. oversaw the excavation of test pits TP-1 through TP-6 by Timberline Construction on April 16, 2025, at locations depicted in Figure 2. The test pits were reportedly advanced to 5 feet bgs to obtain waste characterization samples for future soil disposal. Arsenic, lead, PCE, and benzo(a)pyrene were identified in one or more samples at concentrations exceeding the RCS-1 thresholds. These analytes were also detected in one or more of the other soil samples at concentrations exceeding laboratory reporting limits but below the RCS-1 thresholds, as shown in the table below.

Analyte	**> RCS-1**	**<RCS-1**
Arsenic	TP-1 (1-4')	TP-2
	TP-3 (0-3')	TP-4 (3-4')
	TP-6 (1-3')	TP-5 (2-3')
Lead	TP-1 (1-4')	TP-2
	TP-3 (0-3')	TP-6 (1-3')
	TP-4 (3-4')	
	TP-5 (2-3')	
Tetrachloroethylene	TP-3 (0-3')	TP-5 (2-3')
Benzo(a)pyrene	TP-1 (1-4')	TP-3 (0-3')
	TP-5 (2-3')	

Lead was detected at a concentration of 3,860 milligrams per kilogram (mg/kg) in soil sample TP-1 (1-4'). Accordingly, the sample was submitted for analysis of total lead following toxicity characteristic leaching procedure (TCLP) extraction. Reportedly, the TCLP result did not indicate that the material would be a toxicity characteristic hazardous waste; however, TCLP analytical results have not been made available. The sample results are included in Appendix C on Table 4: Summary of Test Pit Soil Analytical Data.

2.4.4 May 2025 Hand Auger Grid Soil Sampling

According to a letter prepared by JTS Group, Inc. dated June 8, 2025, a 10-foot by 10-foot grid with columns A through D and rows 0 through 7 was established within the footprint of the proposed greenhouse building. On May 23, 2025, a hand auger was used to collect soil samples from 2 to 3 feet bgs in each grid cell, with the exceptions of cells A0, A7, and C0 due to access issues and subsurface conditions. The discrete soil samples were submitted for laboratory analysis of VOCs and a composite sample was submitted for analysis of total lead by TCLP.

PCE was detected at concentrations above the laboratory reporting limit but below RCS-1 threshold in soil samples C1, C2, and D1, and naphthalene was detected in soil sample D3. TCLP results indicated the composite soil sample was not toxicity characteristic hazardous for lead. The sample results are included in Appendix C as Table 5: Summary of Soil Analytical Data – Grid Investigation and sample locations are depicted on Figure 2.

2.4.5 December 2025 Subsurface Investigation

On December 12 and 16, 2025, Wilcox and Barton, Inc. conducted a subsurface investigation to delineate the vertical and horizontal extent of PCE detected in soil sample TP-3 and further delineate lead in soil outside the planned building footprint at the 47 Oread Street property. The results of the investigation will be used to aid the excavation and assess risk to future receptors. Analytical results have not been received and the information collected during this investigation will be included in future submittals.

2.5 Project Goal

The primary goal of this project is to redevelop the property with a permanent greenhouse structure with in-ground growing to be used as part of the YouthGROW program, which is an urban agriculture-focused youth development and employment program for teenage residents in Worcester. To achieve this goal, REC will be required to remove, manage, and dispose soil impacted with oil and/or hazardous materials in order to construct the greenhouse structure and complete the exterior surfaces/drainage structures. The removal of contaminated soil will allow for the planned redevelopment of the property.

3.0 APPLICABLE REGULATIONS AND CLEANUP STANDARDS

3.1 Cleanup Oversight Responsibility

An EPA Brownfields Revolving Loan Fund obtained by the City of Worcester will be used to facilitate the cleanup of contaminated soil. The cleanup will be overseen by the EPA and City of Worcester for compliance with applicable laws and regulations and to confirm that work was completed according to the reviewed and accepted plans.

Oversight of activities conducted under the MCP; 310 CMR 40.0000 will be the responsibility of a Licensed Site Professional (LSP) and their designated representatives. In Massachusetts, LSPs are licensed by the Board of Registration of Hazardous Waste Site Cleanup Professionals. REC has retained Wilcox & Barton, Inc. to provide LSP oversight.

3.2 Cleanup Standards

MassDEP regulates the remediation of releases of oil and/or hazardous materials within the Commonwealth of Massachusetts. The MCP establishes requirements and procedures for the prevention, notification, assessment, investigation, and remediation of releases. The MCP contains risk-based cleanup standards to use in the evaluation of risk to health and the environment. The MCP Method 1 S-1/GW-2, S-1/GW-3, S-2/GW-2, S-2/GW-3, S-3/GW-2, and S-3/GW-3 apply. Under the MCP, a condition of No Significant Risk to human health and the environment must be achieved to reach regulatory closure.

3.3 Laws and Regulations Applicable to the Cleanup

The primary laws and regulations that are applicable to this cleanup include:

- Federal Small Business Liability Relief and Brownfields Revitalization Act;
- Federal Davis-Bacon Act;
- 310 Code of Massachusetts Regulation (CMR) 40.0000 *Massachusetts Contingency Plan*; and
- City of Worcester by-laws.

In addition to the regulations promulgated under the referenced laws, MassDEP and EPA have provided numerous guidance documents and policies. Such regulations are prescriptive and require close adherence, except in unusual instances when state and/or federal regulators waive specific requirements following review of property conditions.

All applicable permits and documentation, including building permits and DigSafe, will be obtained prior to the work commencing.

4.0 EVALUATION OF CLEANUP ALTERNATIVES

4.1 Cleanup Alternatives Considered

To address contamination at the property, three alternatives were considered to achieve the project objectives and allow the proposed redevelopment. The three alternatives are as follows:

Alternative #1: No Action

Alternative #2: Targeted Soil Removal and Encapsulation, Offsite Disposal, and Implementation of an Activity and Use Limitation (AUL)

Alternative #3: Complete Removal of Impacted Soil and Offsite Disposal

4.2 Evaluation of Effectiveness, Implementability, and Cost

4.2.1 Effectiveness

- Alternative #1 – No Action: As detailed in Section 2.4 above, contaminated soil was identified by laboratory testing. Based on the available data, construction of the proposed greenhouse will disturb contaminated soil. The No Action alternative does not include any mitigation, elimination, or reduction of exposure to the contaminated media; therefore, exposure scenarios (through direct contact, inhalation, or ingestion) will not be controlled and will exist for all receptors, including visitors, workers, construction/utility workers, and/or trespassers. "No Action" is not effective in controlling or preventing exposure of receptors to contamination; as a result, the building could not be safely and legally constructed, and the project goal would not be achieved.

Alternative #2 – Targeted Soil Removal and Encapsulation, Offsite Disposal, and Implementation of an AUL: Under this alternative, approximately 620 cubic yards of soil and buried foundation/building materials in the footprint of the proposed greenhouse would be removed to a depth of 5 feet bgs. The five-foot excavation is required for building footings/foundations and to remove the former foundation and debris. Excavations will be sloped in accordance OSHA 29 CFR 1926.651. The use of shoring is not anticipated as excavations are anticipated to extend only to 5 feet below grade.

With respect to the PCE-impacted soil in the vicinity of TP-3, as it is shallow (0 to 3 feet bgs) and is easily accessible, it is anticipated that the PCE-impacted soil will be excavated during construction of the greenhouse pursuant to the provisions in 310 CMR 40.0000, the Massachusetts Contingency Plan (MCP) and the Massachusetts Department of Environmental Protection (MassDEP) Construction of Buildings in Contaminated Areas, January 2000, Policy #WSC-00-425. If the additional characterization data collected in December 2025 indicates that PCE may extend deeper than the 5-foot excavation depth beneath or immediately adjacent to the planned building, potential risk to receptors will be evaluated and site work may be modified to include additional excavation and/or vapor intrusion assessment. It is noted that the planned structure will not be consistently occupied and will not have a constructed floor.

Based on information presented in the February 2025 Limited Subsurface Investigation by CMG Environmental, Inc., depth to groundwater at 47 Oread Street ranges between 7.65 and 13.45 feet bgs. As excavations are not anticipated to be deeper than 5 feet below grade, the need for dewatering during excavation activities is not anticipated.

Confirmatory post-excavation soil sampling would be performed to evaluate remaining conditions and to calculate risk. As contaminants may not be removed to levels below the threshold for unrestricted use, installation of a geomembrane/clean soil and/or an AUL may be required to mitigate exposure to remaining contamination and maintain a condition of No Significant Risk (NSR).

- Alternative #3 – Complete Removal of Impacted Soil and Offsite Disposal: Removal, transportation, and off-site disposal of all impacted soil with complete removal of any remaining buried foundation/building materials is an effective way to eliminate risk at the property, as removing OHM at concentrations exceeding background levels will ensure that exposure pathways no longer exist.

4.2.2 Implementability

- Alternative #1 – No Action: The implementation of a "No Action" remedial approach is simple and technically feasible, as no action would be conducted at the property. If no remedial action is implemented, safe and legal development of the property is not feasible and the project goal cannot be achieved.

- Alternative #2 – Targeted Soil Removal and Encapsulation, Offsite Disposal, and Implementation of an AUL: Targeted soil removal requires coordination to maintain environmental controls (e.g., dust suppression) during remediation. Based on the existing data set, it is estimated that approximately 625 cubic yards of soil will require excavation, transport, and disposal. Cap construction would also require slope stabilization and monitoring. This alternative will require the implementation of an AUL. This alternative is moderately easy to implement.

- Alternative #3 – Complete Removal of Impacted Soil and Offsite Disposal: Extensive excavation with off-site disposal will be more challenging to implement due to the volume of soil to be excavated and disposed. The estimated volume is likely greater than 1,440 cubic yards, with the maximum volume potentially as high as 1,656 cubic yards. This alternative would create significant truck traffic and carry a large carbon footprint. It may also require multiple soil disposal facilities because the volume of soil could overwhelm most regional receiving facilities. This alternative is not in line with EPA and MassDEP greener cleanup goals and objectives.

4.2.3 Cost

- Alternative #1 – No Action: No cost will immediately be incurred under this alternative. Taking no action will eliminate the possibility of redevelopment of the property to a use that benefits the community. Therefore, potential opportunity cost of no action will be borne by REC, the City, and surrounding neighbors, including the carrying costs of an unused building, a reduction of the property and surrounding properties in market value, lack of improvement of economic and cultural aspects for residents, and the elimination of remediation, construction, and permanent jobs that will be created by the redevelopment. The above-referenced opportunity costs do not have a specific endpoint and could cost far more than remediation activities in the long run. Additionally, inaction does not eliminate potential exposure hazards to receptors, which could worsen over time and cause a need for future action, including contaminant excavation and removal or capping.

- Alternative #2 – Targeted Soil Removal and Encapsulation, Offsite Disposal, and Implementation of an AUL: The cost for the excavation and disposal of a limited volume of OHM-impacted soil, excavation crews, the collection and analysis of confirmatory soil sampling, and professional/technical services is estimated to be $257,550 to $301,750.

Remedial Alterative #2		
Item	**Low Range**	**High Range**
Soil Disposal - 625 cubic yards (934 tons) at $85 to $125/ton	$79,730	$116,750
Laboratory Analysis	$7,500	$9,000
Environmental Labor and Equipment (assumes 25 days)	$51,000	$51,000
MCP Reporting	$25,000	$45,000
Contractor Labor and Equipment (assumes 25 days)	$60,000	$80,000
Estimated Total	**$257,550**	**$301,750**

Alternative #3 – Complete Removal of Impacted Soil and Offsite Disposal: This remedial alternative includes the disposal of 625 cubic yards (934 tons) for the construction of the greenhouse and an additional 515 to 1,031 cubic yards (773 to 1,547 tons) of soil on the remaining portion of the site, assuming a 3 to 6 foot cut outside of the greenhouse.

Remedial Alterative # 3		
Item	**Low Range**	**High Range**
Soil Disposal - 1,440 to 1,656 cubic yards (1,711 to 2,484 tons) at $80 to $125/ton	$145,435	$310,500
Laboratory Analysis	$11,250	$13,500
Environmental Labor and Equipment (assumes 30 to 35 days)	$61,200	$71,400
MCP Reporting No AUL	$25,000	$35,000
Contractor Labor and Equipment (assumes 30 to 35 days)	$72,000	$112,000
Estimated Total	**$314,875**	**$542,420**

Costs for remedial alternatives have been updated since the submittal of the November 2025 ABCA and are provided for comparison purposes only. Actual disposal costs will be determined upon acceptance at a receiving facility and final volume requiring disposal. Estimates assume 1.5 tons per cubic yard. Costs do not include labor and materials associated with placement of clean fill to bring the site back to grade following excavation.

4.3 Recommended Cleanup Alternative

The recommended cleanup alternative is Alternative #2 – Targeted Soil Removal and Encapsulation, Offsite Disposal, and Implementation of an AUL. However, if the results of confirmatory soil sampling show remaining concentrations below applicable MCP Method 1 soil standards, capping and implementation of an AUL will not be required.

Alternative #1 - No Action cannot be recommended since it does not address property risks or achieve the redevelopment goal. The costs for Alternative #3 – Complete Removal Impacted Soil and Offsite Disposal exceed the available financial resources.

4.3.1 Green and Sustainable Remediation Measures for Selected Alternative

To the extent feasible, elements of greener and sustainable remediation measures for the Selected Cleanup Alternative include the following:

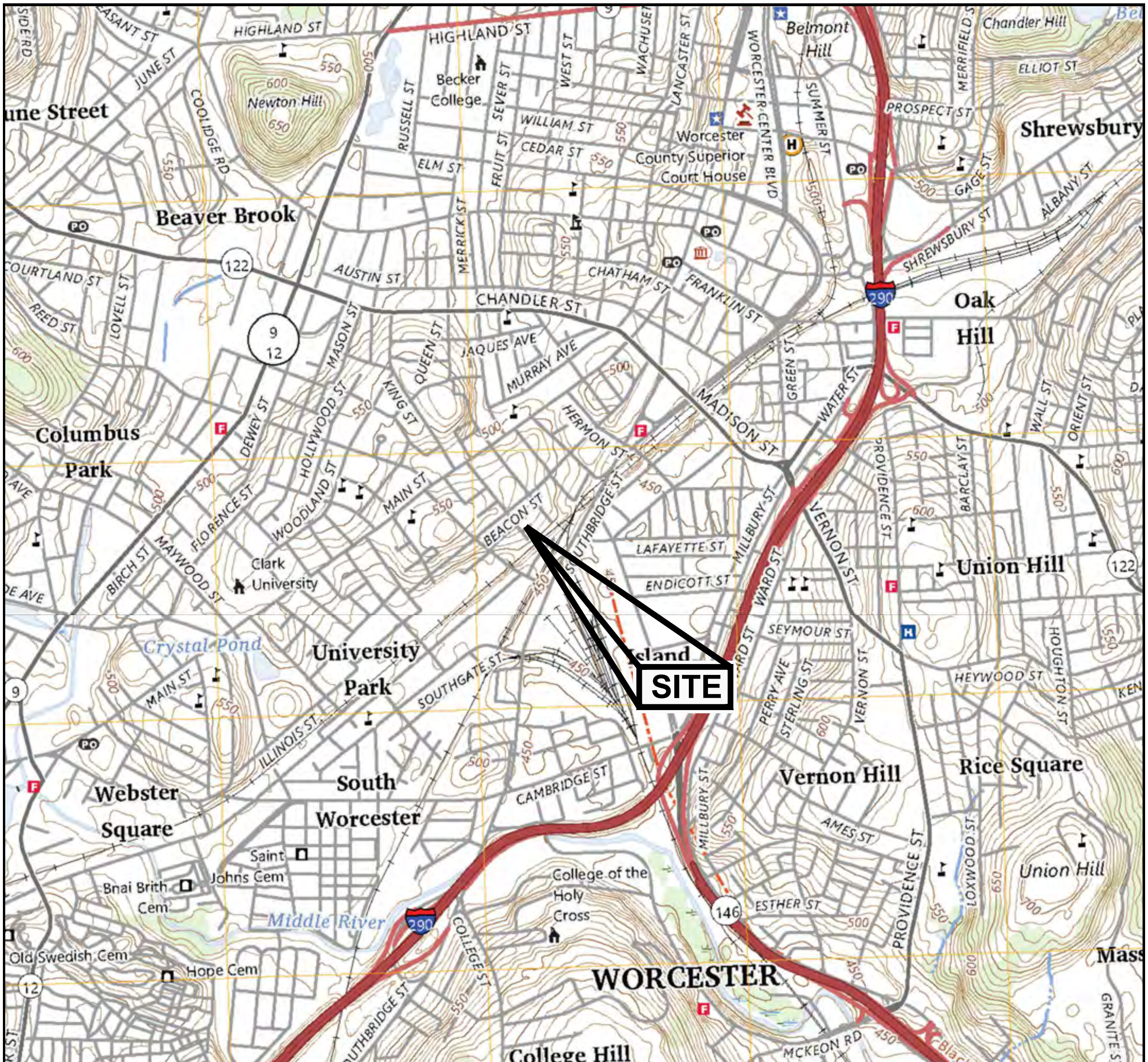
- To reduce carbon emissions:
  - Conduct remedial soil excavation concurrently with construction earthwork to limit mobilization of equipment.
  - Select local sources for backfill to reduce carbon emissions.
  - When costs are generally consistent, select the closest location for off-site soil reuse or recycling. Prioritize reuse/recycling over disposal.
  - Deploy appropriately sized machinery to increase efficiency.

    - Deploy machinery capable of performing multiple tasks, such as using machinery with multiple attachments.
    - Implement an engine idle reduction plan.
    - Request that operators confirm routine maintenance is being performed on machinery.
- For soil sampling, use direct push drilling techniques instead of rotary drilling to reduce the duration of drilling, reduce drill cuttings, and eliminate drilling fluids.
- For soil management:
    - Deploy erosion control around the property.
    - Limit the on-site speed limit of vehicles crossing the site to less than 10 miles per hour to minimize dust.
    - When needed, activate dust suppression while managing runoff.
    - Surround stockpiles with berms to prevent erosion and cover the stockpile to mitigate dust.
    - Use rip rap or a wheel wash to prevent dust and dirt from leaving the property.

MassDEP's Greener Cleanup Guidance (WSC #14-150), ASTM Standard E-2893: Standard Guide for Greener Cleanups, and the most recent relevant Best Management Practices (BMPs) issued by EPA were used to assess greener and sustainable remedial measures for the Selected Alternative. The EPA BMPs listed below are included as Appendix D.

- Green Remediation Best Management Practices: Excavation and Surface Restoration (EPA 542-F-19-002), updated August 2019;
- Green Remediation Best Management Practices: Materials and Waste Management (EPA 542-F-13-003), published December 2013;
- Green Remediation Best Management Practices: Cleaner Fuels and Air Emissions for Site Cleanup (EPA 542-F-23-001), updated March 2023; and
- Green Remediation Best Management Practices: Site Investigation and Environmental Monitoring (EPA 542-F-16-002), updated September 2016.

FIGURES



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CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

DATE 10/29/2025	SCALE AS SHOWN	FILE RECI0001-SP
APPROVED BY AAR	DRAWN BY ELD	REVISED
CLIENT REGIONAL ENVIRONMENTAL COUNCIL, INC.		JOB NUMBER RECI0001
LOCATION 47 OREAD STREET WORCESTER, MASSACHUSETTS		MAP SOURCE WORCESTER NORTH, MA WORCESTER SOUTH, MA USGS QUAD 2024

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SITE LOCATION MAP

FIGURE 1

LEGEND

	PROPERTY LINE
	ABUTTER'S PROPERTY LINE
W	UNDERGROUND WATER LINE
S	UNDERGROUND SEWER LINE
D	UNDERGROUND DRAINAGE LINE
A1	GRID SOIL SAMPLE LOCATION (APPROXIMATE)
B-1	SOIL BORING LOCATION
B(MW)-1	SOIL BORING AND MONITORING WELL LOCATION
TP-1	TEST PIT LOCATION
	PROPOSED STORMWATER CATCH BASIN
	SEWER MANHOLE
C.O.	PROPOSED DRAINAGE CLEANOUT
	PROPOSED WATER GATE

NOTES

1. EXISTING CONDITIONS, TOPOGRAPHICAL INFORMATION, UNDERGROUND UTILITIES LOCATIONS, NORTH ORIENTATION, AND COORDINATE VALUES DEPICTED ON THESE DRAWINGS ARE BASED ON "BOUNDARY, TOPOGRAPHIC & UTILITY SURVEY" PREPARED BY CONTROL POINT ASSOCIATES, INC. AND "PROPOSED SITE PLAN" AND "PROPOSED SITE PLUMBING PLAN" PREPARED BY DAVIS SQUARE ARCHITECTS.
2. THIS DRAWING IS NOT INTENDED TO BE A BOUNDARY SURVEY.
3. EXISTING UNDERGROUND UTILITIES LOCATIONS ARE APPROXIMATE. UTILITY CONNECTIONS TO THE SUBJECT PROPERTY ARE PROPOSED AND DO NOT REPRESENT EXISITING CONDITIONS.

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40 feet

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DRAWING TITLE
SITE PLAN

DATE 10/13/2025	SCALE 1" = 40'	FILE RECI0001-SP
APPROVED BY AAR	DRAFTED BY CMM/ELD	REVISED 10/29/2025
CLIENT REGIONAL ENVIRONMENTAL COUNCIL, INC.		JOB NO. RECI0001
LOCATION 47 OREAD STREET WORCESTER, MASSACHUSETTS		DRAWING NO. FIGURE 2

APPENDIX A

NOAA State Climate Summary

MASSACHUSETTS

Key Messages

Temperatures in Massachusetts have risen almost 3.5°F since the beginning of the 20th century. Under a higher emissions pathway, historically unprecedented warming is projected during this century, with associated increases in heat wave intensity and decreases in cold wave intensity.

Precipitation since 1970 has averaged about 4.7 inches more than during 1895–1969, and a record-setting number of extreme precipitation events occurred during 2005–2014. Winter and spring precipitation is projected to increase, as is the frequency of extreme precipitation events.

Global sea level is projected to rise, with a likely range of 1–4 feet by 2100. Sea level rise poses significant risks, including inundation, erosion-induced land loss, and greater flood vulnerability due to higher storm surge.

