

**FOURTH FIVE-YEAR REVIEW
BARKHAMSTED-NEW HARTFORD LANDFILL SUPERFUND SITE
BARKHAMSTED, CONNECTICUT**



Prepared by

**U.S. Environmental Protection Agency
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A handwritten signature in blue ink, appearing to read "Bryan Olson", is written over a dashed horizontal line.

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A handwritten date "9/20/18" in blue ink is written over a dashed horizontal line.

Date



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ABBREVIATIONS & ACRONYMS

ADAF	Age-Dependent Potency Adjustment Factor
ALM	Adult Lead Methodology
ARAR	Applicable or Relevant and Appropriate Requirement
Arcadis	Arcadis U.S., Inc.
AWQCs	Ambient Water Quality Criteria
BLL	Blood Lead Level
BTAG	Biological Technical Assistance Group
CCC	Criteria Continuous Concentration
CD	Consent Decree
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMCs	Criteria Maximum Concentrations
CFR	Code of Federal Regulations
CSF	Cancer Slope Factor
CUG	Cleanup Goal
CTDEP	Connecticut Department of Environmental Protection
CTDEEP	Connecticut Department of Energy and Environmental Protection
DCE	Dichloroethene
DMP	2,4-Dimethylphenol
EE/CA	Engineering Evaluation and Cost Analysis
ELUR	Environmental Land Use Restriction
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
FS	Feasibility Study
FYR	Five-Year Review
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
IEUBK	Integrated Exposure Uptake Biokinetic Model
IRIS	EPA Integrated Risk Information System

ABBREVIATIONS & ACRONYMS (cont.)

MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/L	Milligrams per liter
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHL	Non-Hodgkin's Lymphoma
Nobis	Nobis Engineering, Inc.
NPL	National Priorities List
NTCRA	Non-Time-Critical Response Action
NRWQC	National Recommended Water Quality Criteria
OLEM	EPA Office of Land and Emergency Management
PAH	Polynuclear Aromatic Hydrocarbon
PCE	Tetrachloroethene
PFAS	Perf and poly-fluorinated alkyl substances
PFBS	Perfluorobutanesulfonate
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctanesulfonic Acid
ppm	Parts Per Million
PPRTV	Provisional Peer-reviewed Toxicity Value
PRP	Potentially Responsible Party
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RBA	Relative bioavailability
RfCs	USEPA Risk Reference Concentrations
RfDs	USEPA Risk Reference Doses
RI	Remedial Investigation
ROD	Record of Decision
RPF	Relative Potency Factor
RRDD	Regional Refuse Disposal District No. 1
RSL	EPA Regional Screening Level
RSRs	Connecticut Remediation Standard Regulations

ABBREVIATIONS & ACRONYMS (cont.)

SDWA	Safe Drinking Water Act
SVOC	Semivolatile organic compound
TBC	To Be Considered
TCE	Trichloroethylene
UCL	Upper Control Limit
µg/dL	Micrograms per decaliter
µg/L	micrograms per liter
UST	Underground storage tank
URF	Inhalation Unit Risk Factor
UU/UE	Unlimited Use/Unrestricted Exposure
VISL	EPA Vapor Intrusion Screening Level
VOC	volatile organic compound

I INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and documented recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Section 121, consistent with the National Oil and Hazardous Substances Contingency Plan (NCP) (40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii), and considering EPA policy.

This is the fourth FYR for the Barkhamsted-New Hartford Landfill Superfund Site (Site). The triggering action for this policy review is the completion of the third FYR in 2013. This FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

Site Background

The Barkhamsted-New Hartford Landfill is located within a 97.8-acre parcel of land situated along the western side of New Hartford Road (Route 44) and straddles the municipal borders of Barkhamsted and New Hartford, Litchfield County, Connecticut (see Figure 1). The Site is located on the northern slope of a hill within the Farmington River Valley and is currently used as a transfer station and recycling center for the Regional Refuse Disposal District No. 1 (RRDD). Of the 97.8 acres, approximately 13 acres consist of the capped landfill and appurtenances; the remaining acreage is either undeveloped woodlands or occupied by the transfer station and maintenance and office buildings (see Figure 2). The Site is abutted to northeast by the Barkhamsted Town Garage facility and in other directions by both developed and undeveloped private properties. This includes residential properties to the east and southeast that use private wells for potable water. No Changes are anticipated to the current land use, both on site as well as at adjacent parcels.

Between 1974 and 1993, the land was used for municipal solid waste, industrial waste, and non-processable waste disposal via landfilling. Initial groundwater contamination was identified in

1981, and subsequent investigations conducted between 1992 and 2000 further identified the nature and extent of the contamination. Details regarding these investigations are included in Appendix B. The investigations progressed to the CERCLA response actions described subsequently.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Barkhamsted-New Hartford Landfill		
EPA ID: CTD980732333		
Region: 1	State: CT	City/County: Barkhamsted & New Hartford/ Litchfield County
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	Has the site achieved construction completion? Yes	
REVIEW STATUS		
Lead agency: EPA If "Other Federal Agency" was selected above, enter Agency name: Click here to enter text.		
Author name (Federal or State Project Manager): Almerinda Silva		
Author affiliation: U.S. EPA Region I		
Review period: 2/22/18 – 9/30/18		
Date of site inspection: 5/2/18		
Type of review: Policy		
Review number: 4		
Triggering action date: September 2013		
Due date (five years after triggering action date): September 2018		

II RESPONSE ACTION SUMMARY

Basis for Taking Action

EPA completed a baseline human health risk assessment (HHRA) in February 1996 and updated it in April 2000. Potential human health effects associated with exposure to contaminants of concern (COCs) were documented for various exposure scenarios. Of these scenarios, only future groundwater exposure presented an unacceptable risk. The total cancer risk from dermal and oral exposure via drinking water was 5×10^{-4} , which was primarily driven by the presence of arsenic. Additionally, Hazard Indices (HI) of greater than 1 were calculated for several target endpoints.

An Ecological Risk Assessment was completed in 2000, after the completion of a Non-Time-Critical Removal Action (NTCRA). The result of this assessment suggested that the NTCRA had mitigated the pre-NTCRA ecological risks or would likely mitigate them in the future. The assessment suggested long-term monitoring of leachate seeps and sediment would assist in determining whether ecological risks continue to decrease.

Based upon the results of the Human Health and Ecological Risk Assessments, the only medium that potentially poses an unacceptable risk is groundwater. Table 2-1 presents the COCs for groundwater.

**Table 2-1
Groundwater Contaminants of Concern**

Volatile Organic Compounds		
1,2-dichloroethane	benzene	dibromochloromethane
1,2-dichloropropane	chloroethane	methylene chloride
1,4-dichlorobenzene	chloroform	toluene
4-methyl-2-pentanone	chloromethane	trichloroethene
methyl ethyl ketone	acetone	vinyl chloride
Semi-Volatile Organic Compounds		
2,4-dimethylphenol	4-methylphenol	bis(2-ethyl hexyl) phthalate
Metals		
Arsenic	Lead	Manganese
Total chromium		

Response Actions

Initial Response

Pursuant to Section 105(8)(b) of CERCLA, the Site was proposed for inclusion on the National Priorities List (NPL) on June 21, 1988 and was subsequently listed on the NPL on October 5, 1989. In 1990, an Administrative Order of Consent (AOC) was issued by the Connecticut Department of Environmental Protection (CTDEP) (now known and hereafter referred to as the Connecticut Department of Energy and Environmental Protection [CTDEEP]) and EPA to investigate waste materials and disposal activities on site; the extent of impact to soil, groundwater and surface water; and to conduct a Remedial Investigation (RI) and Feasibility Study (FS).

In April 1994, an Engineering Evaluation/Cost Analysis (EE/CA) was performed. In September 1994 a Consent Order was entered among EPA, CTDEP, and RRDD which required RRDD to design and implement the approved NTCRA. The NTCRA, was completed in 1998 and included re-location of impacted soil and sediment to areas of the Site to be capped, installation of a leachate collection system and underground storage tank (UST), construction of a low-permeability landfill cap, relocation of an existing stream, vertical extension of existing monitoring wells, site restoration, and installation of perimeter fencing.

The Record of Decision (ROD) for the Site was signed on September 28, 2001. The ROD identified the remedial action objectives (RAOs) for the remedy to mitigate and prevent existing and future potential threats to human health and the environment. The RAOs for the selected remedy include:

- **Response Action Objectives - Groundwater (Human Health)**
 - Prevent ingestion or dermal contact with groundwater having constituent concentrations exceeding EPA Safe Drinking Water Act Maximum Contaminant Levels (MCLs), or in their absence, the more stringent of an excess cancer risk of 1×10^{-6} for each carcinogen or a hazard quotient of 1 for each non-carcinogenic substance.

- Restore groundwater beyond the compliance boundary (limits of the landfill) to MCLs or any more stringent Connecticut Remediation Standards (background concentrations), or in their absence, the more stringent of an excess cancer risk of 1×10^{-6} for each carcinogen or a hazard quotient of 1 for each non-carcinogenic substance.
- **Response Action Objectives - Sediment (Environmental Protection)**
 - Protect benthic invertebrates and mammals from ingesting contaminated prey from direct contact with, or ingestion of, sediment having constituent concentrations exceeding a hazard index of 1.
 - Prevent releases of constituents from sediments that would result in surface water levels exceeding federal Ambient Water Quality Criteria, Connecticut Water Quality Standards, or in their absence, a hazard index of 1.

Remedy Components

Monitored natural attenuation (MNA) was selected as the groundwater remedy. The remedy at this Site is designed to protect human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through monitored natural reductions in toxicity, engineering controls (i.e., capping), and institutional controls. Groundwater cleanup levels will be achieved through natural attenuation processes and exposures are controlled through the installation of the engineered landfill cap. Environmental Land Use Restrictions (ELURs) prohibit residential use of the Site, prevent the use of groundwater, and maintain the protection of the landfill cap installed as part of the NTCRA.