Massachusetts is located on the eastern edge of the North American continent. Its northerly latitude and geographic location expose the state to both the moderating and moistening influence of the Atlantic Ocean and the effects of hot and cold air masses from the interior of the continent. Its climate is characterized by cold, snowy winters and warm summers. The jet stream, often located near the state, gives it highly variable weather patterns, wide-ranging daily and annual temperatures, and generally abundant precipitation throughout the year. Massachusetts comprises approximately one-eighth of New England's total land area (8,257 square miles). Although small in size and with forestland covering more than half of the state, Massachusetts is home to more than 6 million residents. The topography, varying from the flat coastal plains in the east to hillier and higher terrain in the west, provides some regional variations in climate. For the most part, summer temperatures are comfortably warm and relatively uniform across the state. Average (1991–2020 normals) temperatures in July range from the upper 60s (°F) to mid-70s (°F), with western portions of the state being cooler and eastern portions being warmer. January temperatures are more variable than summer temperatures, ranging from the low 20s (°F) in the west to around 30°F near the coast. Annual average precipitation varies from 45 to 55 inches across the state.

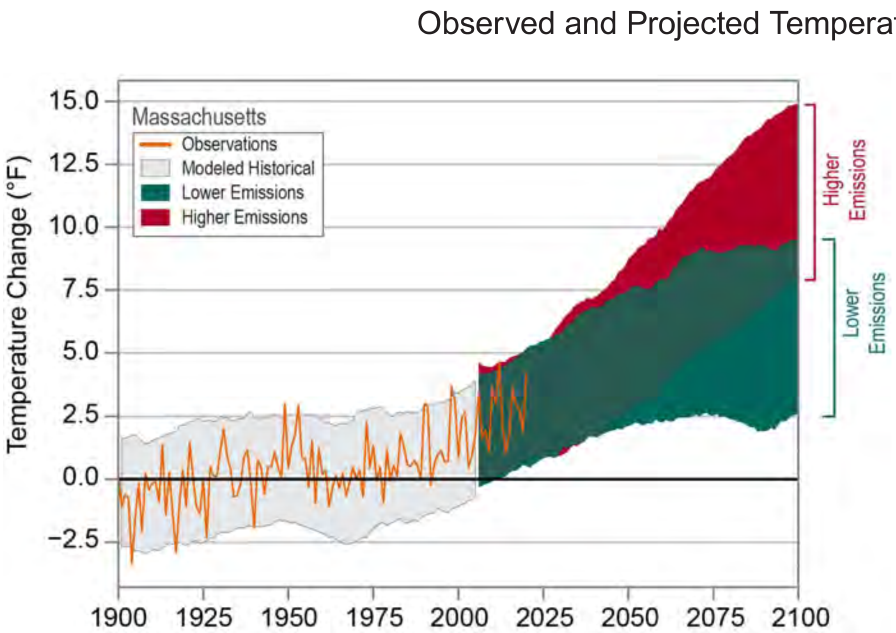


Figure 1. Observed and projected changes (compared to the 1901–1960 average) in near-surface air temperature for Massachusetts. Observed data are for 1900–2020. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions). Temperatures in Massachusetts (orange line) have risen almost 3.5°F since the beginning of the 20th century. Shading indicates the range of annual temperatures from the set of models. Observed temperatures are generally within the envelope of model simulations of the historical period (gray shading). Historically unprecedented warming is projected during this century. Less warming is expected under a lower emissions future (the coldest end-of-year projections being about 2°F warmer than the historical average; green shading) and more warming under a higher emissions future (the hottest end-of-year projections being about 10°F warmer than the hottest year in the historical record; red shading). Sources: CISESS and NOAA NCEI.

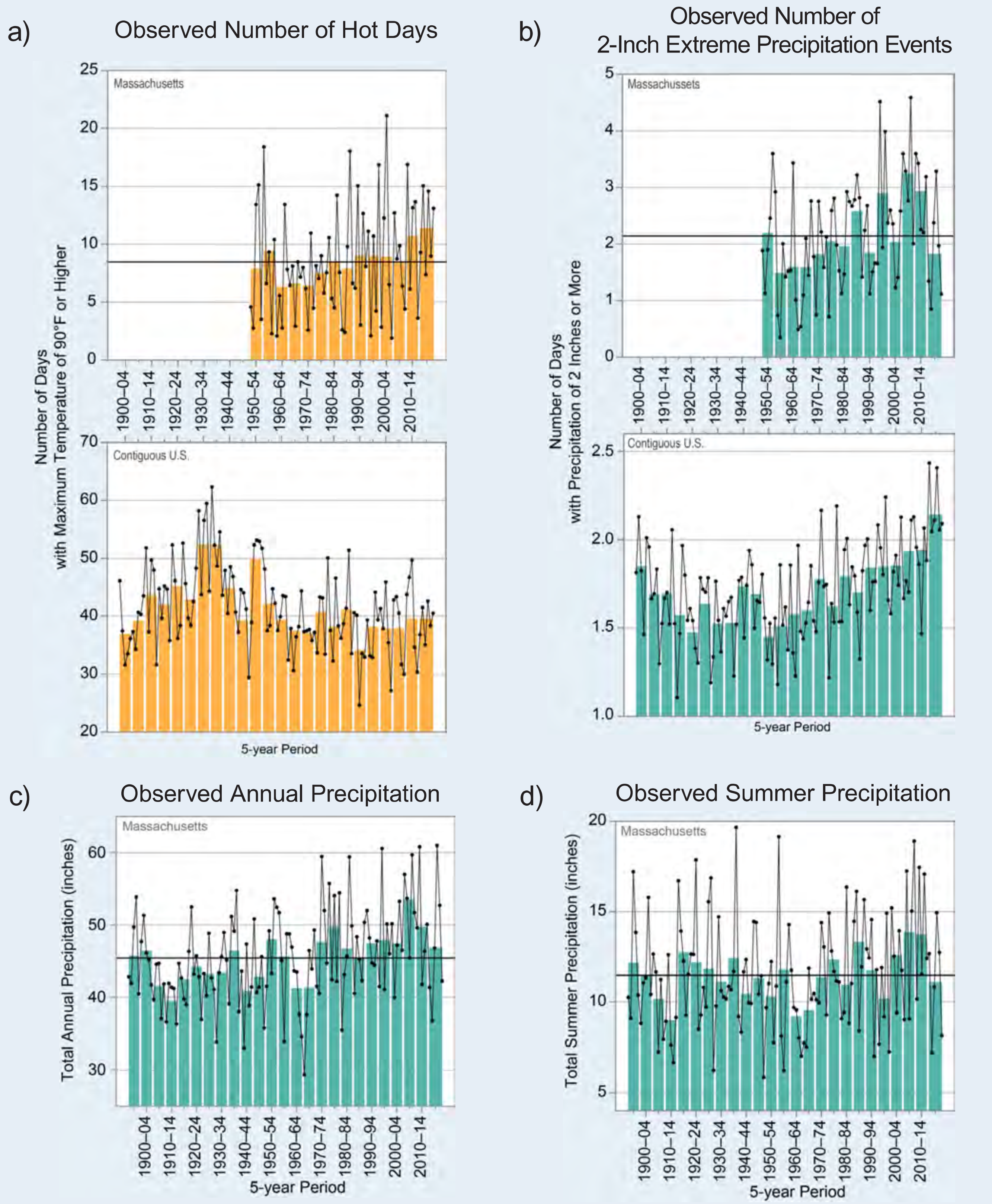


Figure 2. Observed (a) annual number of hot days (maximum temperature of 90°F or higher), (b) annual number of 2-inch extreme precipitation events (days with precipitation of 2 inches or more), (c) total annual precipitation, and (d) total summer (June–August) precipitation for Massachusetts from (a, b) 1950 to 2020 and (c, d) 1895 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black lines show the long-term (entire period) averages for Massachusetts: (a) 8.5 days, (b) 2.1 days, (c) 45.4 inches, (d) 11.5 inches. Values for the contiguous United States (CONUS) from 1900 to 2020 are included for Figures 2a and 2b to provide a longer and larger context. Long-term stations dating back to 1900 were not available for Massachusetts. The number of hot days in Massachusetts has consistently remained above average since 2010, with the 2015–2020 multiyear average setting a record high. All precipitation metrics were highest during the 2005–2014 interval. Sources: CISESS and NOAA NCEI. Data: (a) GHCN-Daily from 15 (MA) and 655 (CONUS) long-term stations, (b) GHCN-Daily from 23 (MA) and 832 (CONUS) long-term stations, (c, d) nClimDiv.

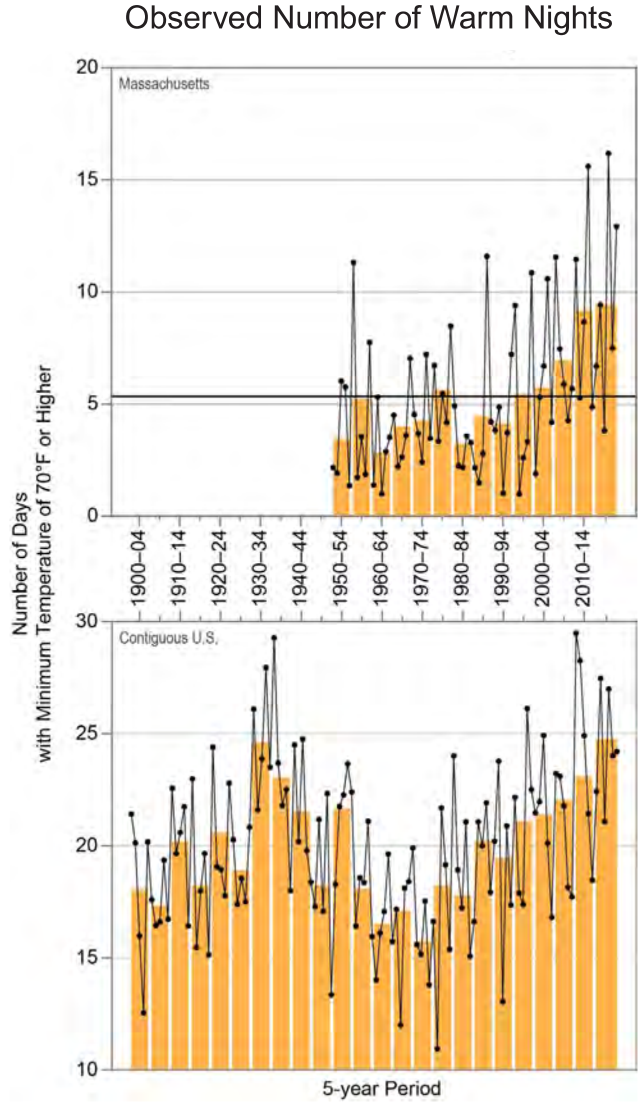


Figure 3. Observed annual number of warm nights (minimum temperature of 70°F or higher) for Massachusetts from 1950 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average for Massachusetts of 5.3 nights. Values for the contiguous United States (CONUS) from 1900 to 2020 are included to provide a longer and larger context. Long-term stations dating back to 1900 were not available for Massachusetts. The number of warm nights in Massachusetts has steadily increased since the mid-1990s, with the highest multiyear average (since 1950) occurring during the 2015–2020 period. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 15 (MA) and 655 (CONUS) long-term stations.

Temperatures in Massachusetts have risen almost 3.5°F since the beginning of the 20th century (Figure 1). The number of hot days has been considerably above the long-term (1950–2020) average since 2010 (Figure 2a); the highest multiyear average since 1950 (11.5 days per year) occurred during the 2015–2020 period. **The number of warm nights has been steadily increasing since 1995**, with the highest multiyear average occurring during the 2015–2020 period (Figure 3). In 2012, Boston experienced the warmest January to July in 85 years. During that span, Boston's average temperature was 53.5°F—almost 4°F warmer than the historical average temperature. Changes in extreme low temperatures also reflect this warming trend. The number of very cold nights has been below average since the early 1990s (Figure 4). Despite this overall trend, the recent winter of 2014–15 was rather severe, when the eastern United States was one of few places globally with colder than normal temperatures. Heavy snowfall was the most prominent feature of that winter, with Boston setting several records for snowfall, including 110 inches for seasonal snowfall and the snowiest month on record; the Massachusetts Bay Transportation Authority rail service also shut down for several days. The winter average temperature was the 30th coldest for Massachusetts.

Precipitation is abundant but highly variable from year to year. The driest conditions were observed in the early 1910s and again in the 1960s, with wetter conditions occurring since the 1970s (Figures 2c and 2d). The wettest consecutive 10-year interval on record was 2005–2014, averaging about 51 inches per year, well above the long-term (1895–2020) annual average of 45.4 inches (Figure 2c). The driest consecutive 5-year interval was 1962–1966, and the wettest was 2005–2009. Massachusetts experienced extreme drought during 2016–2017 and again in 2020, straining water supplies. During 2005–2014, Massachusetts experienced the largest number of 2-inch extreme precipitation events (Figure 2b), about 30% above the long-term average. In March 2010 alone, three intense rainstorms led to extensive flooding throughout the state and southern New England, with estimated damages exceeding $2 billion. The heaviest rain fell in eastern Massachusetts, with more than 19 inches recorded near Jamaica Plain, Middleton, and Winchester.

Periodic weather events include extreme precipitation and flooding, severe storms (coastal, winter, and thunder), drought, and, on occasion, tropical storms and hurricanes. **The state's coastline is highly vulnerable to damage from powerful nor'easters and tropical storms and hurricanes**. Landfalling hurricanes have produced hurricane-force winds in Massachusetts 7 times between 1900 and 2020. In 2012, Superstorm Sandy (a post-tropical storm) was the most extreme and destructive event to affect the northeastern United States in 40 years and the fourth costliest in the Nation's history. Massachusetts was one of more than a dozen northeastern states impacted by Sandy. Storm impacts included strong winds, record high storm tides, flooding of some coastal areas, and loss of power for 385,000 residents. The state suffered more than $300 million in property losses alone. A year earlier, Hurricane Irene, dubbed the "costliest Category 1 storm" (with more than $15 billion in damages), swept through northern New England. Irene's most severe impact was catastrophic inland flooding in New Jersey, Massachusetts, and Vermont. A number of weather stations in central and western Massachusetts recorded more than 4 inches of rainfall during August 27–29, 2011, with a few locations exceeding 7 inches, including Granville Dam and Westhampton.

Under a higher emissions pathway, historically unprecedented warming is projected during this century (Figure 1). Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical record levels by the middle of this century. However, a large range of temperature increases is projected under both pathways, and under the lower pathway, a few projections are only slightly warmer than historical records. Heat waves are projected to increase in intensity, while cold waves are projected to become less intense. Massachusetts is vulnerable to extreme heat because of its densely populated urban areas. Excessive heat exposure is projected to contribute to more heat-related illnesses and, in severe cases, deaths. The annual number of days above 90°F is projected to increase by up to 40 days for parts of Massachusetts by midcentury under a higher emissions pathway.

Winter and spring precipitation is projected to continue to increase for Massachusetts over this century (Figure 5). In response to winter warming, projections indicate that more precipitation (12%–30%) will fall as rain rather than snow, and there will be earlier lake ice-out dates and a reduction in winter snowpack. As winters become warmer, the number of snow events is expected to decline from an average of 5 each month of winter to 1 to 3. The number of extreme precipitation events is also projected to more than double by the end of this century. Projections of above average precipitation totals and more frequent extreme precipitation events may also result in increased coastal and inland flooding, including substantial increases in riverine flooding in Boston by 2050. Increased evaporation from warmer temperatures, alterations in the timing and amount of streamflow following reductions in snowpack, and changes in the amount, timing, and type of precipitation may intensify naturally occurring droughts.

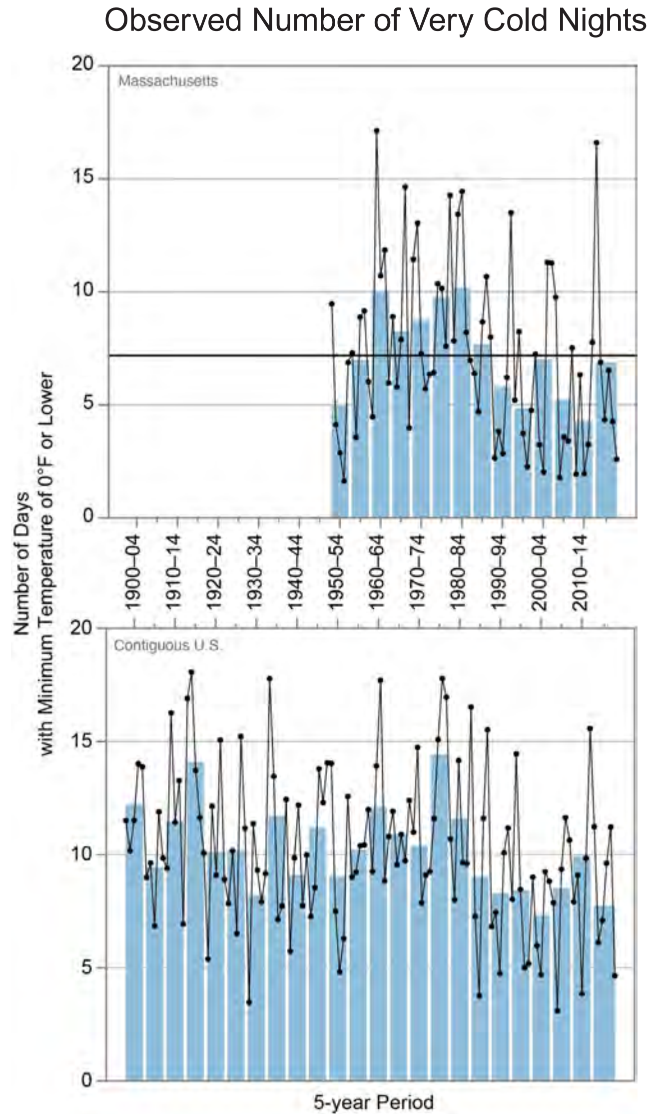


Figure 4. Observed annual number of very cold nights (minimum temperature of 0°F or lower) for Massachusetts from 1950 to 2020. Dots show annual values. Bars show averages over 5-year periods (last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average for Massachusetts of 7.2 nights. Values for the contiguous United States (CONUS) from 1900 to 2020 are included to provide a longer and larger context. Long-term stations dating back to 1900 were not available for Massachusetts. The number of very cold nights has been consistently below average since the early 1990s. The lowest number of cold nights occurred during the 2010–2014 period. Sources: CISESS and NOAA NCEI. Data: GHCN-Daily from 15 (MA) and 655 (CONUS) long-term stations.

Coastal communities are particularly vulnerable to sea level rise and coastal storm surge. **Since 1900, global average sea level has risen by about 7–8 inches. It is projected to rise another 1–8 feet, with a likely range of 1–4 feet by 2100 as a result of both past and future emissions from human activities** (Figure 6). From 1921 to 2020, relative sea level increased 0.11 inches per year in Massachusetts, or approximately 11 inches per century, greater than the global rate. Land in the state is naturally subsiding (sinking); thus, sea level rise has and will continue to contribute to increases in coastal flooding frequency, shoreline erosion, and saltwater intrusion. While local elevation conditions and trends (e.g., subsidence and sediment compaction) need to be accounted for in the adjustment of global sea level rise scenarios to derive relative sea level rise, thermal expansion and melting glacial ice sheets are projected to dominate any local changes in land movement by 2050. State-level findings indicate that sea level rise by 2100 could range from 4 feet (Intermediate scenario) to 10 feet (Extreme scenario), given a high emissions pathway. Sea level rise–induced coastal flooding of densely populated, low-lying coastal communities has important future implications for the state's economy, public health, natural resources, and infrastructure.

Sea level rise has caused an increase in tidal floods associated with nuisance-level impacts. Nuisance floods are events in which water levels exceed the local threshold (set by NOAA's National Weather Service) for minor impacts. These events can damage infrastructure, cause road closures, and overwhelm storm drains. As sea level has risen along the Massachusetts coastline, the number of tidal flood days (all days exceeding the nuisance-level threshold) has also increased, with the greatest number (22 days) occurring at Boston in both 2009 and 2017 (Figure 7).

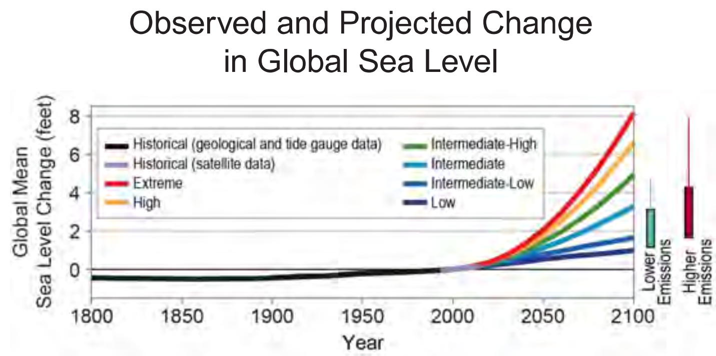


Figure 6. Global mean sea level (GMSL) change from 1800 to 2100. Projections include the six U.S. Interagency Sea Level Rise Task Force GMSL scenarios (Low, navy blue; Intermediate-Low, royal blue; Intermediate, cyan; Intermediate-High, green; High, orange; and Extreme, red curves) relative to historical geological, tide gauge, and satellite altimeter GMSL reconstructions from 1800–2015 (black and magenta lines) and the very likely ranges in 2100 under both lower and higher emissions futures (teal and dark red boxes). Global sea level rise projections range from 1 to 8 feet by 2100, with a likely range of 1 to 4 feet. Source: adapted from Sweet et al. 2017.

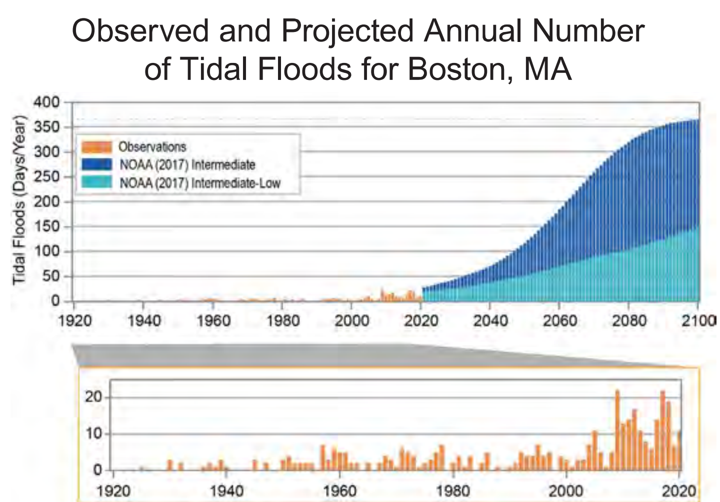


Figure 7. Number of tidal flood days per year at Boston, Massachusetts, for the observed record (1921–2020; orange bars) and projections for two NOAA (2017) sea level rise scenarios (2021–2100): Intermediate (dark blue bars) and Intermediate-Low (light blue bars). The NOAA (2017) scenarios are based on local projections of the GMSL scenarios shown in Figure 6. Sea level rise has caused a gradual increase in tidal floods associated with nuisance-level impacts. The greatest number of tidal flood days (all days exceeding the nuisance-level threshold) occurred in 2009 and 2017 at Boston. Projected increases are large even under the Intermediate-Low scenario. Under the Intermediate scenario, tidal flooding is projected to occur nearly every day of the year by the end of the century. Additional information on tidal flooding observations and scenarios is available at https://statesummaries.ncics.org/technicaldetails. Sources: CISESS and NOAA NOS.

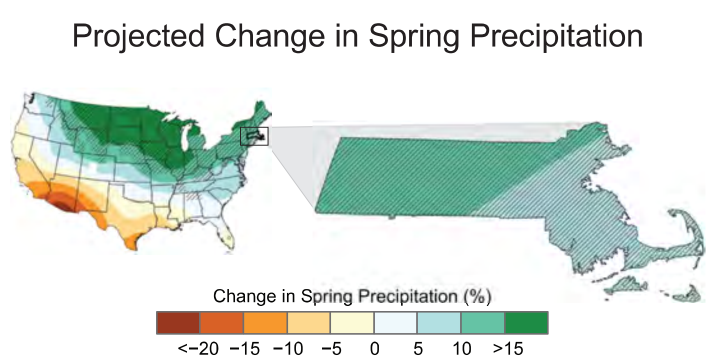


Figure 5. Projected changes in total spring (March–May) precipitation (%) for the middle of the 21st century relative to the late 20th century under a higher emissions pathway. The whited-out area indicates that the climate models are uncertain about the direction of change. Hatching represents areas where the majority of climate models indicate a statistically significant change. Spring precipitation is projected to increase in Massachusetts by midcentury. Sources: CISESS and NEMAC. Data: CMIP5.

Technical details on observations and projections are available online at https://statesummaries.ncics.org/technicaldetails.

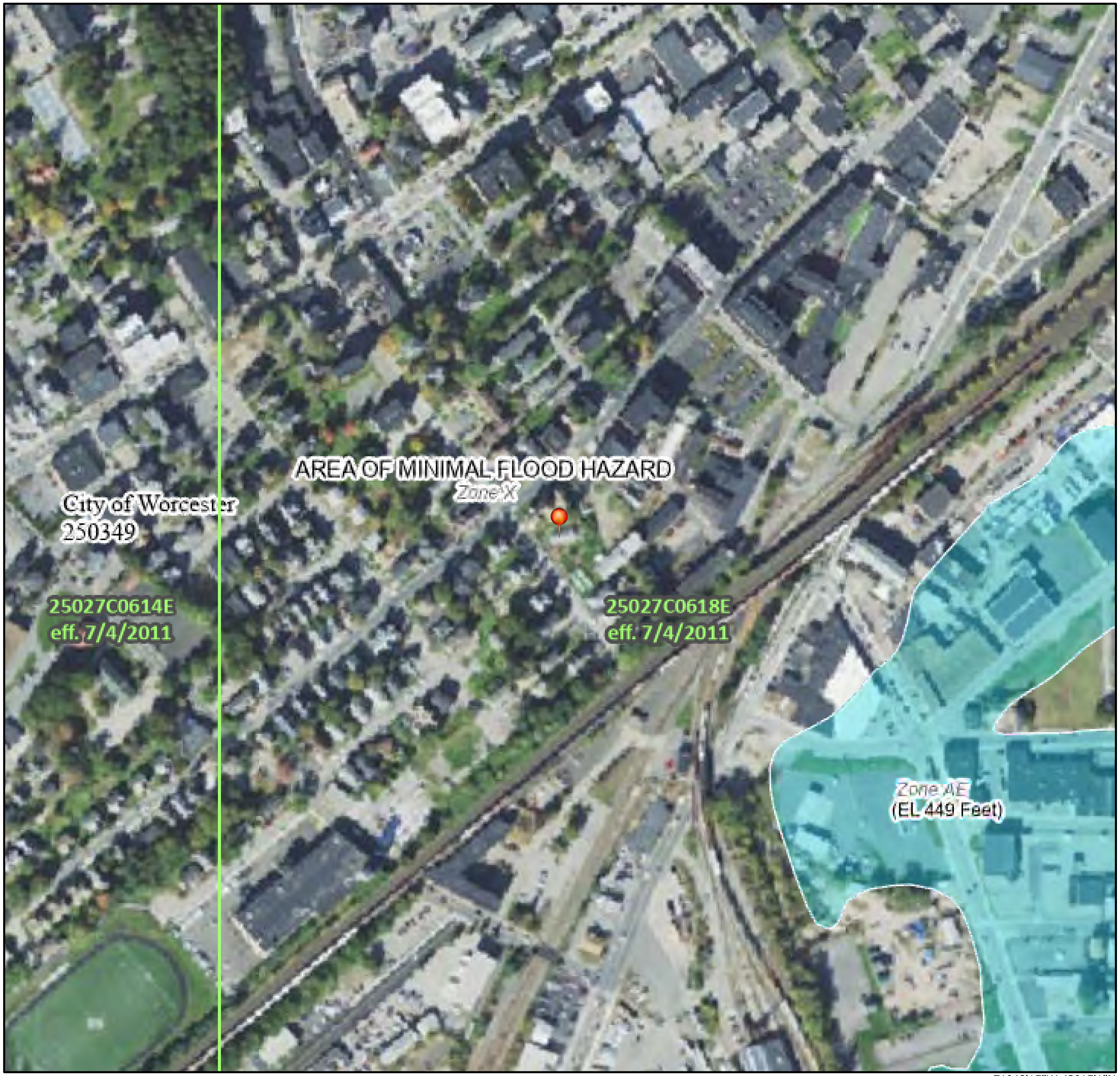
APPENDIX B

FEMA Flood Map

National Flood Hazard Layer FIRMette

FEMA

71°48'52"W 42°15'28"N



71°48'15"W 42°15'1"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/21/2025 at 2:05 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX C

Historical Data Tables

TABLE 1 SOIL QUALITY DATA (MG/KG)

47 OREAD STREET

Test	Parameter	RCS-1 Reportable Concentrations	MW-1	MW-2	MW-3	MW-4	SB-1	SB-2	MW-5		MW-6		MW-7		SB-3	
			9-10' 12/11/24	12-13' 12/11/24	13-14' 12/11/24	9-10' 12/11/24	9-10' 12/11/24	9-10' 12/11/24	2-3' 12/12/24	9-10' 12/12/24	2-4' 12/12/24	19-20' 12/12/24	4-5' 12/12/24	14½-16' 12/12/24	4-5' 12/12/24	9-10' 12/12/24
PID	Total Organic Vapors	—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VOCs	*sec*-Butylbenzene	See VPH C_9-C_{10} Aromatics	BRL<0.0061	BRL<0.0057	BRL<0.006	BRL<0.006	BRL<0.0049	BRL<0.0072	NT	BRL<0.0062	NT	BRL<0.0056	NT	0.013	NT	BRL<0.0069
	Ethylbenzene	40	BRL<0.0061	BRL<0.0057	BRL<0.006	BRL<0.006	BRL<0.0049	BRL<0.0072	NT	BRL<0.0062	NT	BRL<0.0056	NT	0.12	NT	BRL<0.0069
	Naphthalene	4	BRL<0.0061	BRL<0.0057	BRL<0.006	BRL<0.006	BRL<0.0049	BRL<0.0072	NT	BRL<0.0062	NT	BRL<0.0056	NT	0.0073	NT	BRL<0.0069
	All Other VOCs by 8260	Varies	All BRL	All BRL	All BRL	All BRL	All BRL	All BRL	NT	All BRL	NT	All BRL	NT	All BRL	NT	All BRL
PFAS	Total PFAS6	NE	All BRL	NT	All BRL	NT	NT	NT	NT	All BRL	NT	NT	NT	All BRL	NT	NT
VPH	C_5-C_8 Aliphatics	100	BRL<6.2	BRL<6.3	BRL<5.7	BRL<6.0	BRL<6.5	BRL<5.1	NT	BRL<5.6	NT	BRL<6.3	NT	BRL<5.6	NT	BRL<5.9
	C_9-C_{12} Aliphatics	1,000	BRL<6.2	BRL<6.3	BRL<5.7	BRL<6.0	BRL<6.5	BRL<5.1	NT	BRL<5.6	NT	BRL<6.3	NT	85	NT	BRL<5.9
	C_9-C_{10} Aromatics	100	BRL<6.2	BRL<6.3	BRL<5.7	BRL<6.0	BRL<6.5	BRL<5.1	NT	BRL<5.6	NT	BRL<6.3	NT	33	NT	BRL<5.9
EPH	C_9-C_{18} Aliphatics	1,000	BRL<74	BRL<73	BRL<71	BRL<73	BRL<75	BRL<74	NT	BRL<72	NT	BRL<75	NT	150	NT	BRL<73
	C_{19}-C_{36} Aliphatics	3,000	BRL<74	BRL<73	BRL<71	BRL<73	BRL<75	BRL<74	NT	BRL<72	NT	BRL<75	NT	BRL<71	NT	BRL<73
	C_{11}-C_{22} Aromatics	1,000	BRL<74	BRL<73	BRL<71	BRL<73	BRL<75	BRL<74	NT	BRL<72	NT	BRL<75	NT	BRL<71	NT	BRL<73
Target PAHs	Acenaphthene	4	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Acenaphthylene	2	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Anthracene	1,000	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Benzo(a)anthracene	20	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Benzo(a)pyrene	2	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Benzo(b)fluoranthene	20	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Benzo(g,h,i)perylene	1,000	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Benzo(k)fluoranthene	200	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Chrysene	200	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Dibenzo(a,h)anthracene	2	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Fluoranthene	1,000	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Fluorene	1,000	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	0.37	NT	BRL<0.25
	Indeno(1,2,3-cd)pyrene	20	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	2-Methylnaphthalene	0.7	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Naphthalene	4	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
	Phenanthrene	10	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	0.83	NT	BRL<0.25
	Pyrene	1,000	BRL<0.26	BRL<0.25	BRL<0.25	BRL<0.26	BRL<0.26	BRL<0.26	NT	BRL<0.25	NT	BRL<0.26	NT	BRL<0.25	NT	BRL<0.25
Total Metals	Arsenic	20	26.0	21.5	28.8	34.9	26.0	23.4	NT	19.6	NT	24.6	NT	19.0	NT	25.3
	Barium	1,000	72.8	69.7	59.4	62.8	75.2	56.1	NT	64.7	NT	68.1	NT	74.6	NT	76.7
	Cadmium	80	BRL<0.38	BRL<0.34	0.39	0.43	BRL<0.38	0.41	NT	BRL<0.36	NT	BRL<0.35	NT	0.38	NT	0.38
	Chromium (any valence)	100	33.2	67.8	58.7	30.0	31.5	28.4	NT	31.3	NT	31.9	NT	38.2	NT	41.1
	Lead	200	8.75	8.18	7.21	9.89	8.09	8.42	31.6	8.28	1,310	7.99	156	8.4	4.66	10.3
	Mercury	20	BRL<0.03	BRL<0.03	BRL<0.03	BRL<0.03	BRL<0.03	BRL<0.03	NT	BRL<0.03	NT	BRL<0.03	NT	BRL<0.03	NT	BRL<0.03
	Selenium	400	BRL<1.5	BRL<1.3	BRL<1.4	BRL<1.3	BRL<1.5	BRL<1.5	NT	BRL<1.4	NT	BRL<1.4	NT	BRL<1.4	NT	BRL<1.4
	Silver	100	BRL<0.38	BRL<0.34	BRL<0.34	BRL<0.33	BRL<0.38	BRL<0.39	NT	BRL<0.36	NT	BRL<0.35	NT	BRL<0.35	NT	BRL<0.35
Other	Percent Solids	—	88%	91%	92%	89%	88%	90%	NT	91%	NT	88%	NT	93%	NT	90%

Notes BRL = Below laboratory Reporting Limit
NT = Not Tested (for that parameter)
M1RC = Method 1 Risk Characterization
Yellow highlight = Meets or exceeds RCS-1 standard

Table from Limited Subsurface Investigation, prepared by CMG Environmental, Inc. for Bowditch & Dewey, dated February 13, 2025

TABLE 2 GROUNDWATER QUALITY DATA (μG/L)

47 OREAD STREET

Test	Parameter	RCGW-2 Reportable Concentrations	MW-1 5.89 1/10/25	MW-2 6.70 1/10/25	MW-3 8.99 12/24/24	MW-4 9.8 1/10/25	MW-5 7.65 1/10/25	MW-6 9.93 1/10/25	Sump — 1/10/25	MW-7 12.10 1/22/25
VOCs	*sec*-Butylbenzene	**See VPH C9-C10 Aromatics**	*BRL<1.0*	*BRL<1.0*	*BRL<1.0*	*BRL<1.0*	*BRL<1.0*	*BRL<1.0*	*BRL<1.0*	2.6
All Other VOCs by 8260		**Varies**	*All BRL*	*All BRL*	*All BRL*	*All BRL*	*All BRL*	*All BRL*	*All BRL*	*All BRL*
VPH	C_5-C_8 Aliphatics	**3,000**	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*
	C_9-C_{12} Aliphatics	**5,000**	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*
	C_9-C_{10} Aromatics	**4,000**	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*	*BRL<100*
EPH	C_9-C_{18} Aliphatics	**5,000**	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<200*
	C_{19}-C_{36} Aliphatics	**50,000**	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<200*
	C_{11}-C_{22} Aromatics	**5,000**	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<190*	*BRL<200*
Target PAHs	Acenaphthene	**10,000**	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.52*	*BRL<0.47*	*BRL<0.50*	*BRL<0.57*
	Acenaphthylene	**40**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	*BRL<0.10*	0.12
	Anthracene	**30**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	*BRL<0.09*	*BRL<0.11*
	Benzo(a)anthracene	**1,000**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	0.17	*BRL<0.11*
	Benzo(a)pyrene	**500**	*BRL<0.19*	*BRL<0.19*	*BRL<0.19*	*BRL<0.19*	*BRL<0.20*	*BRL<0.19*	0.20	*BRL<0.20*
	Benzo(b)fluoranthene	**400**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	0.21	*BRL<0.11*
	Benzo(g,h,i)perylene	**20**	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	0.19	0.04
	Benzo(k)fluoranthene	**100**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	0.21	*BRL<0.11*
	Chrysene	**70**	*BRL<0.05*	*BRL<0.05*	*BRL<0.05*	*BRL<0.05*	*BRL<0.05*	*BRL<0.05*	0.22	0.07
	Dibenzo(a,h)anthracene	**40**	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	*BRL<0.02*	0.04	*BRL<0.02*
	Fluoranthene	**200**	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.52*	*BRL<0.47*	*BRL<0.50*	*BRL<0.57*
	Fluorene	**40**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	*BRL<0.10*	0.47
	Indeno(1,2,3-cd)pyrene	**100**	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.09*	*BRL<0.10*	*BRL<0.09*	0.19	*BRL<0.11*
	2-Methylnaphthalene	**2,000**	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.52*	*BRL<0.47*	*BRL<0.50*	*BRL<0.57*
	Naphthalene	**700**	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.52*	*BRL<0.47*	*BRL<0.50*	*BRL<0.57*
	Phenanthrene	**10,000**	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.47*	*BRL<0.52*	*BRL<0.47*	*BRL<0.50*	0.69
	Pyrene	**20**	*BRL<0.07*	*BRL<0.07*	*BRL<0.07*	*BRL<0.07*	*BRL<0.07*	*BRL<0.07*	0.36	0.19
Soluble Metals	Arsenic	**900**	*BRL<4*	*BRL<4*	*BRL<4*	*BRL<4*	*BRL<4*	*BRL<4*	*BRL<4*	*BRL<4*
	Barium	**50,000**	48	11	21	16	28	22	35	18
	Cadmium	**8**	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	1	*BRL<1*
	Chromium (any valence)	**300**	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	3	*BRL<1*	*BRL<1*	*BRL<1*
	Lead	**10**	*BRL<2*	*BRL<2*	*BRL<2*	*BRL<2*	*BRL<2*	*BRL<2*	*BRL<2*	*BRL<2*
	Mercury	**20**	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*	*BRL<0.2*
	Selenium	**50**	*BRL<11*	*BRL<11*	*BRL<11*	*BRL<11*	*BRL<11*	*BRL<11*	*BRL<11*	*BRL<11*
	Silver	**7**	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*	*BRL<1*

Notes *BRL = Below laboratory Reporting Limit*
NT = Not Tested (for that parameter)
M1RC = Method 1 Risk Characterization
Yellow highlight = Meets or exceeds RCGW-2 standard

Table from Limited Subsurface Investigation, prepared by CMG Environmental, Inc. for Bowditch & Dewey, dated February 13, 2025

TABLE 3 PFAS IN GROUNDWATER (NG/L)

47 OREAD STREET

Test	Parameter	RCGW-2 Reportable Concentrations	MW-1 5.89 1/10/25	MW-4 9.8 1/10/25	MW-6 9.93 1/10/25	MW-7 12.10 1/22/25
Regulated PFAS	Perfluorodecanoic Acid (PFDA)	**40,000,000**	*BRL<1.78*	*0.864 (J,F)*	*BRL<1.94*	*BRL<2.13*
	Perfluoroheptanoic Acid (PFHpA)	**40,000,000**	13.7	5.83	3.29	*1.26 (J)*
	Perfluorohexanesulfonic Acid (PFHxS)	**500,000**	6.94	4.30	*2.04 (F)*	*1.27 (J)*
	Perfluorononanoic Acid (PFNA)	**40,000,000**	3.62	2.24	*BRL<1.94*	*BRL<2.13*
	Perfluorooctanesulfonic Acid (PFOS)	**500,000**	29.2	81.2	15.4	7.98
	Perfluorooctanoic Acid (PFOA)	**40,000,000**	31.0	20.0	8.65	*4.03*
	Total PFAS6	**NE**	84.5	114	27.3	12.0
	Perfluorobutanoic Acid (PFBA)	**NE**	18.4	4.25	*1.78 (J)*	*1.03 (J)*
	Perfluoropentanoic Acid (PFPeA)		26.8	9.08	3.67	*0.707 (J)*
	Perfluorobutanesulfonic Acid (PFBS)		5.53	4.12	*1.40 (J)*	*1.10 (J)*
	1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorohexanoic Acid (PFHxA)		31.4	8.99	3.45	*1.14 (J)*
	Perfluoropentanesulfonic Acid (PFPeS)		*0.729 (J)*	*0.473 (J)*	*BRL<1.94*	*BRL<2.13*
	1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*1.58 (J)*
	Perfluoroheptanesulfonic (PFHpS)		*0.654 (J)*	*1.08 (J)*	*BRL<1.94*	*BRL<2.13*
	1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorononanesulfonic Acid (PFNS)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluoroundecanoic Acid (PFUnA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorodecanesulfonic Acid (PFDS)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorooctanesulonamide (FOSA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorododecanoic Acid (PFDoA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorotridecanoic Acid (PFTrDA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*
	Perfluorotetradecanoic Acid (PFTA)		*BRL<1.78*	*BRL<1.97*	*BRL<1.94*	*BRL<2.13*

Notes *BRL = Below laboratory Reporting Limit*
Yellow highlight = Meets or exceeds RCGW-1 standard
J - Used when estimating a concentration for TIC where a 1:1 response is assumed or when the result indicates the presence of a compound that meets the identification criteria, but the result is less than the quantitation limit, but greater than zero.
F - Used when the ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be anestimated maximum concentration.