Specific remedial components included:

- Groundwater remediation via natural attenuation;
- Groundwater monitoring well installation;
- Institutional controls to prevent ingestion/contact with contaminated groundwater;
- Public education program involving informational meetings/mailings regarding the potential site-related hazards;

- Long-term monitoring of groundwater, surface water, and sediment; and
- FYRs.

The groundwater cleanup levels were established in the ROD and summarized below.

**Table 2-2
Groundwater Cleanup Levels**

Volatile Organic Compounds	Cleanup Level (µg/L)	Semi-Volatile Organic Compounds & Metals	Cleanup Level (µg/L)
1,2-dichloroethane	<0.5	2,4-dimethylphenol	<10.0
1,2-dichloropropane	<0.5	4-methylphenol	<10.0
1,4-dichlorobenzene	<10.0	bis(2-ethyl hexyl) phthalate	<2.0
4-methyl-2-pentanone	<5.0	Arsenic	5.0
methyl ethyl ketone	<10.0	Total chromium	50.0
acetone	<10.0	Lead	3.0
benzene	<0.5	Manganese	50.0
chloroethane	<1.0		
chloroform	<0.5		
chloromethane	<1.0		
dibromochloromethane	<0.5		
methylene chloride	<2.0		
toluene	<0.5		
trichloroethene	<0.5		
vinyl chloride	<1.0		

Notes:

The cleanup levels are based on background concentrations per the Connecticut RSRs. The ROD states that “During the RA Phase, USEPA in consultation with CTDEEP will determine whether these concentrations represent background for this Site and will change these values, if necessary, through an ESD”.

The 2001 ROD estimated that approximately 15.6 years would be required to achieve RAOs in overburden groundwater, and approximately 6 years to achieve RAOs in the bedrock aquifer outside the boundary of compliance.

Status of Implementation

The source control remedy was addressed by the NTCRA, which included relocation of impacted soil and sediment to below a paved portion of the Site, along with installation of a leachate collection system and RCRA C landfill cap. During the performance of the NTCRA, an

approximate 340-foot reach of the Unnamed Brook was relocated on the west side of the landfill, with the former section of the brook being covered with soil. Sediments were excavated from an approximately 70-foot reach of the brook and placed beneath the cap as part of the NTCRA.

In 2003, EPA and the State of Connecticut settled with certain Settling Defendants under a Consent Decree (CD) (United States v. Regional Refuse Disposal District No. 1, et al.) The CD required that the Settling Defendants contract with a capable supervising contractor, develop and implement a Remedial Action Work Plan (RAWP), establish suitable sampling and quality control requirements, grant access to government representatives, and establish institutional controls.

In spring of 2003, pursuant to the terms of the CD, the Performing Settling Defendant and owner and operator of the Site (RRDD) initiated the long-term monitoring at the Site. Since 2003, groundwater, drinking water, surface water, and sediment monitoring samples have been collected in support of an on-going assessment of the MNA remedy, and to monitor the continued effectiveness of the NTCRA. Figure 3 provides the current monitoring locations.

Table 2-3 presents the ELURs implemented at the Site.

**Table 2-3
Summary of Implemented Institutional Controls**

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	ELURs 2003-2004
Engineered controls (landfill cap system; groundwater)	Yes	Yes	Parcel 49/18/14-R	Prevent residential use; prevent groundwater use as drinking water; prevent disturbance of the engineered control; prevent construction within the engineered control	Barkhamsted – Volume 124, Page 140; New Hartford – Volume 217, Page 1019
Groundwater	Yes	Yes	Parcel 49/18/10	Prevent groundwater use as drinking water	Barkhamsted – Volume 126, Page 347
Groundwater	Yes	Yes	Parcel 49/18/21	Prevent groundwater use as drinking water	Barkhamsted – Volume 126, Page 689
Groundwater	Yes	Yes	Volume 35, Pages 229 (Parcels 1 and 2)	Prevent groundwater use as drinking water	Barkhamsted – Volume 126, Page 689

Systems Operations/Operation & Maintenance

Visual inspections by RRDD of the landfill occur on an approximately quarterly basis. The inspections evaluate the condition of the landfill cap (for erosion, thinning vegetation, excess vegetation, drainage problems, settlement problems, slope instability, burrowing animals, and seepage), the gas venting system, the leachate collection system, surface water runoff structures, the access road, the groundwater monitoring system, the physical site security, the sedimentation basins, and the condition of the unnamed brook.

In May 2018, personnel from EPA, Nobis Engineering, Arcadis, and RRDD performed a site inspection for this FYR (see Section IV Site Inspection for more information). No significant changes to the operations/maintenance of the landfill have occurred.