Table from Limited Subsurface Investigation, prepared by CMG Environmental, Inc. for Bowditch & Dewey, dated February 13, 2025

Table 4: Summary of Test Pit Soil Analytical Data

Phoenix Environmental Laboratories, Inc.
587 East Middle Turnpike
P.O. Box 370
Manchester, CT 06040
(860) 645-1102

Project Id : 47 OREAD ST

Lab Sample Id				CT10163		CT10164		CT10165		CT10166		CT10167		CT10168	
Collection Date				4/16/2025		4/16/2025		4/16/2025		4/16/2025		4/16/2025		4/16/2025	
Client Id				TEST PIT 1 1-4`		TEST PIT 2		TEST PIT 3 0-3`		TEST PIT 4 3-4`		TEST PIT 5 2-3`		TEST PIT 6 1-3`	
Matrix				Soil		Soil		Soil		Soil		Soil		Soil	
	CAS	Units	EPA Toxicity Characteristics	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Miscellaneous/Inorganics															
Percent Solid	PHNX - PCTSOLID	%		73		84		81		81		72		82	
Conductivity - Soil Matrix	PHNX - COND	umhos/cm		167	5	105	5	54	5	151	5	1,390	5	29	5
Corrosivity	PHNX - CORROSIVITY	Pos/Neg		Negative		Negative		Negative		Negative		Negative		Negative	
Flash Point	PHNX - FLASH POINT	Degree F		>200	200	>200	200	>200	200	>200	200	>200	200	>200	200
Ignitability	PHNX - IGNITABILITY	degree F		Passed	140	Passed	140	Passed	140	Passed	140	Passed	140	Passed	140
pH at 22C - Soil	PHNX - PH	pH Units		8.03	1.00	7.57	1.00	6.85	1.00	8.06	1.00	7.68	1.00	7.18	1.00
Reactivity Cyanide	PHNX - REACT CYANIDE	mg/Kg		< 7	7	< 1	1	< 1	1	< 6	6	< 7	7	< 6	6
Reactivity Sulfide	PHNX - REACT SULFIDE	mg/Kg		< 20	20	< 20	20	< 20	20	< 20	20	< 20	20	< 20	20
Reactivity	PHNX - REACTIVITY	Pos/Neg		Negative		Negative		Negative		Negative		Negative		Negative	
Metals, Total															
Antimony	7440-36-0	mg/Kg		< 4.4	4.4	< 3.9	3.9	< 4.0	4.0	< 4.1	4.1	< 4.9	4.9	< 3.8	3.8
Arsenic	7440-38-2	mg/Kg		21.9	0.89	19.9	0.77	24.7	0.79	19.4	0.82	13.1	0.98	25.1	0.75
Barium	7440-39-3	mg/Kg		813	0.44	76	0.39	127	0.40	53.1	0.41	1,720	0.49	49.4	0.38
Beryllium	7440-41-7	mg/Kg		0.88	0.36	0.55	0.31	0.6	0.32	< 0.33	0.33	< 0.39	0.39	0.62	0.30
Cadmium	7440-43-9	mg/Kg		1.44	0.44	0.42	0.39	0.77	0.40	< 0.41	0.41	2.64	0.49	< 0.38	0.38
Chromium	7440-47-3	mg/Kg		38.5	0.44	23	0.39	27.1	0.40	15.9	0.41	22.3	0.49	24.8	0.38
Lead	7439-92-1	mg/Kg		3,860	0.44	155	0.39	435	0.40	322	0.41	2,220	0.49	25.7	0.38
Mercury	7439-97-6	mg/Kg		0.4	0.04	0.05	0.03	0.35	0.03	0.33	0.03	0.82	0.04	0.08	0.03
Nickel	7440-02-0	mg/Kg		28.3	0.44	16	0.39	28.7	0.40	11	0.41	8.14	0.49	15.8	0.38
Selenium	7782-49-2	mg/Kg		< 1.8	1.8	< 1.5	1.5	< 1.6	1.6	< 1.6	1.6	< 2.0	2.0	< 1.5	1.5
Silver	7440-22-4	mg/Kg		< 0.44	0.44	< 0.39	0.39	< 0.40	0.40	< 0.41	0.41	< 0.49	0.49	< 0.38	0.38
Thallium	7440-28-0	mg/Kg		< 4.0	4.0	< 3.5	3.5	< 3.6	3.6	< 3.7	3.7	< 4.4	4.4	< 3.4	3.4
Vanadium	7440-62-2	mg/Kg		87	0.44	21.6	0.39	28	0.40	16.2	0.41	13.8	0.49	26.3	0.38
Zinc	7440-66-6	mg/Kg		617	0.9	162	0.8	210	0.8	99.4	0.8	937	1.0	44.5	0.8
TPH By SW8015D															
Fuel Oil #2 / Diesel Fuel	68476-30-2	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Fuel Oil #4	68476-31-3	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Fuel Oil #6	68553-00-4	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Kerosene	8008-20-6	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Motor Oil	PHNX - MOTOR OIL	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Total TPH	PHNX - TPH	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
Unidentified	PHNX - OTHER OIL	mg/kg		< 340	340	< 58	58	< 300	300	< 61	61	< 340	340	< 61	61
PCBs By SW8082A															
PCB-1016	12674-11-2	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1221	11104-28-2	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1232	11141-16-5	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1242	53469-21-9	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1248	12672-29-6	ug/Kg		110	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1254	11097-69-1	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1260	11096-82-5	ug/Kg		< 90	90	< 77	77	160	80	< 130	130	< 91	91	< 79	79
PCB-1262	37324-23-5	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
PCB-1268	11100-14-4	ug/Kg		< 90	90	< 77	77	< 80	80	< 130	130	< 91	91	< 79	79
Volatiles By SW8260D															
1,1,1,2-Tetrachloroethane	630-20-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,1,1-Trichloroethane	71-55-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,1,2,2-Tetrachloroethane	79-34-5	ug/Kg		< 8.5	8.5			< 310	310			< 320	320	< 5.3	5.3
1,1,2-Trichloroethane	79-00-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,1-Dichloroethane	75-34-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,1-Dichloroethene	75-35-4	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,1-Dichloropropene	563-58-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,2,3-Trichlorobenzene	87-61-6	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2,3-Trichloropropane	96-18-4	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2,4-Trichlorobenzene	120-82-1	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2,4-Trimethylbenzene	95-63-6	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2-Dibromo-3-chloropropane	96-12-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2-Dibromoethane	106-93-4	ug/Kg		< 1.4	1.4			< 0.79	0.79			< 0.85	0.85	< 0.89	0.89
1,2-Dichlorobenzene	95-50-1	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,2-Dichloroethane	107-06-2	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,2-Dichloropropane	78-87-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,3,5-Trimethylbenzene	108-67-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,3-Dichlorobenzene	541-73-1	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
1,3-Dichloropropane	142-28-9	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
1,4-Dichlorobenzene	106-46-7	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
2,2-Dichloropropane	594-20-7	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
2-Chlorotoluene	95-49-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
2-Hexanone	591-78-6	ug/Kg		< 71	71			< 40	40			< 42	42	< 45	45
2-Isopropyltoluene	527-84-4	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
4-Chlorotoluene	106-43-4	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
4-Methyl-2-pentanone	108-10-1	ug/Kg		< 71	71			< 40	40			< 42	42	< 45	45
Acetone	67-64-1	ug/Kg		< 710	710			< 400	400			< 420	420	< 450	450
Acrylonitrile	107-13-1	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Benzene	71-43-2	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Bromobenzene	108-86-1	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
Bromochloromethane	74-97-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Bromodichloromethane	75-27-4	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Bromoform	75-25-2	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Bromomethane	74-83-9	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Carbon Disulfide	75-15-0	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Carbon tetrachloride	56-23-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Chlorobenzene	108-90-7	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Chloroethane	75-00-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Chloroform	67-66-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Chloromethane	74-87-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
cis-1,2-Dichloroethene	156-59-2	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
cis-1,3-Dichloropropene	10061-01-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Dibromochloromethane	124-48-1	ug/Kg		< 8.5	8.5			< 4.7	4.7			< 5.1	5.1	< 5.3	5.3
Dibromomethane	74-95-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Dichlorodifluoromethane	75-71-8	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Ethylbenzene	100-41-4	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Hexachlorobutadiene	87-68-3	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
Isopropylbenzene	98-82-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
m&p-Xylene	179601-23-1	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Methyl Ethyl Ketone	78-93-3	ug/Kg		< 85	85			< 47	47			< 51	51	< 53	53
Methyl t-butyl ether (MTBE)	1634-04-4	ug/Kg		< 28	28			< 16	16			< 17	17	< 18	18
Methylene chloride	75-09-2	ug/Kg		< 28	28			< 16	16			< 17	17	< 18	18
Naphthalene	91-20-3	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
n-Butylbenzene	104-51-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
n-Propylbenzene	103-65-1	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
o-Xylene	95-47-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
p-Isopropyltoluene	99-87-6	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
sec-Butylbenzene	135-98-8	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
Styrene	100-42-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
tert-Butylbenzene	98-06-6	ug/Kg		< 14	14			< 510	510			< 530	530	< 8.9	8.9
Tetrachloroethene	127-18-4	ug/Kg		< 14	14			5,200	510			480	480	< 8.9	8.9
Tetrahydrofuran (THF)	109-99-9	ug/Kg		< 28	28			< 16	16			< 17	17	< 18	18
Toluene	108-88-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Total Xylenes	1330-20-7	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
trans-1,2-Dichloroethene	156-60-5	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
trans-1,3-Dichloropropene	10061-02-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
trans-1,4-dichloro-2-butene	110-57-6	ug/Kg		< 28	28			< 1000	1,000			< 1100	1,100	< 18	18
Trichloroethene	79-01-6	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Trichlorofluoromethane	75-69-4	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Trichlorotrifluoroethane	76-13-1	ug/Kg		< 28	28			< 16	16			< 17	17	< 18	18
Vinyl chloride	75-01-4	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
TCLP Pesticides By SW8081B															
4,4' -DDD	72-54-8	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
4,4' -DDE	72-55-9	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
4,4' -DDT	50-29-3	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
a-BHC	319-84-6	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Alachlor	15972-60-8	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Aldrin	309-00-2	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
b-BHC	319-85-7	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Chlordane	57-74-9	ug/L	30	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0
d-BHC	319-86-8	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Dieldrin	60-57-1	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
Endosulfan I	959-98-8	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Endosulfan II	33213-65-9	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
Endosulfan Sulfate	1031-07-8	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
Endrin	72-20-8	ug/L	20	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
Endrin Aldehyde	7421-93-4	ug/L		< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0	< 1.0	1.0
g-BHC (Lindane)	58-89-9	ug/L	400	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Heptachlor	76-44-8	ug/L	8	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Heptachlor epoxide	1024-57-3	ug/L		< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Methoxychlor	72-43-5	ug/L	10,000	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50	< 0.50	0.50
Toxaphene	8001-35-2	ug/L	500	< 20	20	< 20	20	< 20	20	< 20	20	< 20	20	< 20	20
TCLP Herbicides By SW846 1311/8151															
2,4,5-TP (Silvex)	93-72-1	ug/L	1,000	< 50	50	< 50	50	< 50	50	< 50	50	< 50	50	< 50	50
2,4-D	94-75-7	ug/L	10,000	< 100	100	< 100	100	< 100	100	< 100	100	< 100	100	< 100	100
Semivolatiles By SW8270E															
1,1-Biphenyl	92-52-4	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
1,2,4,5-Tetrachlorobenzene	95-94-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
1,2,4-Trichlorobenzene	120-82-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
1,2-Dichlorobenzene	95-50-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
1,2-Diphenylhydrazine	122-66-7	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
1,3-Dichlorobenzene	541-73-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
1,4-Dichlorobenzene	106-46-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,2'-Oxybis(1-Chloropropane)	108-60-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,4,5-Trichlorophenol	95-95-4	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,4,6-Trichlorophenol	88-06-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,4-Dichlorophenol	120-83-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,4-Dimethylphenol	105-67-9	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,4-Dinitrophenol	51-28-5	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
2,4-Dinitrotoluene	121-14-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2,6-Dinitrotoluene	606-20-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2-Chloronaphthalene	91-58-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2-Chlorophenol	95-57-8	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2-Methylnaphthalene	91-57-6	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2-Methylphenol (o-cresol)	95-48-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
2-Nitroaniline	88-74-4	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
2-Nitrophenol	88-75-5	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
3&4-Methylphenol (m&p-cresol)	PHNX - M&P CRESOL	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
3,3'-Dichlorobenzidine	91-94-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
3-Nitroaniline	99-09-2	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
4,6-Dinitro-2-methylphenol	534-52-1	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
4-Bromophenyl phenyl ether	101-55-3	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
4-Chloro-3-methylphenol	59-50-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
4-Chloroaniline	106-47-8	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
4-Chlorophenyl phenyl ether	7005-72-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
4-Nitroaniline	100-01-6	ug/Kg		< 710	710	< 620	620	< 640	640	< 1300	1,300	< 3700	3,700	< 640	640
4-Nitrophenol	100-02-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Acenaphthene	83-32-9	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Acenaphthylene	208-96-8	ug/Kg		< 310	310	< 270	270	400	280	< 590	590	< 1600	1,600	< 280	280
Acetophenone	98-86-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Aniline	62-53-3	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Anthracene	120-12-7	ug/Kg		1,000	310	< 270	270	430	280	< 590	590	< 1600	1,600	< 280	280
Benz(a)anthracene	56-55-3	ug/Kg		2,900	310	< 270	270	1,600	280	< 590	590	4,300	1,600	< 280	280
Benzidine	92-87-5	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Benzo(a)pyrene	50-32-8	ug/Kg		2,100	310	< 270	270	1,600	280	< 590	590	3,100	1,600	< 280	280
Benzo(b)fluoranthene	205-99-2	ug/Kg		3,100	310	< 270	270	2,000	280	< 590	590	4,600	1,600	< 280	280
Benzo(ghi)perylene	191-24-2	ug/Kg		900	310	< 270	270	930	280	< 590	590	< 1600	1,600	< 280	280
Benzo(k)fluoranthene	207-08-9	ug/Kg		1,000	310	< 270	270	750	280	< 590	590	1,800	1,600	< 280	280
Benzoic acid	65-85-0	ug/Kg		< 890	890	< 780	780	< 800	800	< 1700	1,700	< 4600	4,600	< 810	810
Benzyl butyl phthalate	85-68-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Bis(2-chloroethoxy)methane	111-91-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Bis(2-chloroethyl)ether	111-44-4	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Bis(2-ethylhexyl)phthalate	117-81-7	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Carbazole	86-74-8	ug/Kg		930	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Chrysene	218-01-9	ug/Kg		2,700	310	< 270	270	1,500	280	< 590	590	3,800	1,600	< 280	280
Dibenz(a,h)anthracene	53-70-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Dibenzofuran	132-64-9	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Diethyl phthalate	84-66-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Dimethylphthalate	131-11-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Di-n-butylphthalate	84-74-2	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Di-n-octylphthalate	117-84-0	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Fluoranthene	206-44-0	ug/Kg		7,800	310	< 270	270	3,300	280	< 590	590	6,900	1,600	< 280	280
Fluorene	86-73-7	ug/Kg		380	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Hexachlorobenzene	118-74-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Hexachlorobutadiene	87-68-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Hexachlorocyclopentadiene	77-47-4	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Hexachloroethane	67-72-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Indeno(1,2,3-cd)pyrene	193-39-5	ug/Kg		1,000	310	< 270	270	960	280	< 590	590	< 1600	1,600	< 280	280
Isophorone	78-59-1	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Naphthalene	91-20-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Nitrobenzene	98-95-3	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
N-Nitrosodimethylamine	62-75-9	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
N-Nitrosodi-n-propylamine	621-64-7	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
N-Nitrosodiphenylamine	86-30-6	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Pentachloronitrobenzene	82-68-8	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Pentachlorophenol	87-86-5	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Phenanthrene	85-01-8	ug/Kg		5,500	310	< 270	270	1,600	280	< 590	590	6,300	1,600	< 280	280
Phenol	108-95-2	ug/Kg		< 310	310	< 270	270	< 280	280	< 590	590	< 1600	1,600	< 280	280
Pyrene	129-00-0	ug/Kg		6,000	310	< 270	270	2,900	280	< 590	590	5,100	1,600	< 280	280
Pyridine	110-86-1	ug/Kg		< 440	440	< 390	390	< 400	400	< 840	840	< 2300	2,300	< 400	400
Oxygenates & Dioxane By SW8260D (OXY)															
1,4-Dioxane	123-91-1	ug/Kg		< 280	280			< 160	160			< 170	170	< 180	180
Diethyl ether	60-29-7	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Di-isopropyl ether	108-20-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
Ethyl tert-butyl ether	637-92-3	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9
tert-amyl methyl ether	994-05-8	ug/Kg		< 14	14			< 7.9	7.9			< 8.5	8.5	< 8.9	8.9

Result Detected

RL Exceeds Criteria

Result Exceeds Criteria

Table Taken from Release Abatement Measure (RAM) Plan, Prepared by Mark Germano, LSP for Regional Environmental Council, Inc, dated July 23, 2025.

Table 5: Summary of Soil Analytical Data-Grid Investigation

Phoenix Environmental Laboratories, Inc.
587 East Middle Turnpike
P.O. Box 370
Manchester, CT 06040
(860) 645-1102

Project Id : 47 OREAD ST

	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	CT38140		CT38141		CT38142		CT38143		CT38144		CT38145		CT38146		CT38147		CT38148		CT38149		CT38150		CT38151		CT38154		CT38155		CT38156	
	Lab Sample Id																																		
	Collection Date					5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
	Client Id					GRID A 1		GRID A 2		GRID A 3		GRID A 4		GRID A 5		GRID A 6		GRID B 1		GRID B 2		GRID B 3		GRID B 4		GRID B 5		GRID B 6		GRID B 7		GRID B 0		GRID C 7	
	Matrix					Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
						Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Miscellaneous/Inorganics																																			
Percent Solid	PHNX - PCTSOLID	%																												87					
Metals, TCLP																																			
TCLP Lead	7439-92-1	mg/L	5																																
Volatiles By SW8260D																																			
1,1,1,2-Tetrachloroethane	630-20-6	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,1,1-Trichloroethane	71-55-6	ug/Kg		30,000	30,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,1,2,2-Tetrachloroethane	79-34-5	ug/Kg		5	5	< 4.4	4.4	< 2.9	2.9	< 4.7	4.7	< 3.9	3.9	< 4.4	4.4	< 4.0	4.0	< 4.4	4.4	< 3.9	3.9	< 5.0	5.0	< 4.6	4.6	< 5.0	5.0	< 4.4	4.4	< 5.0	5.0	< 4.5	4.5	< 5.0	5.0
1,1,2-Trichloroethane	79-00-5	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,1-Dichloroethane	75-34-3	ug/Kg		400	400	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,1-Dichloroethene	75-35-4	ug/Kg		3,000	3,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,1-Dichloropropene	563-58-6	ug/Kg				< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,2,3-Trichlorobenzene	87-61-6	ug/Kg				< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2,3-Trichloropropane	96-18-4	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2,4-Trichlorobenzene	120-82-1	ug/Kg		2,000	2,000	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2,4-Trimethylbenzene	95-63-6	ug/Kg		1,000,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,2-Dichloropropane	78-87-5	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,3,5-Trimethylbenzene	108-67-8	ug/Kg		10,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,3-Dichloropropane	142-28-9	ug/Kg		500,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
2,2-Dichloropropane	594-20-7	ug/Kg				< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
2-Hexanone	591-78-6	ug/Kg		100,000		< 36	36	< 25	25	< 39	39	< 33	33	< 36	36	< 33	33	< 37	37	< 33	33	< 42	42	< 39	39	< 42	42	< 37	37	< 28	28	< 38	38	< 48	48
2-Isopropyltoluene	527-84-4	ug/Kg				< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
4-Methyl-2-pentanone	108-10-1	ug/Kg		400	400	< 36	36	< 25	25	< 39	39	< 33	33	< 36	36	< 33	33	< 37	37	< 33	33	< 42	42	< 39	39	< 42	42	< 37	37	< 28	28	< 38	38	< 48	48
Acetone	67-64-1	ug/Kg		6,000	6,000	< 360	360	< 250	250	< 390	390	< 330	330	< 360	360	< 330	330	< 370	370	< 330	330	< 420	420	< 390	390	< 420	420	< 370	370	< 110	110	< 380	380	< 480	480
Acrylonitrile	107-13-1	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 11	11	< 7.5	7.5	< 9.6	9.6
Benzene	71-43-2	ug/Kg		2,000	2,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Bromobenzene	108-86-1	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
Bromochloromethane	74-97-5	ug/Kg				< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Bromodichloromethane	75-27-4	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Bromoform	75-25-2	ug/Kg		100	100	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Bromomethane	74-83-9	ug/Kg		500	500	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
2-Butanone (Methyl Ethyl Ketone)	78-93-3	ug/Kg		4,000	4,000	< 44	44	< 29	29	< 47	47	< 39	39	< 44	44	< 40	40	< 44	44	< 39	39	< 50	50	< 46	46	< 51	51	< 44	44	< 28	28	< 45	45	< 57	57
n-Butylbenzene	104-51-8	ug/Kg				< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
sec-Butylbenzene	135-98-8	ug/Kg				< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
tert-Butylbenzene	98-06-6	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490

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	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	CT38140		CT38141		CT38142		CT38143		CT38144	
	Lab Sample Id					CT38140		CT38141		CT38142		CT38143		CT38144	
	Collection Date					5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
	Client Id					GRID A 1		GRID A 2		GRID A 3		GRID A 4		GRID A 5	
	Matrix					Soil		Soil		Soil		Soil		Soil	
	CAS	Units				Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	75-15-0	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Carbon tetrachloride	56-23-5	ug/Kg		5,000	10,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Chlorobenzene	108-90-7	ug/Kg		1,000	1,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Chloroethane	75-00-3	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Chloroform	67-66-3	ug/Kg		200	400	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Chloromethane	74-87-3	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
2-Chlorotoluene	95-49-8	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
4-Chlorotoluene	106-43-4	ug/Kg				< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
1,2-Dibromo-3-chloropropane	96-12-8	ug/Kg		10,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
1,2-Dibromoethane	106-93-4	ug/Kg		100	100	< 0.73	0.73	< 0.49	0.49	< 0.79	0.79	< 0.65	0.65	< 0.73	0.73
Dibromomethane	74-95-3	ug/Kg		500,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
1,2-Dichlorobenzene	95-50-1	ug/Kg		9,000	9,000	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
1,3-Dichlorobenzene	541-73-1	ug/Kg		3,000	3,000	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
1,4-Dichlorobenzene	106-46-7	ug/Kg		700	700	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Dibromochloromethane	124-48-1	ug/Kg		5	5	< 4.4	4.4	< 2.9	2.9	< 4.7	4.7	< 3.9	3.9	< 4.4	4.4
cis-1,2-Dichloroethene	156-59-2	ug/Kg		100	300	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
cis-1,3-Dichloropropene	10061-01-5	ug/Kg		10		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Dichlorodifluoromethane	75-71-8	ug/Kg		1,000,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Ethylbenzene	100-41-4	ug/Kg		40,000	40,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Hexachlorobutadiene	87-68-3	ug/Kg		30,000	30,000	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Isopropylbenzene	98-82-8	ug/Kg		1,000,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
m&p-Xylene	179601-23-1	ug/Kg		100,000	400,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Methyl t-butyl ether (MTBE)	1634-04-4	ug/Kg		100	100	< 15	15	< 9.8	9.8	< 16	16	< 13	13	< 15	15
Methylene chloride	75-09-2	ug/Kg		100	100	< 15	15	< 9.8	9.8	< 16	16	< 13	13	< 15	15
Naphthalene	91-20-3	ug/Kg		4,000	4,000	< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
n-Propylbenzene	103-65-1	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
o-Xylene	95-47-6	ug/Kg		100,000	400,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
p-Isopropyltoluene	99-87-6	ug/Kg		100,000		< 7.3	7.3	< 290	290	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Styrene	100-42-5	ug/Kg		3,000	3,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Tetrachloroethene	127-18-4	ug/Kg		1,000	1,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Tetrahydrofuran (THF)	109-99-9	ug/Kg		500,000		< 15	15	< 9.8	9.8	< 16	16	< 13	13	< 15	15
Toluene	108-88-3	ug/Kg		30,000	30,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Total Xylenes	1330-20-7	ug/Kg		100,000	400,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
trans-1,2-Dichloroethene	156-60-5	ug/Kg		1,000	1,000	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
trans-1,3-Dichloropropene	10061-02-6	ug/Kg		10		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
trans-1,4-dichloro-2-butene	110-57-6	ug/Kg		10,000		< 15	15	< 590	590	< 16	16	< 13	13	< 15	15
Trichloroethene	79-01-6	ug/Kg		300	300	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Trichlorofluoromethane	75-69-4	ug/Kg		1,000,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Trichlorotrifluoroethane	76-13-1	ug/Kg				< 15	15	< 9.8	9.8	< 16	16	< 13	13	< 15	15
Vinyl chloride	75-01-4	ug/Kg		300	300	< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Oxygenates & Dioxane By SW8260D (OXY)															
1,4-Dioxane	123-91-1	ug/Kg		200	200	< 150	150	< 98	98	< 160	160	< 130	130	< 150	150
Diethyl ether	60-29-7	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Di-isopropyl ether	108-20-3	ug/Kg		100,000		< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
Ethyl tert-butyl ether	637-92-3	ug/Kg				< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3
tert-amyl methyl ether	994-05-8	ug/Kg				< 7.3	7.3	< 4.9	4.9	< 7.9	7.9	< 6.5	6.5	< 7.3	7.3

	CT38145		CT38146		CT38147		CT38148		CT38149	
Collection Date	5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id	GRID A 6		GRID B 1		GRID B 2		GRID B 3		GRID B 4	
Matrix	Soil		Soil		Soil		Soil		Soil	
	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Carbon tetrachloride	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Chlorobenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Chloroethane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Chloroform	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Chloromethane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
2-Chlorotoluene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
4-Chlorotoluene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
1,2-Dibromo-3-chloropropane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
1,2-Dibromoethane	< 0.67	0.67	< 0.74	0.74	< 0.66	0.66	< 0.84	0.84	< 0.77	0.77
Dibromomethane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
1,2-Dichlorobenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
1,3-Dichlorobenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
1,4-Dichlorobenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Dibromochloromethane	< 4.0	4.0	< 4.4	4.4	< 3.9	3.9	< 5.0	5.0	< 4.6	4.6
cis-1,2-Dichloroethene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
cis-1,3-Dichloropropene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Dichlorodifluoromethane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Ethylbenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Hexachlorobutadiene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Isopropylbenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
m&p-Xylene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Methyl t-butyl ether (MTBE)	< 13	13	< 15	15	< 13	13	< 17	17	< 15	15
Methylene chloride	< 13	13	< 15	15	< 13	13	< 17	17	< 15	15
Naphthalene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
n-Propylbenzene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
o-Xylene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
p-Isopropyltoluene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Styrene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Tetrachloroethene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Tetrahydrofuran (THF)	< 13	13	< 15	15	< 13	13	< 17	17	< 15	15
Toluene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Total Xylenes	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
trans-1,2-Dichloroethene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
trans-1,3-Dichloropropene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
trans-1,4-dichloro-2-butene	< 13	13	< 15	15	< 13	13	< 17	17	< 15	15
Trichloroethene	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Trichlorofluoromethane	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Trichlorotrifluoroethane	< 13	13	< 15	15	< 13	13	< 17	17	< 15	15
Vinyl chloride	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Oxygenates & Dioxane By SW8260D (OXY)										
1,4-Dioxane	< 130	130	< 150	150	< 130	130	< 170	170	< 150	150
Diethyl ether	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Di-isopropyl ether	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
Ethyl tert-butyl ether	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7
tert-amyl methyl ether	< 6.7	6.7	< 7.4	7.4	< 6.6	6.6	< 8.4	8.4	< 7.7	7.7

	CT38150		CT38151		CT38154		CT38155		CT38156	
Collection Date	5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id	GRID B 5		GRID B 6		GRID B 7		GRID B 0		GRID C 7	
Matrix	Soil		Soil		Soil		Soil		Soil	
	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Carbon tetrachloride	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Chlorobenzene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Chloroethane	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Chloroform	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Chloromethane	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
2-Chlorotoluene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
4-Chlorotoluene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2-Dibromo-3-chloropropane	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,2-Dibromoethane	< 0.85	0.85	< 0.74	0.74	< 5.7	5.7	< 0.75	0.75	< 0.96	0.96
Dibromomethane	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
1,2-Dichlorobenzene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,3-Dichlorobenzene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
1,4-Dichlorobenzene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
Dibromochloromethane	< 5.0	5.0	< 4.4	4.4	< 5.0	5.0	< 4.5	4.5	< 5.0	5.0
cis-1,2-Dichloroethene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
cis-1,3-Dichloropropene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Dichlorodifluoromethane	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Ethylbenzene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Hexachlorobutadiene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
Isopropylbenzene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
m&p-Xylene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Methyl t-butyl ether (MTBE)	< 17	17	< 15	15	< 11	11	< 15	15	< 19	19
Methylene chloride	< 17	17	< 15	15	< 11	11	< 15	15	< 19	19
Naphthalene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
n-Propylbenzene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
o-Xylene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
p-Isopropyltoluene	< 380	380	< 370	370	< 5.7	5.7	< 7.5	7.5	< 490	490
Styrene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Tetrachloroethene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Tetrahydrofuran (THF)	< 17	17	< 15	15	< 11	11	< 15	15	< 19	19
Toluene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Total Xylenes	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
trans-1,2-Dichloroethene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
trans-1,3-Dichloropropene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
trans-1,4-dichloro-2-butene	< 750	750	< 730	730	< 11	11	< 15	15	< 980	980
Trichloroethene	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Trichlorofluoromethane	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Trichlorotrifluoroethane	< 17	17	< 15	15	< 5.7	5.7	< 15	15	< 19	19
Vinyl chloride	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Oxygenates & Dioxane By SW8260D (OXY)										
1,4-Dioxane	< 170	170	< 150	150	< 110	110	< 150	150	< 190	190
Diethyl ether	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Di-isopropyl ether	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
Ethyl tert-butyl ether	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6
tert-amyl methyl ether	< 8.5	8.5	< 7.4	7.4	< 5.7	5.7	< 7.5	7.5	< 9.6	9.6

Result Detected

RL Exceeds Criteria

Result Exceeds Criteria

Phoenix Environmental Laboratories, Inc.
587 East Middle Turnpike
P.O. Box 370
Manchester, CT 06040
(860) 645-1102

Project Id : 47 OREAD ST

	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	CT38158		CT38159		CT38160		CT38161		CT38162		CT38163		CT38164		CT38165		CT38166		CT38167		CT38168		CT38169		CT38170	
Lab Sample Id						CT38158		CT38159		CT38160		CT38161		CT38162		CT38163		CT38164		CT38165		CT38166		CT38167		CT38168		CT38169		CT38170	
Collection Date						5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id						GRID D 7		GRID D 0		COMPOSITE SOIL		TRIP BLANK LL		GRID C1		GRID C2		GRID C3		GRID C4		GRID C5		GRID C6		GRID D1		GRID D2		GRID D3	
Matrix						Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil		Soil	
	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Miscellaneous/Inorganics																															
Percent Solid	PHNX - PCTSOLID	%				85		83																							
Metals, TCLP																															
TCLP Lead	7439-92-1	mg/L	5							2.52	0.10																				
Volatiles By SW8260D																															
1,1,1,2-Tetrachloroethane	630-20-6	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,1,1-Trichloroethane	71-55-6	ug/Kg		30,000	30,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,1,2,2-Tetrachloroethane	79-34-5	ug/Kg		5	5	< 5.0	5.0	< 5.0	5.0			< 3.0	3.0	< 4.1	4.1	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0	< 4.1	4.1	< 5.0	5.0	< 4.1	4.1	< 4.7	4.7	< 5.0	5.0
1,1,2-Trichloroethane	79-00-5	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,1-Dichloroethane	75-34-3	ug/Kg		400	400	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,1-Dichloroethene	75-35-4	ug/Kg		3,000	3,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,1-Dichloropropene	563-58-6	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,2,3-Trichlorobenzene	87-61-6	ug/Kg				< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2,3-Trichloropropane	96-18-4	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2,4-Trichlorobenzene	120-82-1	ug/Kg		2,000	2,000	< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2,4-Trimethylbenzene	95-63-6	ug/Kg		1,000,000		< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,2-Dichloropropane	78-87-5	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,3,5-Trimethylbenzene	108-67-8	ug/Kg		10,000		< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,3-Dichloropropane	142-28-9	ug/Kg		500,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
2,2-Dichloropropane	594-20-7	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
2-Hexanone	591-78-6	ug/Kg		100,000		< 29	29	< 30	30			< 25	25	< 35	35	< 48	48	< 43	43	< 45	45	< 34	34	< 43	43	< 34	34	< 39	39	< 44	44
2-Isopropyltoluene	527-84-4	ug/Kg				< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
4-Methyl-2-pentanone	108-10-1	ug/Kg		400	400	< 29	29	< 30	30			< 25	25	< 35	35	< 48	48	< 43	43	< 45	45	< 34	34	< 43	43	< 34	34	< 39	39	< 44	44
Acetone	67-64-1	ug/Kg		6,000	6,000	< 120	120	< 120	120			< 250	250	< 350	350	< 480	480	< 430	430	< 450	450	< 340	340	< 430	430	< 340	340	< 390	390	< 440	440
Acrylonitrile	107-13-1	ug/Kg		100,000		< 12	12	< 12	12			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Benzene	71-43-2	ug/Kg		2,000	2,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Bromobenzene	108-86-1	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
Bromochloromethane	74-97-5	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Bromodichloromethane	75-27-4	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Bromoform	75-25-2	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Bromomethane	74-83-9	ug/Kg		500	500	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
2-Butanone (Methyl Ethyl Ketone)	78-93-3	ug/Kg		4,000	4,000	< 29	29	< 30	30			< 30	30	< 41	41	< 57	57	< 51	51	< 54	54	< 41	41	< 52	52	< 41	41	< 47	47	< 53	53
n-Butylbenzene	104-51-8	ug/Kg				< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
sec-Butylbenzene	135-98-8	ug/Kg				< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
tert-Butylbenzene	98-06-6	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8

Phoenix Environmental Laboratories, Inc.
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Project Id : 47 OREAD ST

Lab Sample Id	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	CT38158		CT38159		CT38160		CT38161	
Collection Date						5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id						GRID D 7		GRID D 0		COMPOSITE SOIL		TRIP BLANK LL	
Matrix						Soil		Soil		Soil		Soil	
						Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	75-15-0	ug/Kg		100,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Carbon tetrachloride	56-23-5	ug/Kg		5,000	10,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Chlorobenzene	108-90-7	ug/Kg		1,000	1,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Chloroethane	75-00-3	ug/Kg		100,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Chloroform	67-66-3	ug/Kg		200	400	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Chloromethane	74-87-3	ug/Kg		100,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
2-Chlorotoluene	95-49-8	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0
4-Chlorotoluene	106-43-4	ug/Kg				< 330	330	< 6.0	6.0			< 5.0	5.0
1,2-Dibromo-3-chloropropane	96-12-8	ug/Kg		10,000		< 330	330	< 6.0	6.0			< 5.0	5.0
1,2-Dibromoethane	106-93-4	ug/Kg		100	100	< 5.9	5.9	< 6.0	6.0			< 0.50	0.50
Dibromomethane	74-95-3	ug/Kg		500,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
1,2-Dichlorobenzene	95-50-1	ug/Kg		9,000	9,000	< 330	330	< 6.0	6.0			< 5.0	5.0
1,3-Dichlorobenzene	541-73-1	ug/Kg		3,000	3,000	< 330	330	< 6.0	6.0			< 5.0	5.0
1,4-Dichlorobenzene	106-46-7	ug/Kg		700	700	< 330	330	< 6.0	6.0			< 5.0	5.0
Dibromochloromethane	124-48-1	ug/Kg		5	5	< 5.0	5.0	< 5.0	5.0			< 3.0	3.0
cis-1,2-Dichloroethene	156-59-2	ug/Kg		100	300	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
cis-1,3-Dichloropropene	10061-01-5	ug/Kg		10		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Dichlorodifluoromethane	75-71-8	ug/Kg		1,000,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Ethylbenzene	100-41-4	ug/Kg		40,000	40,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Hexachlorobutadiene	87-68-3	ug/Kg		30,000	30,000	< 330	330	< 6.0	6.0			< 5.0	5.0
Isopropylbenzene	98-82-8	ug/Kg		1,000,000		< 330	330	< 6.0	6.0			< 5.0	5.0
m&p-Xylene	179601-23-1	ug/Kg		100,000	400,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Methyl t-butyl ether (MTBE)	1634-04-4	ug/Kg		100	100	< 12	12	< 12	12			< 10	10
Methylene chloride	75-09-2	ug/Kg		100	100	< 12	12	< 12	12			< 10	10
Naphthalene	91-20-3	ug/Kg		4,000	4,000	< 330	330	< 6.0	6.0			< 5.0	5.0
n-Propylbenzene	103-65-1	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0
o-Xylene	95-47-6	ug/Kg		100,000	400,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
p-Isopropyltoluene	99-87-6	ug/Kg		100,000		< 330	330	< 6.0	6.0			< 5.0	5.0
Styrene	100-42-5	ug/Kg		3,000	3,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Tetrachloroethene	127-18-4	ug/Kg		1,000	1,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Tetrahydrofuran (THF)	109-99-9	ug/Kg		500,000		< 12	12	< 12	12			< 10	10
Toluene	108-88-3	ug/Kg		30,000	30,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Total Xylenes	1330-20-7	ug/Kg		100,000	400,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
trans-1,2-Dichloroethene	156-60-5	ug/Kg		1,000	1,000	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
trans-1,3-Dichloropropene	10061-02-6	ug/Kg		10		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
trans-1,4-dichloro-2-butene	110-57-6	ug/Kg		10,000		< 670	670	< 12	12			< 10	10
Trichloroethene	79-01-6	ug/Kg		300	300	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Trichlorofluoromethane	75-69-4	ug/Kg		1,000,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Trichlorotrifluoroethane	76-13-1	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 10	10
Vinyl chloride	75-01-4	ug/Kg		300	300	< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Oxygenates & Dioxane By SW8260D (OXY)													
1,4-Dioxane	123-91-1	ug/Kg		200	200	< 120	120	< 120	120			< 100	100
Diethyl ether	60-29-7	ug/Kg		100,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Di-isopropyl ether	108-20-3	ug/Kg		100,000		< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
Ethyl tert-butyl ether	637-92-3	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 5.0	5.0
tert-amyl methyl ether	994-05-8	ug/Kg				< 5.9	5.9	< 6.0	6.0			< 5.0	5.0

Lab Sample Id	CT38162		CT38163		CT38164		CT38165		CT38166	
Collection Date	5/23/2025		5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id	GRID C1		GRID C2		GRID C3		GRID C4		GRID C5	
Matrix	Soil		Soil		Soil		Soil		Soil	
	Result	RL	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Carbon tetrachloride	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Chlorobenzene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Chloroethane	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Chloroform	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Chloromethane	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
2-Chlorotoluene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
4-Chlorotoluene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
1,2-Dibromo-3-chloropropane	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
1,2-Dibromoethane	< 0.69	0.69	< 0.96	0.96	< 0.85	0.85	< 0.90	0.90	< 0.69	0.69
Dibromomethane	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
1,2-Dichlorobenzene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
1,3-Dichlorobenzene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
1,4-Dichlorobenzene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
Dibromochloromethane	< 4.1	4.1	< 5.0	5.0	< 5.0	5.0	< 5.0	5.0	< 4.1	4.1
cis-1,2-Dichloroethene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
cis-1,3-Dichloropropene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Dichlorodifluoromethane	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Ethylbenzene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Hexachlorobutadiene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
Isopropylbenzene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
m&p-Xylene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Methyl t-butyl ether (MTBE)	< 14	14	< 19	19	< 17	17	< 18	18	< 14	14
Methylene chloride	< 14	14	< 19	19	< 17	17	< 18	18	< 14	14
Naphthalene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
n-Propylbenzene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
o-Xylene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
p-Isopropyltoluene	< 320	320	< 9.6	9.6	< 350	350	< 9.0	9.0	< 370	370
Styrene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Tetrachloroethene	550	320	450	400	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Tetrahydrofuran (THF)	< 14	14	< 19	19	< 17	17	< 18	18	< 14	14
Toluene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Total Xylenes	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
trans-1,2-Dichloroethene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
trans-1,3-Dichloropropene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
trans-1,4-dichloro-2-butene	< 640	640	< 19	19	< 700	700	< 18	18	< 750	750
Trichloroethene	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Trichlorofluoromethane	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Trichlorotrifluoroethane	< 14	14	< 19	19	< 17	17	< 18	18	< 14	14
Vinyl chloride	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Oxygenates & Dioxane By SW8260D (OXY)										
1,4-Dioxane	< 140	140	< 190	190	< 170	170	< 180	180	< 140	140
Diethyl ether	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Di-isopropyl ether	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
Ethyl tert-butyl ether	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9
tert-amyl methyl ether	< 6.9	6.9	< 9.6	9.6	< 8.5	8.5	< 9.0	9.0	< 6.9	6.9

Lab Sample Id	CT38167		CT38168		CT38169		CT38170	
Collection Date	5/23/2025		5/23/2025		5/23/2025		5/23/2025	
Client Id	GRID C6		GRID D1		GRID D2		GRID D3	
Matrix	Soil		Soil		Soil		Soil	
	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Carbon tetrachloride	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Chlorobenzene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Chloroethane	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Chloroform	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Chloromethane	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
2-Chlorotoluene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
4-Chlorotoluene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2-Dibromo-3-chloropropane	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,2-Dibromoethane	< 0.87	0.87	< 0.68	0.68	< 0.78	0.78	< 0.88	0.88
Dibromomethane	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
1,2-Dichlorobenzene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,3-Dichlorobenzene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
1,4-Dichlorobenzene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
Dibromochloromethane	< 5.0	5.0	< 4.1	4.1	< 4.7	4.7	< 5.0	5.0
cis-1,2-Dichloroethene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
cis-1,3-Dichloropropene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Dichlorodifluoromethane	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Ethylbenzene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Hexachlorobutadiene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
Isopropylbenzene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
m&p-Xylene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Methyl t-butyl ether (MTBE)	< 17	17	< 14	14	< 16	16	< 18	18
Methylene chloride	< 17	17	< 14	14	< 16	16	< 18	18
Naphthalene	< 8.7	8.7	< 6.8	6.8	< 370	370	630	360
n-Propylbenzene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
o-Xylene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
p-Isopropyltoluene	< 8.7	8.7	< 6.8	6.8	< 370	370	< 8.8	8.8
Styrene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Tetrachloroethene	< 8.7	8.7	650	310	< 7.8	7.8	< 8.8	8.8
Tetrahydrofuran (THF)	< 17	17	< 14	14	< 16	16	< 18	18
Toluene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Total Xylenes	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
trans-1,2-Dichloroethene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
trans-1,3-Dichloropropene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
trans-1,4-dichloro-2-butene	< 17	17	< 14	14	< 730	730	< 18	18
Trichloroethene	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Trichlorofluoromethane	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Trichlorotrifluoroethane	< 17	17	< 14	14	< 16	16	< 18	18
Vinyl chloride	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Oxygenates & Dioxane By SW8260D (OXY)								
1,4-Dioxane	< 170	170	< 140	140	< 160	160	< 180	180
Diethyl ether	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Di-isopropyl ether	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
Ethyl tert-butyl ether	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8
tert-amyl methyl ether	< 8.7	8.7	< 6.8	6.8	< 7.8	7.8	< 8.8	8.8

Result Detected

RL Exceeds Criteria

Result Exceeds Criteria

Phoenix Environmental Laboratories, Inc.
587 East Middle Turnpike
P.O. Box 370
Manchester, CT 06040
(860) 645-1102

Project Id : 47 OREAD ST

	Lab Sample Id					CT38171		CT38172		CT38173		CT38174	
	Collection Date					5/23/2025		5/23/2025		5/23/2025		5/23/2025	
	Client Id					GRID D4		GRID D5		GRID D6		TRIP BLANK HL	
	Matrix					Soil		Soil		Soil		Soil	
	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	Result	RL	Result	RL	Result	RL	Result	RL
Miscellaneous/Inorganics													
Percent Solid	PHNX - PCTSOLID	%											
Metals, TCLP													
TCLP Lead	7439-92-1	mg/L	5										
Volatiles By SW8260D													
1,1,1,2-Tetrachloroethane	630-20-6	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,1,1-Trichloroethane	71-55-6	ug/Kg		30,000	30,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,1,2,2-Tetrachloroethane	79-34-5	ug/Kg		5	5	< 5.0	5.0	< 5.0	5.0	< 4.9	4.9	< 250	250
1,1,2-Trichloroethane	79-00-5	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,1-Dichloroethane	75-34-3	ug/Kg		400	400	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,1-Dichloroethene	75-35-4	ug/Kg		3,000	3,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,1-Dichloropropene	563-58-6	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2,3-Trichlorobenzene	87-61-6	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2,3-Trichloropropane	96-18-4	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2,4-Trichlorobenzene	120-82-1	ug/Kg		2,000	2,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2,4-Trimethylbenzene	95-63-6	ug/Kg		1,000,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dichloroethane	107-06-2	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dichloropropane	78-87-5	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,3,5-Trimethylbenzene	108-67-8	ug/Kg		10,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,3-Dichloropropane	142-28-9	ug/Kg		500,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
2,2-Dichloropropane	594-20-7	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
2-Hexanone	591-78-6	ug/Kg		100,000		< 41	41	< 57	57	< 41	41	< 1300	1,300
2-Isopropyltoluene	527-84-4	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
4-Methyl-2-pentanone	108-10-1	ug/Kg		400	400	< 41	41	< 57	57	< 41	41	< 1300	1,300
Acetone	67-64-1	ug/Kg		6,000	6,000	< 410	410	< 570	570	< 410	410	< 5000	5,000
Acrylonitrile	107-13-1	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 500	500
Benzene	71-43-2	ug/Kg		2,000	2,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Bromobenzene	108-86-1	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Bromochloromethane	74-97-5	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Bromodichloromethane	75-27-4	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Bromoform	75-25-2	ug/Kg		100	100	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Bromomethane	74-83-9	ug/Kg		500	500	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
2-Butanone (Methyl Ethyl Ketone)	78-93-3	ug/Kg		4,000	4,000	< 50	50	< 68	68	< 49	49	< 3000	3,000
n-Butylbenzene	104-51-8	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
sec-Butylbenzene	135-98-8	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
tert-Butylbenzene	98-06-6	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250