The RRDD administrator noted that the volume of leachate generated by the landfill has been declining in recent years. No leachate pumping has been needed within the last two years, and the leachate UST is approximately half-full.

III PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This section includes the protectiveness determination and statement as well as the recommendations from the last FYR. The status of those recommendations is also included.

Table 3-1
Protectiveness Determinations/Statements from the 2013 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Will be Protective	<i>The remedy at the Barkhamsted-New Hartford Landfill Site currently protects human health and the environment because remedial activities completed to date adequately addressed all exposure pathways that could result in unacceptable risk. There are no current exposures to contaminated groundwater originating from the site; the landfill cap continues to be an effective remedy; a long-term monitoring program is in place; and institutional controls have been recorded. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: 1) repair the northeastern portion of the landfill perimeter fence; 2) fill in animal burrows and repair drainage features on the cap; 3) select analytical methods to ensure laboratory reporting limits meet all COC cleanup goals for groundwater and ecological benchmarks for surface water and sediment; 4) perform the sediment hazard index analysis to evaluate compliance with the RAO; 5) as the current estimate to achieve cleanup goals will not be met, verify that monitored natural attenuation processes continue to be effective and develop a revised estimate of time to achieve cleanup goals, and continue to maintain the ELURs; and 6) include drinking water samples from the new "Garage Well" into the long-term monitoring plan.</i>

The third FYR recommended that several actions be taken to enhance the remedy. Table 3-2 outlines the recommendations included in the third FYR and the outcome/resolution of those recommendations.

Table 3-2
Status of Recommendations from the 2013 Five-Year Review

Issue	Recommendations/ Follow-up Actions	Current Status	Implementation Status Description	Completion Date
Minor Landfill Repairs	Repair the damaged perimeter fencing in the northeast portion of the landfill, fill animal burrows and inspect for additional burrows, repair drainage features if necessary	Completed	Perimeter fencing was repaired, animal burrows were filled, but more small burrows were noticed in 2018, and with limited exceptions, the drainage appears to be effectively transported.	Varied
Long-Term Monitoring Analytical Quantitation Limits*	Verify analytical methods to ensure that reporting limits meet cleanup levels and ecological benchmarks. Once sufficient sediment data has been collected, perform a sediment hazard index analysis to evaluate compliance with the RAO.	Groundwater reporting limit evaluation is ongoing Sediment hazard index analysis was completed	Groundwater analytical reporting limits continue to exceed ROD cleanup levels for several contaminants. A sediment hazard index analysis was completed which concluded that the RAOs for sediment were being met and no potential ecological risks to benthic invertebrates remain.	Analytical reporting limits remain an issue. The sediment hazard index analysis was completed on September 30, 2014.
Long-Term Monitoring Modifications	Modify the long-term monitoring plan to include the new "Garage Well".	Completed	The "Garage Well" was added to the regular monitoring program.	April 17, 2013
Groundwater remedy will likely not achieve cleanup goals within the timeframe stated in the ROD*	Continue to verify that the MNA process remains on-going, and develop a revised estimate of time required to achieve cleanup goals.	Completed	Revised MNA Timeframe to Cleanup Assessment developed.	Revised MNA Timeframe to Cleanup Assessment completed on December 29, 2016.

Notes:

*Further details pertaining to this recommendation are provided in subsequent paragraphs.

Long-Term Monitoring Analytical Quantitation Limits

The majority of the non-detect reporting limits for groundwater samples collected between 2013 and 2018 for the following contaminants exceeded the ROD cleanup levels: 1,2-dichloroethane, 1,2-dichloropropane, methyl ethyl ketone, 4-methyl-2-pentanone, acetone, benzene, bis(2-ethylhexyl)phthalate, chlorodibromomethane, chloroethane, chloroform, chloromethane, toluene, trichloroethylene, vinyl chloride and arsenic. Table 3-3 provides a summary of the non-compliant reporting limits.

Table 3-3
Non-Compliant Reporting Limits for Groundwater Samples 2013-2017

Contaminant of Concern	# Non-Compliant Non-Detect RLs/# Non-Detects	Contaminant of Concern	# Non-Compliant Non-Detect RLs/# Non-Detects
1,2-Dichloroethane	106/162	Chloroform	109/161
1,2-Dichloropropane	162/162	Chloromethane	109/166
Acetone	95/146	Methyl ethyl ketone	100/164
Arsenic	22/51	4-Methyl-2-pentanone	108/165
Benzene	75/121	Toluene	150/150
bis(2-Ethylhexyl)phthalate	123/138	Trichloroethene	102/153
Chlorodibromomethane	112/165	Vinyl chloride	112/165
Chloroethane	86/141		

With respect to drinking water samples, the majority of non-detect results did achieve the ROD cleanup levels; however, several samples which contained non-detect results did not. These contaminants in drinking water include: 1,2-dichloroethane, 1,2-dichloropropane, benzene, bis(2-ethylhexyl)phthalate, chlorodibromomethane, chloroethane, chloroform, toluene, trichloroethylene, and vinyl chloride. Table 3-4 provides a summary of the non-compliant drinking water reporting limits.