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Project Id : 47 OREAD ST

Lab Sample Id / Collection Date / Client Id / Matrix						CT38171 5/23/2025 GRID D4 Soil		CT38172 5/23/2025 GRID D5 Soil		CT38173 5/23/2025 GRID D6 Soil		CT38174 5/23/2025 TRIP BLANK HL Soil	
	CAS	Units	EPA Toxicity Characteristics	MassDEP RCS-1	MCP Method 1 S-1/GW-1	Result	RL	Result	RL	Result	RL	Result	RL
Carbon Disulfide	75-15-0	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Carbon tetrachloride	56-23-5	ug/Kg		5,000	10,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Chlorobenzene	108-90-7	ug/Kg		1,000	1,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Chloroethane	75-00-3	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Chloroform	67-66-3	ug/Kg		200	400	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Chloromethane	74-87-3	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
2-Chlorotoluene	95-49-8	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
4-Chlorotoluene	106-43-4	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dibromo-3-chloropropane	96-12-8	ug/Kg		10,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dibromoethane	106-93-4	ug/Kg		100	100	< 0.83	0.83	< 1.1	1.1	< 0.81	0.81	< 250	250
Dibromomethane	74-95-3	ug/Kg		500,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,2-Dichlorobenzene	95-50-1	ug/Kg		9,000	9,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,3-Dichlorobenzene	541-73-1	ug/Kg		3,000	3,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
1,4-Dichlorobenzene	106-46-7	ug/Kg		700	700	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Dibromochloromethane	124-48-1	ug/Kg		5	5	< 5.0	5.0	< 5.0	5.0	< 4.9	4.9	< 250	250
cis-1,2-Dichloroethene	156-59-2	ug/Kg		100	300	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
cis-1,3-Dichloropropene	10061-01-5	ug/Kg		10		< 8.3	8.3	< 10	10	< 8.1	8.1	< 250	250
Dichlorodifluoromethane	75-71-8	ug/Kg		1,000,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Ethylbenzene	100-41-4	ug/Kg		40,000	40,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Hexachlorobutadiene	87-68-3	ug/Kg		30,000	30,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Isopropylbenzene	98-82-8	ug/Kg		1,000,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
m&p-Xylene	179601-23-1	ug/Kg		100,000	400,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Methyl t-butyl ether (MTBE)	1634-04-4	ug/Kg		100	100	< 17	17	< 23	23	< 16	16	< 250	250
Methylene chloride	75-09-2	ug/Kg		100	100	< 17	17	< 23	23	< 16	16	< 500	500
Naphthalene	91-20-3	ug/Kg		4,000	4,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
n-Propylbenzene	103-65-1	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
o-Xylene	95-47-6	ug/Kg		100,000	400,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
p-Isopropyltoluene	99-87-6	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Styrene	100-42-5	ug/Kg		3,000	3,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Tetrachloroethene	127-18-4	ug/Kg		1,000	1,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Tetrahydrofuran (THF)	109-99-9	ug/Kg		500,000		< 17	17	< 23	23	< 16	16	< 500	500
Toluene	108-88-3	ug/Kg		30,000	30,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Total Xylenes	1330-20-7	ug/Kg		100,000	400,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
trans-1,2-Dichloroethene	156-60-5	ug/Kg		1,000	1,000	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
trans-1,3-Dichloropropene	10061-02-6	ug/Kg		10		< 8.3	8.3	< 10	10	< 8.1	8.1	< 250	250
trans-1,4-dichloro-2-butene	110-57-6	ug/Kg		10,000		< 17	17	< 23	23	< 16	16	< 500	500
Trichloroethene	79-01-6	ug/Kg		300	300	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Trichlorofluoromethane	75-69-4	ug/Kg		1,000,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Trichlorotrifluoroethane	76-13-1	ug/Kg				< 17	17	< 23	23	< 16	16	< 250	250
Vinyl chloride	75-01-4	ug/Kg		300	300	< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Oxygenates & Dioxane By SW8260D (OXY)													
1,4-Dioxane	123-91-1	ug/Kg		200	200	< 170	170	< 200	200	< 160	160	< 5000	5,000
Diethyl ether	60-29-7	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Di-isopropyl ether	108-20-3	ug/Kg		100,000		< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
Ethyl tert-butyl ether	637-92-3	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250
tert-amyl methyl ether	994-05-8	ug/Kg				< 8.3	8.3	< 11	11	< 8.1	8.1	< 250	250

Result Detected

RL Exceeds Criteria

Result Exceeds Criteria

APPENDIX D

Best Management Practices

United States Environmental Protection Agency
Office of Land and Emergency Management (5203)
EPA 542-F-23-001 March 2023 Update

Green Remediation Best Management Practices: Cleaner Fuels and Air Emissions for Site Cleanups

A fact sheet about the concepts and tools for using best management practices to reduce the environmental footprint of fuel consumption and associated air emissions during site investigation and remediation

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental footprint of activities involved in cleaning up contaminated sites.[1] Best management practices (BMPs) of green remediation involve specific activities to address the core elements of greener cleanups:

- Reduce total energy use and increase the percentage of energy from renewable resources.
- Reduce air pollutants and greenhouse gas (GHG) emissions.
- Reduce water use and preserve water quality.
- Conserve material resources and reduce waste.
- Protect land and ecosystem services.

BMPs focused on the core elements concerning energy consumption and air quality may also help mitigate and adapt to ongoing climate change.

Overview

Environmental investigation and remediation at hazardous waste sites can involve significant consumption of fossil fuels such as gasoline and diesel by vehicles and mobile or stationary equipment that may act as non-point sources of air pollution. Minimizing emission of air pollutants such as GHGs and particulate matter (PM) resulting from cleanup activities is a core element of green remediation strategies. Efforts to reduce these emissions during site investigation, remedial or corrective actions, and long-term operation and maintenance (O&M) of site remedies must meet Clean Air Act (CAA) requirements and state air quality standards as well as relevant requirements of federal and state cleanup programs. The CAA specifies ground-level ozone, PM, carbon monoxide, nitrogen dioxide, sulfur dioxide and lead as the nation's criteria air pollutants. EPA's air quality criteria and national ambient air quality standards (NAAQS) for criteria pollutants must be met in all state implementation plans.

Burning of fossil fuels results in significant emission of carbon dioxide (CO_2), a GHG that disturbs the earth's natural carbon cycle and greatly contributes to climate changes.[2] Ongoing EPA analyses indicate that CO_2 accounted for 79.5 percent of the GHGs emitted in the United States in 2021.[3] Related EPA studies of GHG emissions by U.S. economic sectors indicate that the transportation sector and electric power sector are the two largest contributors to CO_2 emissions resulting from the combustion of petroleum, coal and natural gas. The majority of fossil fuel directly consumed during site cleanup results from using onroad and offroad vehicles and stationary or mobile equipment powered by internal combustion engines.

EPA's *Green Remediation Best Management Practices: Integrating Renewable Energy* fact sheet provides information about applying solar electric and other renewable energy technologies to avoid or offset the use of grid electricity produced from fossil fuels.[4]

The use of fossil fuels also increases production of ground-level ozone, which can trigger human health problems such as aggravated asthma and reduced lung function. As of late 2020, EPA analyses indicate that about 22 percent of the U.S. population lives within three miles of a Superfund remedial site.[5] Additionally, airborne pollutants are among the impacts that disproportionally affect communities with environmental justice concerns, including those regarding local Superfunds sites; hazardous waste treatment, storage and disposal facilities; and brownfields.[6] EPA is accordingly collecting air quality data in such communities to support improved compliance with state and federal air quality standards.

EPA's Spreadsheets for Environmental Footprint Analysis (SEFA) tool was used to estimate fuel consumption and air emissions involved in corrective action at the Bay Road Holdings LLC site in East Palo Alto, California.[7]

Green remediation BMPs focused on air quality can reduce the environmental footprints of cleanup projects while improving their public health outcomes and helping mitigate climate change. BMPs relating to air quality also help meet goals of the Diesel Emissions Reduction Act, which prioritizes environmental justice and emissions reductions in areas receiving disproportionate impacts from diesel fleets. EPA's Web-based EJScreen provides information and mapping on socioeconomic demographics and environmental indicators such as Superfund site proximity and diesel PM within a given geographic area.[8]

Fleets of transportation and construction vehicles deployed for site cleanup typically encompass a range of vehicle types. Light-duty vehicles with a gross vehicle weight rating (GVWR) below 8,500 pounds (such as sport-utility vehicles, light-duty trucks and medium-duty passenger vehicles) are commonly used to transport workers, small equipment and small quantities of supplies. Heavy-duty commercial vehicles such as cargo vans or light-duty trucks rated above 8,500 pounds GVWR are often deployed to transport heavier loads and serve as a platform for field equipment such as hollow-stem auger drill rigs needed for collection of subsurface environmental samples.

Nonroad vehicles such as bulldozers, excavators and graders are used for purposes such as demolishing buildings, constructing remedies such as landfill caps, or contouring disturbed ground surfaces. Additionally, tractor trailers may be intermittently required to transport heavy construction equipment or materials to and from the site or to transfer contaminated waste to an offsite facility.

Diesel Consumption and Estimated CO_2 Emissions in an Illustrative Excavation and Soil Amendment Project

Activity	Diesel Consumption (gallons)	CO_2 Emission (tons)*
Removing 35,000 cubic yards of contaminated soil by way of an excavator	4,000	89,800
Hauling excavated soil to a hazardous waste disposal facility 100 miles away by way of tractor trailers	11,666	261,902
Importing wood milling and agricultural waste from sources 50 miles away by way of dump trucks	2,400	53,880
Applying soil amendments and contouring ground surfaces by way of a grader	288	6,465
Using two medium-duty pickup trucks for site preparation and remedy construction over six months	500	11,225
Total diesel consumption and associated air emissions	18,854	423,272

*Based on an emission coefficient of 22.45 pounds per gallon, https://www.eia.gov/environment/emissions/co2_vol_mass.php

Advanced Emission Control Technologies for Vehicles and Engines

Reductions in PM, nitrogen oxides (NOx) and other air pollutants from vehicles and mobile or stationary equipment can be achieved through BMPs such as:

- Replace older vehicles and older equipment engines with newer ones meeting the most recent emission control standards.
- Use newer emission control components to rebuild engines.
- Retrofit diesel engines with exhaust aftertreatment devices.

EPA continues to update fuel economy and emission standards that must be met by manufacturers of onroad and offroad vehicles deployed in the United States. The "Tier 3" emission and fuel standards finalized in 2014 apply to passenger cars, light-duty trucks, medium-duty passenger vehicles, and some heavy-duty vehicles.[9] Vehicles meeting Tier 3 standards are equipped with emission reduction technologies as well as engines that have been calibrated to optimize fuel consumption while minimizing emissions.

"Tier 4" emission standards apply to nonroad compression-ignition (diesel) engines used in machines such as the drill rigs, excavators, pumps and compressors commonly required for site characterization, remedy construction or remedial operations. Tier 4 standards also apply to nonroad spark-ignition engines used in equipment such as generators and forklifts fueled by propane, gasoline or natural gas.[10]

EPA and the California Air Resources Board maintain lists of relevant technologies that have been verified to reduce the harmful impacts of diesel exhaust.[11,12] Technologies commonly integrated in newer vehicles and engines include diesel oxidation catalysts (DOCs) and diesel particulate filters (DPFs). Information about installing DOCs and DPFs in older vehicles is available in EPA technical bulletins.[13]

Offroad vehicles equipped with diesel-electric power trains and Tier 4 compliant engines were used to minimize fuel consumption and air emissions during remedy construction at the Elizabeth Mine Superfund site in Vermont. Use of a bulldozer with an electric power train, for example, decreased its fuel consumption by about 30 percent and increased its productivity by about 10 percent. Deployment of excavators powered by Tier 4 engines over six months was estimated to reduce PM emissions by 90 percent and NOx by 50 percent and improve fuel efficiency by 5 percent.[14]

Another technology that has been integrated in newer vehicles and engines involves selective catalytic reduction (SCR) systems, which reduce the excess NOx formed by a lean-burn engine. EPA conducted a modeling study of the potential changes in local air quality attributable to applying SCR technology in mobile equipment such as diesel-fired generators and in onroad or offroad vehicles deployed for Superfund remedy construction. Results showed a 65 percent reduction of NOx emission could be achieved over a five-day period, leading to a 49 percent reduction in ground-level ozone formation over the same period.[15] The findings are particularly relevant in areas where NAAQS are exceeded (non-attainment areas) and to populations that are disproportionately exposed to ground-level ozone or other air pollutants and consequently suffer associated health problems. Ground-level ozone also reduces respiration and associated photosynthesis in trees and other vegetation providing communities with ecosystem services such as air purification and flood control.

Requirements for emission reduction and tracking are increasingly integrated in contracts for site investigative or remedial services and associated purchase or rental agreements. EPA's Motor Vehicle Emission Simulator (MOVES) can be used to estimate air pollution emissions for criteria air pollutants, GHGs and air toxics associated with onroad vehicle and nonroad fleets.[16] Decisions regarding vehicle or engine replacements may be informed by EPA's Power Profiler, which describes the type and amount of emissions associated with electricity production in specific regions of the United States.[17] In certain applications, government funding under the Diesel Emissions Reductions Act may be available to help cover the costs of replacing diesel vehicles and engines with ones fueled by electricity, which is considered an alternative fuel under the Energy Policy Act.[18]

To evaluate replacement and upgrade options for heavy-duty diesel engines in greater detail, access EPA's web-based Diesel Emissions Quantifier.[19]

Operation and Maintenance

Site management plans and service or product procurements can specify other BMPs relevant to onsite driving and in some cases offsite driving. The manners in which vehicles and equipment are operated and maintained directly affect their performance and fuel efficiency; the harder an engine must work, the more fuel it requires. As a result, many BMPs focused on O&M can help decrease fuel-related project costs.

Eliminating unnecessary vehicle engine idle can significantly reduce fuel consumption and associated air emissions. For example, a Class 6 medium-duty commercial truck is often used to transport large quantities of supplies. A single hour of idling by this type of vehicle during loading or unloading would typically consume approximately 0.84 gallons of gasoline[20] and emit an estimated 16.5 pounds of CO_2 equivalent.[21] Similarly, heavy nonroad vehicles are often used for remedy construction activities such as excavating contaminated materials and building subsurface pipelines. Manufacturers estimate that such vehicles conventionally idle an average of 28 to 38 percent of their operating times.[22]

In addition to unnecessarily burning fuel, excessive idling also shortens engine service lives, poses health and safety risks to vehicle and cab occupants if emission leaks occur, and increases noise pollution in local communities. Relevant BMPs include:

- Manually shut down engines of vehicles not actively engaged for more than 10 seconds, except for work requiring intermittent engine use or when in traffic.[23]
- Engage automatic shut-down devices, which typically can be programmed to cut an engine after as little as five consecutive minutes of idling.
- Install a direct-fired air heater, which consumes only a small amount of a vehicle's fuel supply and eliminates the need for idling to heat an engine or a cab interior.
- Improve a vehicle engine's cold-weather startup ease by installing a coolant heater in the engine compartment or adding a waste-heat recovery system.
- Deploy energy storage batteries in the back of a truck that provides power take-off for auxiliary equipment.
- Recharge laptop computers and mobile devices in vehicles that are in active motion rather than idling.

Application of the *ASTM Standard Guide for Greener Cleanups* (E2893)[24] to plan bioremediation activities at Travis Air Force Base in Solano County, California, indicated that minimizing usage of transportation fuel and related air emissions was a high priority. Bulk quantities of the selected biological reagent (emulsified vegetable oil) were shipped to the site via rail lines rather than trucks. Locomotive engines meeting Tier 4 emission standards are estimated to produce about two-thirds less GHG than typical truck engines. Additionally, the reagents were injected into the subsurface via hydraulic pressure instead of fuel-fired hydraulic pumps.[25]

Fuel conservation can also be maximized by properly maintaining all onroad and offroad vehicles to avoid overworking their engines. Routine maintenance should include practices such as:

- Ensure sufficient inflation and tread and proper alignment of tires, to minimize rolling resistance. For example, a 10 percent reduction in rolling resistance would improve fuel economy by about 3 percent for light- and heavy-duty vehicles. Additional efficiency may be gained by replacing worn tires with models that are SmartWay verified for low rolling resistance.[26]
- Use the vehicle manufacturer's recommended grade of motor oil, which can impact fuel economy up to 2 percent.

- Replace filters in air and fuel systems in accordance with the vehicle manufacturer's recommended frequencies, which typically distinguish between a normal-duty cycle versus a severe-duty cycle that accounts for usage conditions such as unpaved roads or high levels of dust or pollen.
- Clean emission control systems such as SCR systems and DPFs on a regular basis to prevent plugging, remove contaminants, and reduce engine back pressure.
- Check brake parts such as calipers and pads and promptly replace worn parts to avoid brake drag.
- Clean mass airflow sensors to assure the proper air-fuel mixture is entering the engines.
- Replace engine oil on a timely basis to avoid worn piston rings that reduce engine efficiency.
- Secure prompt interim maintenance when the vehicle's "check engine" light becomes illuminated.

Other BMPs focus on sources of air pollutants attributable to diesel, gasoline, propane or natural gas consumed by stationary or mobile equipment deployed in site characterization or in groundwater, soil or sediment treatment systems. For example:

- Use solar or wind energy resources instead of diesel to generate electricity for equipment such as water pumps that recirculate, extract or transfer contaminated groundwater. Any excess energy produced from these renewable resources can be stored in transportable battery banks that could power additional equipment, recharge electric vehicles or provide emergency backup power.
- Use hydrogen fuel cells to operate critical equipment or provide additional backup power. Fuel cell generators are twice as efficient as diesel generators and emit little or no emissions.[27]
- Maintain diesel-fueled compression engines in equipment such as air compressors and blowers in accordance with manufacture recommendations, and retrofit or replace such equipment as needed to meet Tier 4 emission standards.
- Integrate heat exchangers in groundwater treatment systems involving heated fluids, to beneficially use the systems' waste heat. A heat exchange process can eliminate or reduce the use of fuel-fired equipment for purposes such as pre-heating cold fluids entering the treatment stream.
- Replace aged equipment supporting onsite building operations, such as material chilling units and water heaters, with newer models meeting the latest energy-efficiency standards set by the U.S. Department of Energy (DOE).[28]
- Replace gasoline engines with diesel engines meeting Tier 4 emission standards, which are typically equipped with SCR and DPF technologies that reduce NOx and PM by more than 90%.
- Ensure the leak detection systems of pressurized equipment such as propane storage tanks and natural gas pipelines operate at all times, to avoid fugitive emission of methane and other GHGs. Leaky valves and seals typically account for a significant portion of fugitive emissions from an industrial process.
- Downsize energy-intensive equipment that has become oversized as cleanup progresses.

Operation of photovoltaic systems at the Frontier Fertilizer Superfund site in Davis, California, avoids an estimated 147,500 pounds in CO_2 (equivalent) emissions each year. The systems involve a ground-mounted solar array as well as a roof-mounted solar array that together offset 100 percent of the grid electricity used to pump and treat the site's contaminated groundwater.[29]

The California Air Resources Board offers a list of verified diesel emission control devices applying to stationary engines.[30] Related compliance requirements issued by EPA may be used to guide selection and retrofitting of stationary engines at area sources of hazardous air pollutants.[31]

Green remediation BMPs specific to pump and treat technology, bioremediation, soil vapor extraction and other frequently used remediation technologies are described in companion EPA fact sheets.[32]

Transportation Plans

Transportation planning for a site cleanup project can specify strategies to minimize fuel consumption and related air emissions throughout the project's life. General BMPs include:

- Choose the nearest offsite site laboratories, material vendors and waste facilities, to reduce shipping distances.
- Import supplies and export wastes via full rather than partial vehicle loads whenever feasible.
- Facilitate staff carpooling opportunities, to minimize travel to and from the site or other destinations on a given day.
- Deploy plug-in or hybrid electric vehicles to the greatest extent possible as the U.S. transition to electric vehicles continues.
- Schedule heavy shipping or construction activities to occur during spring or autumn, to avoid contributing to ground-level ozone formation that is typically higher during summer due to higher air temperatures and humidity levels.
- Purchase lower carbon fuels where available, such as E15 for gasoline vehicles or E85 for flex-fuel vehicles. Diesel-fueled equipment can often use diesel blends containing up to 20% biodiesel (B20), and renewable diesel (an advanced renewable fuel) can be used safely in diesel engines in any amount.[33]
- Choose material or waste haulers that use SmartWay designated trailers and tractors and SmartWay verified technologies relating to low rolling resistance tires, idling reduction and aerodynamic devices.[34]

Transportation plans can encourage offsite drivers to reduce fuel consumption through sensible driving techniques. Also, certain techniques help reduce local noise pollution attributed to operating transport vehicles. BMPs include:

- Use a suitably sized vehicle for the task at hand. For example, use of an oversized truck to transfer a small amount of waste to a disposal facility results in wasted fuel.
- Combine trips to avoid unnecessary stopping and starting of engines. Multiple short trips can use twice as much fuel as one long, multi-purpose trip that covers the same distance while the engine is warm and at its most fuel-efficient temperature.
- Reduce vehicle loads by offloading any unneeded items, and avoid using rooftop cargo carriers.
- Use overdrive gearing whenever feasible to reduce an engine's speed, which in turn reduces fuel consumption, extends engine life, and lessens engine noise.
- Avoid rapid acceleration, excessive speed and repetitive hard braking, which lowers gas mileage by as much as 30 percent.
- Refrain from using a jake brake in or near residential neighborhoods and other sensitive communities.
- Use a reliable navigation system that enables selecting the shortest route to destinations and avoiding traffic events that may trigger vehicle idling.

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This fact sheet provides an update on information compiled in the August 2010 "Best Management Practices: Clean Fuel & Emission Technologies for Site Cleanup" fact sheet (EPA 542-F-10-008), in collaboration with the Greener Cleanups Subcommittee of the U.S. EPA Technical Support Project's Engineering Forum.

To view BMP fact sheets on other topics, visit CLU-IN Green Remediation Focus: www.clu-in.org/greenremediation.

United States Environmental Protection Agency
Office of Land and Emergency Management (5203)
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Green Remediation Best Management Practices: Excavation and Surface Restoration

A fact sheet about the concepts and tools for using best management practices to reduce the environmental footprint of activities associated with assessing and remediating contaminated sites

www.clu-in.org/greenremediation

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental footprint of activities involved in cleaning up contaminated sites.[1] Best management practices (BMPs) of green remediation involve specific activities to address the core elements of greener cleanups:

- Reduce total energy use and increase the percentage of energy from renewable resources.
- Reduce air pollutants and greenhouse gas emissions.
- Reduce water use and preserve water quality.
- Conserve material resources and reduce waste.
- Protect land and ecosystem services.

Overview

Excavation of soil, sediment or waste material is often undertaken at contaminated sites to:

- Address immediate risk to human health or the environment as part of immediate or long-term removal actions.
- Prepare for implementation of in situ or ex situ remediation technologies and construction of associated infrastructure.
- Address contaminant hot spots in soil or sediment for which other remedies may be infeasible due to extremely high cost, long duration or technical constraints.

Many opportunities exist to reduce the environmental footprint of excavation activities and final restoration of disturbed land, surface water and ecosystems. Excavation as well as subsequent backfilling activities rely on use of heavy earth-moving machinery and often involve managing large volumes of material.

Project Planning

Early and integrated project planning allows excavation approaches to set the stage for sharing natural resources, processes and infrastructures throughout site investigation, remediation and reuse. Planning-related BMPs for excavation projects include:

- Maximize use of available satellite imagery to define the boundaries of excavation areas and operate machinery in the field with high "surgical" precision.
- Incorporate a high-resolution site characterization strategy, which uses high-density data sets rather than repeated field mobilizations to address information gaps as cleanup progresses.
- Establish a dynamic work strategy, which provides flexibility to adjust cleanup activities according to real-time field measurements. For example, screening soil samples at pre-determined decision points through use of laser-induced fluorescence technology might indicate that contaminated subsurface material in some areas could be left in place and covered with clean material instead of excavated.
- Develop advanced schedules for anticipated onsite activities, to minimize traffic between onsite contaminated and clean zones and the days in which work is actively performed in the field.
- Identify onsite or nearby sources of topsoil, to avoid long-distance transport of clean soil. Options may include onsite manufacturing of topsoil through use of locally sourced industrial byproducts such as compost or silica-based spent foundry sands.[2]

Waste coordination assistance is offered by many state and municipal agencies to plan beneficial reuse of excavated materials. For example, the New York City Clean Soil Bank (CSB) matches projects generating surplus clean native soil with projects needing soil for construction. In the first three years of operation, the CSB enabled a 1.2 million-mile reduction in truck transportation, which reduced diesel fuel consumption by approximately 250,000 gallons.[3]

- Identify onsite or nearby sources of backfill material such as shredded tires or crushed concrete.
- Incorporate green requirements into cleanup and supporting service procurements.
- Choose service providers with local offices, to minimize the distance of worker commutes and machinery transport.
- Choose equipment and product vendors with nearby production or distribution centers, to minimize delivery-related fuel use.
- Retrieve native, noninvasive plants for later replanting.
- Rescue and relocate wildlife that rely on habitat in areas to be excavated. Many environmental, academic or community groups offer help in conducting wildlife rescues and compiling wildlife or plant inventories.
- Identify existing or anticipated ecosystem services to be considered in project designs.[4]

Onsite air emissions can be reduced by finding opportunities to use less fuel. Selection of BMPs may be influenced by site conditions, the regional air quality status, local ordinance or the weather anticipated during field work. Related BMPs that may be incorporated into project plans include:

Consumption of fuel and associated emission of air contaminants typically account for a major portion of the environmental footprint of excavation and backfilling activities.

- Use fuel-efficient on-road vehicles such as hybrid electric sport utility vehicles and pickup trucks.
- Use off-road machinery fueled by biodiesel blends that minimize emission of particulate matter.
- Use on-road or off-road utility vehicles fully powered by electricity.
- Use retrofitted diesel-fired machinery or portable equipment with emission control technologies such as diesel oxidation catalysts, diesel particulate filters or approved fuel additives. Information on verified technologies is available from the U.S. EPA[5] or California Air Resources Board.[6]

BMPs to reduce diesel fuel consumption and associated air emissions from trucks or tractor trailers that will transfer excavated soil or other materials to offsite locations for disposal, recycling or reuse include:

- Select the closest qualified waste facility.
- Combine excavated material with comparable waste generated at nearby sites, for consolidated transfer in a single trip or fewer trips to the intended facility or site.
- Choose trucking fleets that use vehicles equipped with fuel efficiency options such as tractor-trailer skirts and air tabs as well as clean diesel technology, which is generally available in newer trucks or through engine and emission system retrofits in older trucks. Details about engine retrofits are available from the Diesel Technology Forum.[7]
- Use alternate shipping methods that may be available, such as rail lines.

Field Activities

The amount of diesel fuel needed to operate heavy machinery such as backhoes or graders may be reduced by BMPs such as:

- Deploy machinery that is suitably sized; use of undersized or oversized equipment can decrease efficiencies considerably.
- Use machine models capable of performing assorted tasks, whenever feasible, to avoid field deployment of multiple types of machines. For instance, a single excavator can be equipped with a bucket for digging, a breaker for demolition or a grapple for land clearing.
- Use an automated coupling system rather than a manual pin-on system for changing excavator attachments, to reduce machine operating time.
- Incorporate electronic intelligence systems to improve productivity within and among field machines. "Smart" systems enable work managers to remotely monitor field operations via machine-to-machine communications and identify changes to be made by machinery operators accordingly.
- Use machines with variable-speed control technology, which automatically reduces engine speed during low workload requirements, or with pump torque control, which allows a machine operator to change a machine's hydraulic pump torque.
- Use machines with repowered or newer engines that are more fuel efficient.
- Implement an engine idle reduction plan to avoid fuel consumption when machinery is not actively engaged. Options include manual shutdown after a specified time such as five minutes, engagement of automatic shutdown devices, or use of auxiliary power units to heat or cool machinery cabs.
- Perform routine, on-time maintenance such as oil changes to assure fuel efficiency.

Characterization and excavation of lead-contaminated soil at the Ross Metals Inc. NPL site in Rossville, Tennessee, were completed simultaneously through high-resolution site characterization and dynamic work strategies deployed in a single field mobilization. Real-time measurements were made with a portable x-ray fluorescence (XRF) spectrometer, which reduced the need for sample analyses by an offsite laboratory and avoided potential overexcavation. Following excavation and offsite disposal of approximately 70,600 cubic yards of material, additional XRF data combined with offsite laboratory analytical results confirmed that the site's targeted standard for lead in residential soils had been met.[8]

- ♦ Deploy direct-push technology (DPT) instead of rotary drilling rigs whenever feasible for additional subsurface sampling or for monitoring well installation. DPT can reduce drilling duration by as much as 50-60% while eliminating generation of drill cuttings or the need to dispose of drilling fluids.

The amount of additional diesel fuel as well as gasoline, propane or non-rechargeable electric batteries needed to operate small or mid-sized auxiliary field equipment can be minimized by using onsite sources of renewable energy. Relevant BMPs include:

By reducing the need to transport liquid fuel or extend the local electricity grid, onsite renewable energy offers the potential to significantly reduce the environmental footprint of excavation at sites in remote areas, such as former mining sites.

- ♦ Use solar power packs to recharge batteries in small electronic devices such as cell phones, laptop computers and sensors.
- ♦ Deploy mobile power systems to operate construction equipment or tools such as electricity generators, chainsaws, wood chippers, refrigeration units, or temporary lighting fixtures. Mobile power systems typically use maneuverable photovoltaic (PV) panels or small wind turbines that can be easily transported via carts, pick-up trucks or trailers.
- ♦ Install a ground-mounted PV array, wind turbine or mechanical windmill to power equipment needed for long-term site monitoring or maintenance. If properly scaled and configured, these renewable energy systems also could power equipment for other remediation activities such as groundwater pumping.

Generation of dust and potential mobilization of airborne contaminants during excavation and backfilling can be reduced through BMPs such as:

- ♦ Limit the speed of trucks and other vehicles traversing the site to 10 miles per hour.
- ♦ Spray water onto surfaces of vulnerable work areas, in conjunction with water conservation and runoff management techniques.
- ♦ Emplace a fabric cover over excavated material that is loaded into open trucks for onsite or offsite hauling.

Green remediation strategies also help reduce consumption of fresh water, reclaim or reuse uncontaminated water, and avoid introduction of toxic processing materials into groundwater or surface water. Related BMPs include:

- ♦ Cover soil in work areas with tarps or heavy mats for dust suppression, instead of periodically spraying water onto exposed surfaces. Use of biodegradable cover fabric will help control erosion and provide a substrate for future plant growth. Alternatively, a synthetic fabric can often be reused for other purposes.
- ♦ Contain and properly dispose of all decontamination fluids to prevent their entrance into storm drains or ground surfaces.
- ♦ Use graywater that may be available from onsite or nearby sources for purposes such as washing or steam-cleaning excavation machinery or irrigation of affected vegetation.

Other BMPs focus on preserving water quality and conserving natural resources during the process of dewatering contaminated sediment after its excavation or dredging:

- ♦ Lay synthetic barriers and fluid collection systems on ground surfaces of staging and work areas, to avoid introducing toxic materials to underlying groundwater.
- ♦ Avoid use of dewatering coagulants or flocculants containing chemicals that are potentially toxic to aquatic life.
- ♦ Use a passive rather than active mechanical process to dewater sediment when possible. A passive process relies on natural gravity flow and evaporation of the water rather than equipment such as filter presses powered by slurry pumps.
- ♦ Implement a dewatering process that maximizes recycling of slurry and other process water.
- ♦ Use geotextile bags or nets when possible to assure containment of excavated sediment during dewatering and to increase efficiency when handling and transporting the dewatered sediment.
- ♦ Transfer treated slurry water to other onsite areas or nearby sites for beneficial use in remedial or non-remedial applications such as wetlands enhancement or plant irrigation.

Designs for backfilling, grading and stabilizing a 3-acre basin affected by mining waste at the Elizabeth Mine NPL site in South Strafford, Vermont, included intent to mirror the site's natural contours and drainage patterns. The fully graded surfaces were seeded with native plant species that target Vermont state conservation and wildlife goals.

Other BMPs used at this 250-acre site included using biodiesel to operate heavy machinery; choosing machinery equipped with clean diesel technologies for excavation, waste consolidation and construction of a 45-acre capping system; using onsite resources to manufacture needed topsoil rather than importing raw materials; and choosing construction products verified as environmentally friendly or preferable. Use of biodiesel (B-20), alone, over six months of remedy construction was estimated to reduce emission of hydrocarbons and sulfur dioxide by 20%, carbon dioxide by 16% and particulate matter and carbon monoxide each by 12%.[9]

Countless and diverse manufactured products are purchased for use during excavation and surface restoration, such as personal protective equipment, synthetic sheeting and routine business materials. Green purchasing considers product lifecycles and gives preference to products with recycled and bio-based instead of petroleum-based contents; products, packing material and disposable equipment with reuse or recycling potential; and contents and manufacturing processes involving nontoxic materials. BMPs relating to environmentally sound purchasing include:

- Choose geotextile fabrics/tarps made of recycled material.
- Use hydraulic fluids that are biodegradable for operating equipment such as drill rigs.[10]
- Use phosphate-free detergents instead of organic solvents or acids to decontaminate equipment not used directly for sample collection.
- Substitute temporary silt fences with biodegradable erosion controls such as tubular devices filled with organic materials. Such devices capture sediment transported by stormwater runoff from or to adjoining slopes while building substrates for future vegetation.[11]

Selection of BMPs concerning excavation and surface restoration activities at a specific site can be facilitated through use of the ASTM Standard Guide for Greener Cleanups.[12] Use of the U.S. EPA *Methodology for Understanding and Reducing a Project's Environmental Footprint* and associated spreadsheets can additionally help project managers make informed decisions by quantifying the anticipated environmental footprint and adjusting project activities accordingly.[13]

BMPs focused on maximizing reuse or recycling of excavated material and minimizing generation of waste during the process of excavating contaminated material include:

- Segregate and stockpile drill cuttings generated by drilling, to facilitate onsite reuse of the material.
- Reclaim and stockpile uncontaminated soil for use as infill or other purposes such as habitat creation.
- Salvage organic debris that is uncontaminated and free of pests or disease, for use as supplemental infill, mulch or compost.
- Salvage uncontaminated objects with potential recycle, resale, donation or onsite infrastructure value, such as steel, concrete and granite.
- Designate collection points for recycling single-use items such as metal, plastic and glass containers; paper and cardboard; and other consumable items.

Cleanup at the 113-acre Curtis Bay Coast Guard Yard NPL site in Baltimore, Maryland, involved soil excavation, sediment dredging and extensive building demolition. Use of BMPs aimed at sustainable materials and waste management resulted in recycling of approximately 2,620 tons of concrete, 20 tons of steel, 110 tons of timber and 2,050 tons of petroleum-contaminated soil. The project's greener cleanup strategy also created approximately 60,000 square feet of greenspace and introduced drainage controls such as permeable pavement that allow infiltration of precipitation.[14]

Safeguarding Land & Ecosystems

Additional BMPs can be integrated in work plans to specifically address the potentially significant environmental footprint an excavation project may pose on land and ecosystems. Relevant BMPs include:

- Restrict machinery, vehicle and worker traffic to well-defined corridors that are minimally obtrusive.
- Place metal grates over thick mulch in onsite traffic corridors, which minimizes soil compaction while fostering subsurface infiltration of precipitation.
- Emplace geotextile surface material and quick-growth grass seeds in staging areas, to stabilize the underlying sod.
- Employ rumble grates with a closed-loop graywater washing system or an advanced, self-contained wheel washing system to minimize vehicle tracking of soil and sediment across non-work areas or offsite.
- Inspect equipment left onsite before renewing field activities, to avoid harming animals potentially nesting in the equipment. Operation of equipment with nest debris also could cause equipment inefficiency or breakdown.
- Limit use of artificial lighting that may disturb sensitive animal species.
- Avoid removing trees in staging areas or uncontaminated zones.
- Retain and use downed trees as habitat snags in onsite streams or forests.
- Replicate the site's original contours during soil grading.

Other BMPs focus on minimizing potential soil erosion due to stormwater runoff. For optimal efficiency, stormwater controls at excavation sites can be designed to meet needs of the site's future use. Examples include:

- Convert a portion of the excavation pit to a basin that can capture and store stormwater, instead of fully backfilling the pit.
- Construct permanent earthen berms or dikes to prevent erosion in low-lying onsite or adjacent areas that might remain vulnerable to stormwater flows.
- Incorporate bioswales, tree canopies or other green infrastructure elements that can filter stormwater as well as capture rainwater or snowmelt.[15]

Green infrastructure can significantly decrease the amount of stormwater runoff and pollutants reaching local waters. For example:

- The urban forest in Charlotte, North Carolina, was found to annually intercept about 209 million gallons of rainfall (as of 2006), which saves the city approximately $2,077,400 in annual stormwater management costs.[16]
- In Cincinnati, Ohio, the U.S. EPA and federal partners constructed and studied a rain garden network bordered by berms and populated by drought- and flood-tolerant perennials and grasses. Over four years, the network retained about 90% of all rainfall and achieved an overall stormwater volume retention capacity exceeding 50%.[17]

Use of the National Stormwater Calculator can help estimate frequency of runoff from a specific site based on its soil conditions, land cover and historical rainfall.[18]

- Minimize use of impermeable materials such as concrete to re-surface areas, and maximize retention or creation of permeable surfaces in areas that are contiguous.
- Allocate greenspace as a buffer in sensitive natural areas such as steep hillsides, riparian zones or wetlands that are prone to generating or receiving runoff.
- Establish plans for long-term maintenance and inspections of onsite wet ponds created for stormwater management. Routine maintenance typically includes removing debris after major storms, repairing damaged embankments, and harvesting vegetation when a 50% reduction in water surface occurs.[19]

BMPs applying to the process of revegetating excavated/backfilled areas, particularly those with anticipated ecological reuse, include:

- Revegetate backfilled areas as quickly as possible through use of a diverse mix of grasses, shrubs, forbs and trees supporting many habitat types.
- Include plant species that promote colonization of bees and other pollinators.
- Seed or install native rather than non-native species, which typically increases the rate of plant survival and minimizes the need for irrigation and soil or plant inputs.
- Choose grass species requiring little or no mowing.
- Substitute chemical fertilizers, herbicides or pesticides with non-synthetic inputs, integrated pest management methods, and soil solarizing techniques during vegetation planting, transplanting or ongoing maintenance.

Excavation and backfilling activities also may affect land and ecosystems gradually over time. Potential effects include subsidence, soil chemistry imbalance, reduced subsurface microbial populations or failing wildlife habitat restoration. Selection and prioritization of BMPs to avoid such impacts can be facilitated by compiling a pre-excavation inventory of site characteristics such as land contours, drainage patterns, plant species and densities, and resident and migratory animal species. The availability of a baseline inventory also will facilitate final restoration that best recreates a site's pre-development conditions.

Over 33,000 tons of contaminated soil, debris and sediment were removed at the 10-acre Raleigh Street Dump NPL site in Tampa, Florida. In addition, 40 tons of illegally dumped tires were removed and recycled. After placing clean soil, planting grass and restoring wetlands, the potentially responsible parties worked with the Wildlife Habitat Council to further restore the site's ecological systems. Full restoration included doubling the wetlands acreage, creating a 4-acre upland meadow, installing bird and bat boxes, and planting milkweed gardens for Monarch butterfly habitat. The National Oceanic and Atmospheric Administration provided technical expertise to protect aquatic life and coastal habitats throughout site investigation and cleanup.[20]

This fact sheet provides an update on information compiled in the December 2008 "Best Management Practices for Excavation and Surface Restoration" fact sheet (EPA 542-F-08-012), in collaboration with the Greener Cleanups Subcommittee of the U.S. EPA Technical Support Project's Engineering Forum.

To view BMP fact sheets on other topics, visit CLU-IN Green Remediation Focus: www.clu-in.org/greenremediation.

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United States Environmental Protection Agency

Office of Solid Waste and Emergency Response (5203P)

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Green Remediation Best Management Practices:
Materials and Waste Management

Office of Superfund Remediation and Technology Innovation — Quick Reference Fact Sheet

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental "footprint" of activities undertaken when cleaning up a contaminated site.[1] Use of the best management practices (BMPs) identified in EPA's series of green remediation fact sheets can help project managers and other stakeholders apply the principles on a routine basis, while maintaining the cleanup objectives, ensuring protectiveness of a remedy, and improving its environmental outcome.

The use of non-renewable materials such as minerals, metals, and fossil fuel-derived products has significantly increased in the United States over recent decades. In 1900, for example, 41% of the materials used in the United States consisted of renewable resources such as agricultural, fishery, and forestry products. By 1995, renewable resources accounted for only 6%.[2] Much of this increase is due to the rapid growth of manufacturing processes that consume nonfuel minerals. Currently, more than 25,000 pounds per capita of new nonfuel minerals are extracted from the earth each year as input for manufactured products used in the United States.

Increased reliance on non-renewable resources and accelerated consumption of raw, processed, and manufactured materials has led to adverse environmental effects. The effects include habitat destruction, biodiversity loss, over-stressed fisheries, desertification, and greenhouse gas (GHG) emission. In 2006, materials management accounted for 42% of GHG emissions in the United States.[3]

Materials management refers to the control of material resources throughout their life cycle as they flow through the economy, from extraction or harvest through production and transport of goods, provision of services, reuse of materials, and, if necessary, disposal.

The process of cleaning up a contaminated site often involves purchasing and consuming large volumes of manufactured items as well as raw or processed resources. Site cleanup can also generate significant volumes of waste such as:

- Industrial materials and products accumulated as debris during onsite demolition of structures and during remedy construction
- Organic materials such as wood and plant matter displaced during excavation
- Metal, glass, plastic, or paper containers and packaging from single-use products, including field supplies such as test kits for soil or water sampling, and
- Expended products such as fabric tarps and metal tooling or chemical solutions used to clean equipment or treat contaminated environmental media.

Much of this waste could be recycled or salvaged for reuse rather than disposed of at landfills.

Techniques for sustainable materials management can help reduce the environmental footprint of a cleanup. EPA's *Methodology for Understanding and Reducing a Project's Environmental Footprint* specifies seven metrics associated with materials and waste, which together constitute a core element of greener cleanups.[4]

Materials & Waste: Environmental Footprint Metrics & Units of Measure
1) Refined materials used on site (tons)
2) Refined materials from recycled or waste material (percent)
3) Unrefined materials used on site (tons)
4) Unrefined materials from recycled or waste material (percent)
5) Onsite hazardous waste generated (tons)
6) Onsite non-hazardous waste generated (tons)
7) Total potential onsite waste recycled or reused (percent)

Industrial materials salvaged from demolition activities, for example, can be reused to construct new buildings and transportation systems, enhance infrastructure for water storage or drainage, or provide supplies for local agriculture, while remaining consistent with state regulations and appropriate environmental considerations.[5] Similarly, organic matter can be reused as remediation material or site restoration components, and other solid or liquid wastes can be recycled.

EPA's suite of green remediation BMPs describes specific techniques or tools to achieve a greener cleanup.[6] Opportunities to reduce the environmental footprint associated with materials and waste focus on:

- ***Purchase of greener products***, and
- ***Material reuse or recycling versus disposal***.

Purchase of Greener Products

Implementation of green remediation BMPs should begin during planning stages of a cleanup, to facilitate sustainable materials management throughout remedy construction and maintenance. Key BMPs to reduce purchasing of virgin resources include:

- Survey onsite buildings and infrastructures to determine the potential to reuse existing structures and equipment or their components as a substitute for virgin materials
- Investigate potential offsite sources such as nearby facilities that may have surplus inventory or are undergoing decommissioning, for additional substitutes
- Check for availability of needed products at local non-profit or retail centers that facilitate product reuse
- Select products that are environmentally preferable (when compared to other products serving the same purpose) with respect to raw materials consumption, manufacturing processes and locations, packaging, distribution, recycled content and recycling capability, maintenance needs, and disposal procedures
- Choose vendors with production and distribution centers near the site, to minimize fuel consumption associated with delivery
- Choose suppliers that will take back scraps or unused materials
- Design new construction to utilize standard material sizes, which minimizes excess purchasing volumes and avoids waste from custom sizing, and
- Plan new construction with future deconstruction or material reuse in mind.

EPA recommends taking advantage of existing resources to help select and purchase environmentally preferred products. The U.S. General Services Administration (GSA), for example, offers the Sustainable Facilities Tool (SF Tool), a comprehensive, online source of information and electronic links on materials for constructing and operating buildings or conducting facility activities in a sustainable way.[7] Product categories in the SF Tool's "green production compilation" area cover a range of topics, including construction materials, landscaping elements such as compost and fertilizers, cleaning products, HVAC/mechanical equipment, and non-paper office products. The tool includes a search function to identify specific items such as fencing, signage, and bioremediation materials.

Environmental programs and standards captured within the tool include the:

- Design for the Environment (DfE) Program safety screening for lower hazard products
- Biopreferred® Program for products with biobased content
- WaterSense® performance testing for water-efficient products
- Federal Energy Management Program (FEMP) for water- and energy-efficient products
- ENERGY STAR verified ratings for energy-efficient products
- Significant New Alternatives Policy (SNAP) Program for ozone-depleting chemical substitutes, and
- American National Standards Institute (ANSI), Green Seal, and other independent certification programs.