Table 3-4
Non-Compliant Reporting Limits for Drinking Water Samples 2013-2017

Contaminant of Concern	# Non-Compliant Non-Detect RLs/# Non-Detects	Contaminant of Concern	# Non-Compliant Non-Detect RLs/# Non-Detects
1,2-Dichloroethane	6/27	Chloroform	7/25
1,2-Dichloropropane	10/27	Toluene	10/27
Benzene	5/27	Trichloroethylene	7/27
bis(2-Ethylhexyl)phthalate	4/27	Vinyl chloride	7/27
Chlorodibromomethane	8/27		
Chloroethane	4/27		

Groundwater remedy will likely not achieve cleanup goals within the timeframe stated in the ROD

In response to the issue raised and recommendations provided in the Third FYR, in December 2016, Arcadis U.S., Inc. (Arcadis) (contractor for RRDD) developed a Revised Monitored Natural Attenuation Timeframe to Cleanup Assessment Technical Memorandum. The memorandum stated that although some contaminants of concern will attain their respective ROD cleanup levels by December 2017, several contaminants will not. These contaminants include 2,4-dimethylphenol, benzene, toluene, trichloroethylene, arsenic, and manganese.

Table 3-5 summarizes the range of estimated target dates to achieve the ROD cleanup levels.

**Table 3-5
Summary of Time Estimates to Reach Cleanup Levels**

Monitoring Well	Parameter	Range of Dates to Achieve Cleanup Levels (90% Confidence Interval)	Targeted Year to Achieve Cleanup Levels
S-3	Benzene	2012-2033	2018
	Manganese	2041-2121	2062
MW-4S	Arsenic	2016-2106	2030
	Benzene	2018-2039	2026
	Manganese	2031-2082	2046
MW-5S	Benzene	2015-2057	2025
	Manganese	Not calculable	Not calculable
MW-101S	2,4-Dimethylphenol	Not calculable	Not calculable
	Arsenic	Not calculable	Not calculable
	Benzene	Not calculable	Not calculable
	Manganese	Not calculable	Not calculable
	Toluene	2015-2023	2019
MW-103S	Manganese	Not calculable	Not calculable
MW-4R	Arsenic	Not calculable	Not calculable
	Benzene	2026-2041	2032
	Manganese	2092-2213	2128
MW-5B	Manganese	Not calculable	Not calculable
MW-101B	Manganese	Not calculable	Not calculable
MW-103B	Manganese	Not calculable	Not calculable
MW-120B	Trichloroethylene	2014-2021	2017 (achieved)

Notes:

Estimations of cleanup times for certain parameters could not be calculated due to insufficient data.

As noted above, the latest calculated year to achieve cleanup levels at the boundary of compliance for inorganics (primarily manganese) is 2128, and for organic constituents it is 2030. A much longer period is anticipated for arsenic and manganese (both presumed to be naturally occurring and mobilized by changes in groundwater geochemistry) to reach cleanup levels due to the time required until oxidative groundwater conditions begin to dominate the overburden and bedrock aquifers (Appendix G). Although a longer period is expected to reach RAOs than originally expected during the time of the ROD, the remedy remains protective because the waste is covered by the cap, and there are no drinking water impacts from these contaminants. Statistically significant trends for some of the contaminants (primarily arsenic and manganese) could not be calculated for several of the wells.

IV FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available via press release on the EPA Region 1 website on February 16, 2018. The notice stated that there was a FYR upcoming and invited the public to submit comments. The results of the review and the report will be made available at EPA's Site-specific website as well as the public information repository at the Beardsley & Memorial Library located at 690 Main Street, Winsted, Connecticut. A copy of the press release is included in Appendix C.

During the FYR process, interviews were conducted to document any perceived problems with the remedy that has been implemented, to date. The results of these interviews are summarized below and are presented in greater detail in Appendix F.

Interviews were conducted with the RRDD Administrator, the CTDEEP Project Manager, and the Barkhamsted First Selectman.

No operational issues were encountered or discovered during the review period. Leachate accumulation has slowed from prior periods such that the storage tank is approximately only half full after at least two years. A 1.5-megawatt solar array went live on the RRDD property in March 2017 outside the limits of the landfill cap. Each of the interviewees believed that the remedy was functioning well.

Data Review

A summary of relevant data regarding the components of the Site remedy is presented below. The data reviewed were collected as part of the long-term monitoring program between 2003 and 2017. The results of these sampling events are summarized below by media. Analytical result summaries are presented below, and the results of the most recent monitoring rounds are depicted on Figures 4 through 7.

The long-term monitoring program consisted of semi-annual groundwater monitoring, annual monitoring of seeps, and sediment monitoring every 5 years to support the FYR effort. Table 4-1 presents a summary of the monitoring conducted between 2013 and 2017.

**Table 4-1
Summary of Monitoring Performed 2013-2017**

Matrix	Target	2013		2014		2015		2016		2017	
		Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Groundwater	Semi-Annual	✓	✓	✓	✓	✓	✓	✓	✓		✓
Drinking Water	Semi-Annual	✓	✓	✓	✓	✓	✓	✓	✓		✓
Surface Water	Semi-Annual	✓	✓	✓	✓	✓	✓	✓	✓		✓
Seeps	Annual (Spring)	✓		✓		✓		✓	✓		✓
Sediment	Every fifth year		✓						✓		

As shown above, the spring round from 2017 was not completed in accordance with the monitoring schedule. The October 2016 monitoring data was not provided in time to be included in this FYR. The October 2017 technical memorandum regarding the Monitoring Program for Compliance with Groundwater Remedial Action Objectives and Proposed Monitoring Plan Revision presents a revised monitoring program to reduce most of the monitoring from semi-annual to annual. EPA and CTDEEP are reviewing the proposal.

Groundwater

The quantitation limits of 17 of the 22 COCs which were reported as not detected in groundwater samples exceeded their respective ROD cleanup goals at least once. This failure suggests that conventional laboratory analytical methods for groundwater samples may not be sufficiently precise to achieve the ROD cleanup goals. EPA, in conjunction with the CT DEEP, will evaluate analytical method precision to promote routine achievement of the ROD cleanup goals. Additionally, EPA in consultation with the CT DEEP, will also evaluate the viability of the ROD cleanup goals as representative of background concentrations.

Overburden

The interpreted overburden groundwater flow direction is north and northeast, toward the Farmington River (Figure 4). The current long-term monitoring program appears to be sufficient to evaluate groundwater contamination status. Overburden groundwater COC concentrations continued to decline between 2013 and 2017 (see Appendix D). Overburden groundwater contamination above cleanup criteria exists beyond the limit of the landfill (i.e., the compliance boundary) but within the limit of the ELURs preventing groundwater usage as drinking water. Table 4-2 presents a summary of the overburden groundwater monitoring locations with 2017 COC concentrations above the ROD cleanup goals.

Table 4-2
Summary of 2017 Overburden Groundwater Monitoring Locations
Where Detections Exceed ROD Cleanup Goals

Monitoring Location	Analytes and ROD Cleanup Goal (µg/L)			
	2,4-DMP	Benzene	Arsenic	Manganese
	10	0.5	5	50
	Federal Maximum Contaminant Levels (µg/L)			
	NL	5	10	50
MW-101S	130 J	<4.1	8.8	150
MW-103S	<5	<0.41	0.57 J	60 J
MW-106S	<0.25	<0.41	<0.27	50
MW-115S	<0.5	<0.41	<0.27	53
MW-120S	<0.5	<0.41	<0.27	56 J
MW-1S	15 J	4.2 J	6	56 J
MW-4S	<2.5	1.4	8.5	1700
MW-5S	<0.5	<0.41	0.39 J	970
S-3	<0.5	0.47 J	1.1	4400

Notes:

The maximum values from December 2017 samples are presented.

Shaded values are positive detections that exceed cleanup goals.

2,4-DMP – 2,4-Dimethylphenol

MCL – Federal Maximum Contaminant Level for drinking water. Provided for evaluation of current cleanup goals specified in the ROD. The presented MCL for Manganese is a non-enforceable secondary drinking water standard.

< – Less than the value presented.

J – Presented value is an estimate.

Much of the organic along with arsenic contamination is focused within and slightly downgradient of the landfill, decreasing in concentration with distance from the landfill, whereas manganese contamination extends the farthest well beyond the limits of the landfill. Trace elements of arsenic, iron, and manganese are commonly found within the subsurface, and elevated concentrations of

these naturally-occurring elements in groundwater are often the result of microbial activity affecting landfill chemistry, oxygen content, and altering groundwater pH. In general, the overburden groundwater contamination has been decreasing over the five-year monitoring period (Appendix D and G)

Bedrock

The interpreted bedrock groundwater flow direction is north and northeast, toward the Farmington River. The current long-term monitoring program appears to be sufficient to evaluate groundwater contamination status.

Bedrock groundwater COC concentrations continued to decline between 2012 and 2017 (see Appendix D and G). The limit of bedrock groundwater contamination, remaining above cleanup criteria, exists beyond the landfill compliance boundary, but remains within the limits of the ELURs. Table 4-3 presents a summary of the bedrock groundwater monitoring locations with 2017 COC concentrations above the ROD cleanup goals.