A pump-and-treat (P&T) system to treat contaminated groundwater at the ***Lawrence Aviation Site*** *on Long Island, New York, consists of equipment previously used elsewhere in the community:*

- *An air stripper salvaged from a local dry cleaning facility; the unit is equipped with two 3,000-pound filtration vessels containing reactivated (instead of virgin) carbon to treat air prior to its emission from the plant, and*
- *Two aqueous-phase carbon vessels, a vapor-phase carbon vessel, bag filters, a blower, piping, valves, connectors, pumps, and electrical wiring reclaimed from a nearby manufacturing facility undergoing upgrades.*

Construction of a building to house the P&T system involved use of greener products and salvaged construction materials:

- *Lumber from a Certified Green Dealer™ lumberyard and wood certified under the Sustainable Forestry Initiative® or Program for Endorsement of Forest Certification*
- *Low-maintenance, insect- and weather-resistant composite siding made of sustainable materials with low toxicity, such as wood pulp, cement, and sand*
- *Spray-foam insulation made of renewable resources (soybeans) and through processes involving no formaldehyde, petroleum, asbestos, fiberglass, or volatile organic compounds*
- *Common-area flooring made of rapidly renewable cork, with an underlayment of post-consumer recycled granulated rubber from tires*
- *Light-reflective ceiling tiles comprising 45% rapidly renewable resources and 23% recycled content*
- *Cabinetry, hurricane shutters, and exterior doors made of remnant framing lumber instead of virgin wood, and*
- *Landscape mulch containing chipped wood from selected onsite trees requiring removal before remedy construction.*

During construction, 240 tons of soil requiring excavation was transferred and stockpiled at a nearby municipal property for use by the Port Jefferson Highway Department. Prior to transfer, analytical tests were conducted on the soil to assure no residual contamination.

Material Reuse or Recycling Versus Disposal

Green remediation BMPs to facilitate sound planning for material reuse or recycling include:

- Check with applicable state agencies and local authorities to assure acceptable reuse of non-routine waste material or of industrial materials salvaged during construction and demolition (C&D)
- Screen local recyclers and waste haulers to identify organizations that will handle materials in an environmentally responsible manner, including suitable transportation methods and waste destinations, and
- Evaluate environmental or other trade-offs involved in onsite reuse of materials versus shipment offsite for reuse and/or recycling; evaluations can range in level of effort from qualitative comparisons of options to more rigorous quantification of alternative outcomes.[4]

Sustainable materials management can be facilitated through specific procurement practices for cleanup services, including subcontracts; for example:

- Include a requirement for reuse and recycling of all uncontaminated C&D material in documents such as requests for proposals and bid specifications
- Specify materials management goals in documentation such as construction waste management plans
- Develop a plan and reporting format to routinely track materials reuse/recycling and disposal, and
- Consider performance-based service contracts that can additionally motivate cleanup contractors and subcontractors to maximize material reuse/recycling.

EPA's **Greener Cleanups: Contracting and Administrative Toolkit** *provides sample contract language and criteria for sustainable materials management in EPA regions.*[8]

EPA recommends implementing additional BMPs during remedy construction, which may include demolition of existing structures:

- Divert at least 50% (by weight) of the uncontaminated C&D materials generated at the site, and include this goal in the site waste management plan
- Implement deconstruction techniques that involve preserving useable portions of existing structures, dismantling unusable parts for optimized transport, and recovering clean materials
- Salvage and sort clean materials with potential value for onsite reuse, recycling, resale, or donation
- Link a deconstruction project with a current construction or renovation project to facilitate material reuse
- Use crushed concrete as a construction aggregate for road base, pipe bedding, or landscaping
- Use concrete containing secondary cementitious materials to displace a portion of traditional Portland cement
- Use reclaimed asphalt pavement as a granular base for new roads
- Use shredded scrap tires, crushed concrete, and other onsite clean hard materials in place of borrow for fills
- Salvage uncontaminated and pest- or disease-free organic debris for use as infill or mulch as needed
- Optimize product ordering, to prevent purchase and delivery of excess materials, and
- Post onsite signage to designate collection points for routine recycling of single-use items such as metal, plastic, and glass containers, paper and cardboard, and other items that may be locally recyclable.

A comprehensive list of tools and resources for sustainable materials management decision-making is available in EPA's **Sustainable Materials Management in Site Cleanup** *engineering issue paper.*[9] *The information focuses on materials reuse and recycling and addresses topics such as:*

- *Locating C&D recyclers and material exchange networks*
- *State program requirements and beneficial use of materials*
- *Environmental benefits of diverting materials from landfills.*

Sustainable materials management, whether focused on greener product selection or waste reduction techniques, also applies to methods for treating contaminated soil, sediment, or groundwater. For example, the following BMPs may be used for remedy operation and maintenance:

- Use reconstituted reactive media whenever feasible; for example, regenerated rather than virgin granular activated carbon (GAC) can be used in carbon treatment beds or canisters
- Consider non fossil fuel-based substitutes as reactive media, such as locally available coconut shell-derived GAC rather than coal-based GAC
- Explore innovative technology enabling recycling or resale of extracted chemicals; for example, cryogenic compression and condensation processes can enable recovery of hydrocarbon from air stripping condensate[10]
- Maximize use of industrial materials (in ways consistent with agronomic and environmental constraints) such as iron and steel foundry sands, dry wall, flue gas desulfurization (FGD) gypsum, and non-synthetic compost for soil amendments and manufactured soils; FGD gypsum can also serve effectively in flow-through curtains to mitigate phosphorous transport to surface and groundwater
- Use periodic optimization evaluations as opportunities to incorporate industrial material recycling practices and to switch to newer green products, and
- Use continuous process monitoring techniques to maximize capacity of a treatment medium and minimize frequency of treatment media replacement or replenishment.

A range of industrial materials may exist as waste at sites undergoing cleanup. Conversely, industrial materials can effectively contribute to site cleanup. EPA's ***Industrial Materials Recycling*** *website provides more information on recycling and beneficial use of industrial materials such as C&D materials, coal combustion products, foundry sand, and iron and steel slag.*[5]

Cleanup at the ***Sanford Gasification Plant*** *in Seminole County, Florida, incorporated a sustainable materials management plan involving extensive reuse or recycling of onsite materials; minimized offsite disposal of excavated materials; and overall reductions in consumption of water and fossil fuels. The implemented BMPs and associated results included:*

- *Screened clean versus contaminated soil through a "cut line" investigative approach and segregated soils accordingly, which minimized the soil treatment load while averting import of 1,600 cubic yards of non-native soils for site restoration*
- *Used granulated blast furnace slag in lieu of a portion of the cement specified in the typical formula used to stabilize coal tar-contaminated soil, avoiding 13,700 tons of carbon dioxide (CO_2) otherwise emitted by thermal reactions during mixing of cement with other reagents*
- *Chipped and sent 5,000 cubic yards of extracted trees and stumps to local landscapers for use as mulch, avoiding shipment of 800 tons of material to landfills*
- *Installed a solar-powered backup energy system for perimeter air monitoring during remedy construction*
- *Reused 3.7 million gallons of water from onsite dewatering operations in the soil stabilization process*
- *Used B20 (20% biodiesel) to operate diesel vehicles and machinery, averting 177 tons of CO_2 emissions, and*
- *Procured 75% of the remedial labor and supplies (valued at $8 million) from local sources within 50 miles of the site.*

A gravity drain network overlaying recycled concrete was used to divert 500 feet of an onsite creek during remedy construction, which reduced use of diesel pumps.

The stabilization project involved extensive use of recycled concrete serving as riprap to armor the creek bed and limit erosion.

Materials and Waste Management: Recommended Checklist

Purchase of Greener Products

- ✓ Explore options for reusing materials onsite or available from local sources
- ✓ Purchase from local vendors who accept unused materials upon project completion
- ✓ Design for optimized product sizing and product ordering and for future reuse or repurposing
- ✓ Choose environmentally preferable products

Material Reuse or Recycling Versus Disposal

- ✓ Verify acceptable reuse of C&D materials with regulators
- ✓ Screen recyclers and waste haulers
- ✓ Evaluate environmental trade-offs
- ✓ Specify requirements and goals in service contracts
- ✓ Salvage uncontaminated demolition and other materials with value for reuse/recycling, resale, or donation
- ✓ Use onsite or offsite industrial materials such as crushed concrete and shredded scrap tires for remedy construction
- ✓ Recycle routine single-use items regularly
- ✓ Minimize direct or indirect use of fossil fuels during activities such as product purchasing or waste transfer
- ✓ Plan treatment process optimization and monitoring that includes sustainable materials management

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The Agency is publishing this fact sheet as a means of disseminating information regarding the BMPs of green remediation; mention of specific products or vendors does not constitute EPA endorsement.

Visit **Green Remediation Focus** online:
http://www.cluin.org/greenremediation

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EPA United States Environmental Protection Agency
Office of Land and Emergency Management (5203P)
EPA 542-F-16-002 September 2016 Update

Green Remediation Best Management Practices:
Site Investigation and Environmental Monitoring

A fact sheet about the concepts and tools for using best management practices to reduce the environmental footprint of activities associated with assessing or remediating contaminated sites

www.cluin.org/greenremediation

The U.S. Environmental Protection Agency (EPA) *Principles for Greener Cleanups* outline the Agency's policy for evaluating and minimizing the environmental footprint of activities involved in cleaning up contaminated sites.[1] Best management practices (BMPs) of green remediation involve specific activities to address the core elements of greener cleanups:

- Reduce total energy use and increase the percentage of energy from renewable resources.
- Reduce air pollutants and greenhouse gas emissions.
- Reduce water use and preserve water quality.
- Conserve material resources and reduce waste.
- Protect land and ecosystem services.

Overview

The need for site investigation is common to cleanups under any regulatory program. Investigative activities can occur at all points in the cleanup process, from initial site assessment through waste site closeout. A site investigation generally is undertaken to:

- Confirm the presence or absence of specific contaminants.
- Delineate the nature and extent of environmental contamination.
- Identify contaminant sources.
- Provide data for assessing potential risk to human health or the environment.
- Gather data for determining if a remedial or removal action should be taken.
- Identify site characteristics affecting remedial design, construction or operation.

Site investigation as well as long-term environmental monitoring typically involve a range of technologies and techniques to gather field measurements and collect analytical samples of soil and groundwater and often surface water, sediment, soil gas or indoor air. Investigation also may involve searching for underground storage tanks, drums or other buried objects, or evaluating demolition material containing asbestos, lead-based paint or other toxic products. Many of the same techniques and technologies may be used in later stages of a cleanup to evaluate ongoing performance of a remedy; determine the need for any modification to a remedial system; or track factors influencing anticipated closeout of a cleanup project. At certain points, site investigation and environmental monitoring both rely on data analysis or verification conducted by offsite laboratories.

Water monitoring at the New Idria Mercury Mine Superfund site in California involves use of time-interval sampling devices powered by solar energy. Collected sampling data are transmitted via satellite to a website accessible by project staff. This approach supplies a renewable source of onsite energy and reduces the frequency of staff visits to this remote site. Ongoing investigation of this site led to removal actions in 2011 and 2015.

Project Planning

Integration of green remediation BMPs early during the project design phase will help reduce cumulative environmental footprints of a cleanup. The BMP integration process involves selecting BMPs most suitable for the site's unique contamination scenario, potential remedies and anticipated site reuse. BMPs to be considered when planning a site investigation include:

- Schedule activities for suitable seasons to reduce the amount of fuel needed for heating or cooling equipment and supplies.
- Select service providers, product suppliers and analytical laboratories from the local area and consolidate the service and delivery schedules.

The ASTM *Standard Guide for Greener Cleanups* outlines a process for identifying, screening and selecting BMPs to minimize the environmental footprint of site-specific cleanup activities.[2]

- ♦ Identify local sources of trucks and machinery equipped with advanced emission controls and of cleaner alternative fuels.[3]
- ♦ Identify the nearest facility to be used for disposing of hazardous waste.
- ♦ Establish electronic networks for data transfers, team decisions and document preparation, and select electronic products through tools such as the Electronic Product Environmental Assessment Tool (EPEAT).[4]
- ♦ Reduce travel through increased teleconferencing and compressed work hours.
- ♦ Select facilities with green policies for worker accommodations and meetings.
- ♦ Integrate sources of onsite renewable energy to power hand-held devices, portable equipment, and stationery monitoring systems.

Product and service acquisitions provide opportunities to integrate BMPs when planning a site investigation. New contracts awarded by EPA for remediation environmental services at Superfund sites, for example, now require contractors to explore and implement strategies to reduce energy and water usage, promote carbon neutrality, promote industrial materials reuse and recycling, and protect and preserve land resources.[5]

Development of a well-conceived dynamic sampling plan can help assure that data truly representing a site are collected at the project onset, consequently minimizing remobilization of field crews and equipment. Systematic planning, which is a critical component of optimized strategies for investigating hazardous waste sites, involves identifying key decisions to be made, developing a conceptual site model (CSM) to support decision making, and evaluating decision uncertainty along with approaches for actively managing that uncertainty. The CSM combines analytical data with historical information to identify data gaps and allows for refinement as additional data become available.

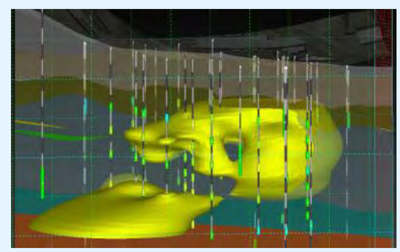
Field Activities

Fewer field mobilizations typically lead to reduced fuel consumption and associated air emissions and often less disturbance to the land and local ecosystems. BMPs that can help minimize mobilization during site investigation and environmental monitoring include:

- ♦ Use in situ data loggers to monitor water quality parameters and water levels, as an alternative to frequent sample collection or physical measurement.
- ♦ Install solar-powered telemetry systems to remotely transmit logging data.
- ♦ Use dynamic work plans involving real-time field measurements, which can immediately provide data to help determine the next activity during a given sampling event.

Technologies for collecting real-time data are typically non-invasive or minimally invasive; examples include:

- Direct sensing equipment such as the membrane interface probe, laser-induced or X-ray fluorescence sensors and cone penetration tests.
- Immunoassay, colorimetric and other field test kits to screen soil and groundwater contaminants.
- Portable vapor/gas detection systems using photoionization or flame ionization for screening purposes.
- Soil gas surveys involving instruments such as SUMMA canisters to determine the presence, composition and distribution of volatile organic compounds (VOCs) in the vadose zone and water table.
- Portable gas chromatography/mass spectrometry for analyzing fuel-related compounds and VOCs in soil and groundwater.
- Ground penetrating radar, magnetometers, and other geophysical survey instrumentation to locate metal objects and delineate disposal areas.



At Well 12A within the Commencement Bay-South Tacoma Channel Superfund site in Washington, high-resolution characterization data and 3D visualization were used to develop a robust CSM. The CSM helped quantify contaminant mass in soil and groundwater, delineate discrete treatment zones and prioritize remediation design approaches. This refined, minimally invasive strategy for site characterization significantly accelerated site cleanup, saving an estimated $1 million in treatment costs. Additionally, use of passive sampling devices for long-term monitoring avoided generation of purge water while saving more than $100,000 in the first five years of monitoring alone.

Other BMPs typically applying to site investigation and environmental monitoring focus on conserving and protecting water and using environmentally friendly products, such as:

- ♦ Deploy passive sampling devices, which involve no well purging.
- ♦ Use supplemental techniques to map the source and extent of a contaminated groundwater plume, such as analyzing core samples taken from rapid-growing trees.
- ♦ Employ a closed-loop graywater washing system to decontaminate trucks or machinery.
- ♦ Steam-clean or use phosphate-free detergents instead of organic solvents or acids to decontaminate sampling equipment.
- ♦ Use plastic sheeting or portable wash pads to contain and collect decontamination fluids and prevent their entrance into storm drains or groundwater.

- Treat potentially contaminated purge water through use of technologies such as activated carbon filtration prior to discharge to storm drains or waterways.
- Quickly restore disturbed areas of vegetation serving as stormwater controls.
- Use biodegradable lubricants and hydraulic fluids.
- Choose groundwater monitoring equipment made of noncorrosive material.

Yet other BMPs concern design and installation of groundwater wells to be used for sampling and monitoring. Relevant BMPs include:

- Design investigative wells in ways that allow for maximum reuse during remediation or to meet water demands of ongoing or future site activities.
- Integrate a horizontal well network where feasible as an alternative to a greater number of vertical wells.
- Choose a multi-port sampling system in wells intended for monitoring, to minimize the total number of wells needing to be installed.
- Use minimally invasive drilling techniques such as direct-push or sonic technology whenever feasible to reduce drilling duration, avoid or minimize use of water, and prevent or reduce generation of cuttings and associated disposal of investigation-derived waste (IDW).
- Use dual tube technology during drilling, which allows collection of continuous soil cores and later reuse of the same boreholes for site investigation, remediation or monitoring.
- Use an electric top drive system to minimize use of hydraulic fluids when rotary drills are used.
- Segregate and screen drill cuttings for potential use such as onsite backfill if allowed under applicable state or federal cleanup programs; use of an organic vapor analyzer may significantly improve or accelerate the screening process.
- Use environmentally friendly pipe dope for drill pipes and casings.
- Emplace mats to limit ground surface disturbance at drilling locations.

Use of passive diffusion bag (PDB) sampling techniques in 56 wells at the Joint Base Lewis McChord Superfund site in Washington significantly reduced the environmental footprint of sampling activities. When compared to using low-flow sampling techniques in other wells, PDB use achieved a:

- 54% reduction in energy used.
- 55% reduction in greenhouse gas emissions.
- 63% reduction in criteria pollutants.

The footprint reductions were driven by demonstrated reductions in the amount of field time, which leads to fewer vehicle miles traveled and associated fuel consumption. A two-person team was able to sample 12 of the wells per day when using PDBs but only five wells per day if using low-flow methods.[6]

Materials and Waste Management

Site investigation and environmental monitoring activities typically involve using an assortment of manufactured products such as personal protective equipment (PPE), sample containers and routine business materials. BMPs concerning green purchasing of such products include:

- Choose products with recycled and biobased contents such as agricultural or forestry waste instead of petroleum-based ingredients.
- Choose products, packing material and equipment that have reuse or recycling potential.
- Choose products manufactured through processes involving nontoxic chemical alternatives.

A comprehensive list of tools and resources for materials management decision-making is available in EPA's *Sustainable Materials Management in Site Cleanup* engineering issue paper.[7]

IDW generation and management frequently account for a significant portion of the environmental footprint of site investigation. IDW includes drill cuttings, well purge water, spent carbon from filtration equipment, reagents used with environmental field test kits, non-reusable or contaminated PPE and solutions for decontaminating non-disposable PPE and equipment. Reducing the volume of generated IDW will decrease the need for waste containers such as 55-gallon storage drums and for treating IDW onsite or disposing of it at a waste facility. Recommended BMPs to reduce the volume of routine waste or IDW, while often decreasing materials consumption, include:

- Compress the number of days needed for a given round of sampling.
- Minimize the need for disposable single-use items such as plastic bags.
- Designate collection points for items that are locally recyclable, such as metal, plastic or glass containers and paper or cardboard.
- Select test kits that generate less waste, such as soil samplers with reusable handles for coring syringes.
- Collect hydraulic fluids and lubricants for recycling at suitable local facilities.
- Maximize use of environmentally friendly additives such as ascorbic acid to preserve or stabilize collected samples, if compatible with target analytes and anticipated analytical methods.[10]

Use of EPA's *Spreadsheets for Environmental Analysis*[8] to estimate the footprint of cleanup activities at the Grants Chlorinated Solvents Plume Site indicated that laboratory analysis (including sample collection and preparation and offsite transport) accounted for approximately 10% of the energy- and carbon dioxide (equivalent)-related footprint of operating, maintaining and monitoring the remedy.[9] As a result, optimization of the sampling program is underway to reduce the frequency of sample collection and analysis.

Laboratory Support

Use of fixed-base laboratories for analytical services may significantly contribute to the environmental footprint of site investigation and environmental monitoring when considering offsite as well as onsite contributions. Green remediation BMPs concerning analytical support include:

- ♦ Use a mobile laboratory or portable analytical equipment, particularly for screening purposes and when rapid analytical results are needed.
- ♦ Specify EPA analytical methods involving procedures that need relatively low volumes of samples or solvents and generate less waste, such as solid phase micro extraction (SPME), pressurized fluid extraction, microwave extraction, and supercritical fluid extraction when possible. For example, SPME is a single-step process using little or no solvents and taking up to 70% less time.
- ♦ Choose fixed laboratories demonstrating a strong commitment to environmental performance, such as routine use of management practices identified by the International Institute for Sustainable Laboratories.[11]

Attributes of high-performing laboratories include:

- Optimized ventilation rates in light of the mixing factor of particular pollutants being removed from the laboratory; simply maximizing ventilation results in unnecessary energy expenditure (and may diminish safety conditions).
- Use of energy recovery devices and systems to reduce energy consumption for interior heating and cooling.
- Use of energy-efficient equipment for ventilation, refrigeration and lighting.
- Use of energy consumption controls such as programmable thermostats, window glass tinting and ample insulation.
- Cooling tower operation with a high concentration ratio, which increases the number of times water circulates before it is bled off and discharged; cooling accounts for an estimated 30-60% of water used in multipurpose laboratories.[12]
- Integration of solenoid valves, timers or other controls on equipment used in processes requiring flowing water.
- Use of less hazardous materials; for example, toluene may substitute for benzene as a solvent.
- Implementation of purchasing strategies and inventory controls that minimize disposal of excess materials.
- Recycling of liquid waste; for example, non-halogenated solvents may be used offsite as fuel blending feedstock.
- Recycling of materials such as clean glass or plastic containers, drums, electronics, and steel or aluminum instrumentation.

Acquisition of laboratory services supporting remedial investigation at the Diaz Chemical Corporation Superfund site in Holley, New York, included specifications meeting EPA greener cleanup policy. The selected laboratory employs practices such as:

- Recycling all paper products and shipping materials.
- Using energy-efficient lighting.
- Maintaining a paperless reporting and invoicing program.
- Minimizing waste through use of EPA-approved microscale methods.

Similar procurement requirements for subcontractor drilling activities reduced the investigative footprint by:

- Using direct-push technology.
- Deploying trucks equipped with advanced emission controls.
- Minimizing waste through waste oil and scrap recycling.

This fact sheet provides an update on information compiled in the December 2009 "Site Investigation" fact sheet (EPA 542-F-09-004), in collaboration with the Greener Cleanups Subcommittee of the EPA Technical Support Project's Engineering Forum.

To view BMP fact sheets on other topics, visit CLU-IN Green Remediation Focus: www.clu-in.org/greenremediation.

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