**Table 4-3
Summary of 2017 Bedrock Groundwater Monitoring Locations
Exceeding ROD Cleanup Goals**

Monitoring Location	Analytes and ROD Cleanup Goal (µg/L)		
	Benzene	Arsenic	Manganese
	0.5	5	50
	Federal MCL (µg/L)		
	5	10	50
MW-101B	<0.41	2.9	3400J
MW-102B	<0.41	<0.27	68
MW-103B	<0.41	<0.27	890J
MW-104B	<0.41	0.61J	24J
MW-111I	<0.41	0.51J	8.9
MW-113B	<0.41	0.3J	4
MW-115B	<0.41	<0.27	15
MW-120B	<0.41	1.5	200J

Monitoring Location	Analytes and ROD Cleanup Goal (µg/L)		
	Benzene	Arsenic	Manganese
	0.5	5	50
	Federal MCL (µg/L)		
	5	10	50
MW-4R	1.9	5.7	3800
MW-5B	<0.41	1.6	2300

Notes:

The maximum values from 2017 samples are presented.

Shaded values indicate positive detections that exceed cleanup goals.

MCL – Federal Maximum Contaminant Level for drinking water. Provided for evaluation of current cleanup goals specified in the ROD. The presented MCL for Manganese is a non-enforceable secondary drinking water standard

< – Less than the value presented.

J – Presented value is an estimate.

In general, the bedrock groundwater contamination has been decreasing over the FYR monitoring period (Appendix D and G). Similar to the overburden sample quantitation limits, many of the those limits for the organic constituents also failed to achieve the ROD cleanup levels.

Drinking Water

For the current review period, drinking water samples were collected semi-annually beginning in the spring 2013 through the fall of 2017 from three residential wells and one Town-owned municipal property that is used as a garage (the well is referred to as the “Garage Well”). All drinking water sample results were compared to both the ROD clean up levels (i.e. background) as well as MCLs. Although there have been a few exceedances of inorganic substances above the background clean up levels, there have been very limited exceedances of MCLs. Specifically, with regards to lead, all samples were below MCLs except for one duplicate sample in April 2014 at the Garage Well. For this one lead exceedance, the results show 9 ppb for the sample (less than the MCL) and 470 ppb (greater than the MCL) for the associated duplicate sample. The MCL for lead is 15 ppb.

Copper (not a COC) concentrations were also detected exceeding the MCL of 1,300 µg/L in DW-1, DW-3, and the Garage Well samples at least once during the five-year monitoring period. All four wells are located outside the boundaries of the Site’s ELURs thus drinking water use is not prohibited. Lead was not reported above ROD cleanup goals in any groundwater sample collected from any monitoring wells across the site, and can have many other (secondary) sources including water distribution systems (i.e., plumbing). Due to the disparate nature of the lead

results, and the infrequent detection above MCLs (i.e., once), EPA is identifying this as an issue and recommending that RRDD collect quarterly samples for metals from these wells as noted in the Issues and Recommendations section of this FYR.

Sediment, Surface Water, Leachate Seep

The environmental protection RAOs are identified in the ROD and included in Section 2.3 of this FYR.

Sediment

No cleanup goals for sediment were included in the ROD. To evaluate the compliance with the ROD RAOs, a comparison of the most recent sediment analytical results (2013/2014) was performed against EPA Region III's 2006 Biological Technical Assistance Group (BTAG) Freshwater Sediment Screening Benchmarks. None of the site COCs exceeded the benchmark criteria; however, the quantitation limits for non-detect 2,4-dimethylphenol and bis(2-ethylhexyl)phthalate results were higher than the BTAG benchmark criteria at each of the three sampling locations. Non-COC mercury was detected in SED-16 above the BTAG benchmarks, and the quantitation limits for several non-COC substances were higher than benchmark criteria. These substances include: 2-methylnaphthalene, benzoic acid, naphthalene, phenol, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, beta-BHC, gamma-BHC, chlordane, dieldrin, endosulfan sulfate, endrin, heptachlor epoxide, methoxychlor, antimony, selenium, and silver.

In September 2014, Arcadis provided a hazard index (HI) analysis for the sediment data collected since the monitoring was initiated in 2003. The analysis indicated that the calculated hazard HI for the following substances exceeded the environmental protection RAO: manganese (HI=2.2), non-COC selenium (HI = 3.5), and bis(2-ethylhexyl)phthalate (HI = 3.0). The Arcadis analysis suggested that the RAOs for sediment have been met and that no potential ecological risks to benthic invertebrates associated with unnamed brook sediment exist. EPA concurs with this conclusion. Arcadis further recommended the cessation of sediment monitoring.

Surface Water

No cleanup goals for surface water were included in the ROD. None of the site COCs were detected in 2017 surface water samples at concentrations that exceeded National Recommended Water

Quality Criteria (NRWQCs) for Aquatic Life. However, manganese exceeded its NRWQCs for Human Health (no aquatic life criteria was available). The results of non-COC substances aluminum and iron exceeded the NRWQC for Aquatic Life in both the upstream and downstream samples.

Table 4-4 summarizes the 2017 exceedances of surface water benchmark criteria.

**Table 4-4
Summary of 2017 Surface Water Sample Results
Exceeding Screening Benchmarks**

Chemical	SW-3 (Upstream)	SW-16 (Adjacent to Site)	SW-9 (Downstream)	NRWQC – AL	NRWQC - HH
Aluminum	440	<60	260	87	N/A
Iron	1,100	870 J	4,000	1,000	N/A
Manganese	16 J	150 J	130 J	N/A	50

Notes:

All results presented in µg/L

Results presented are the maximum values for each sample location for which samples were collected in December 2017.

J – Concentration presented is an estimate

NRWQC - AL – National Recommended Water Quality Criteria-Aquatic Life Chronic scenario as of 2018.

NRWQC - HH – National Recommended Water Quality Criteria Human Health Water & Organism as of 2018.

Shaded values exceed Screening Benchmark.

N/A – Criteria not available.

As with previous surface water sampling performed at the Site, the laboratory reporting limits for several pesticides failed to achieve the NRWQCs for the aquatic life chronic scenario.

Leachate Seep

Seep samples S1, S3, and S6, are scheduled to be collected annually each spring, unless the seeps are dry. Between 2013 and 2017, S1 was dry and no samples were collected. Samples were not collected from S3 in 2015 and 2016 (samples were collected from S6 during these years), and no seep samples were collected in 2017 as they were reportedly frozen.

Sporadic detections of several volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, and metals were reported in seep samples between 2013 and 2017. In general, these detections were low and below the groundwater cleanup goals established

for the Site; however, several detections exceeded groundwater cleanup goals. These are summarized in Table 4-5 below.

Table 4-5
Summary of 2017 Seep Sample Results Exceeding ROD Cleanup Goals

		Acetone	As	Benzene	BEHP	Cr	Pb	Mn
		Cleanup Goals (µg/L)						
Date	Sample	10	5	0.5	2	50	3	50
4/13	S3	17	<10	1.3	<5.2	<4	2 J	2,400
	S6	NS	NS	NS	NS	NS	NS	NS
4/14	S3	<10	9.7	<1	<5	130	260	1,800
	S6	3.8 J	14	<1	<5	330	240	7,300
4/15	S3	NS	NS	NS	NS	NS	NS	NS
	S6	<10	94	<1	14 J	530	760	54,000
4/16	S3	NS	NS	NS	NS	NS	NS	NS
	S6	<3	3.4	<0.41	<2.8	47	110	38,000

Notes:

All results presented in µg/L

Results presented are the maximum values for each sample location for which samples were collected in December 2017.

J – Concentration presented is an estimate

NRWQC - AL – National Recommended Water Quality Criteria-Aquatic Life Chronic scenario as of 2018.

NRWQC - HH – National Recommended Water Quality Criteria Human Health Water & Organism as of 2018.

Shaded values exceed Screening Benchmark.

N/A – Criteria not available.

Shading/bold indicate seep sample constituent concentrations that exceed ROD groundwater cleanup criteria.

Major inorganic components of typical municipal solid waste landfills include, iron, manganese, and zinc. Seep sample concentrations of iron and manganese dominate the remaining inorganic constituents. Results of monitoring performed between 2013 and 2017 suggest that the iron concentrations in seep samples are relatively consistent over time, but manganese concentrations increased by an order of magnitude in 2015.

The anticipated outcome of the seep monitoring after landfill capping was that the seeps would dry out. This has occurred for many of the seeps; however, seeps occasionally occur at S3 and S6.

Site Inspection

On May 2, 2018 personnel from EPA, Nobis Engineering, Arcadis, and RRDD performed a Site Inspection for this FYR (Appendix E). The following summarizes the observations and findings made during the Site Inspection (Figure 8):

- The landfill cap appeared to be in good condition with no differential settlement, holes, cracks, erosion, or other evidence of failure. The RRDD administrator indicated that vegetation was removed when required, and landfill mowing was performed on a regular basis;
- Small animal burrows were seen in the north central portion of the landfill; however, these burrows did not penetrate the vegetated drainage layer;
- An area of minor settlement was noted along one of the benches located on the western portion of the landfill. The area was very wet, appeared to collect vegetation (e.g., cut grass, leaves, etc.), and had evidence of minor rutting likely caused by mowing equipment;
- The area of damaged fence noted in the 2013 FYR along the northeastern landfill perimeter had been repaired.
- The sedimentation basin was observed for possible leakage; however, the sedimentation basin contained standing water, and thus no breach in the basin was noted.
- An apparent iron-stained seep was observed in the Unnamed Brook located along the western portion of the Site upstream of the stone archway.
- Monitoring wells included in the long-term monitoring program were locked and in generally good condition;
- No evidence of trespassing was noted on the landfill cap, RRDD implemented increased security measures following the last FYR; and

- No unauthorized development has been undertaken at the Site since the third FYR. However, a 4,800-panel solar array went on line in March 2017. It is positioned off and to the southeast of the landfill cover system. It is located within ELUR “Subject Area A”, which prevents residential use and drinking water usage. Therefore, this land development complies with the ELUR.

V TECHNICAL ASSESSMENT

This section provides a technical assessment of the remedy implemented at the Site, as outlined in the *Comprehensive Five-Year Review Guidance*. The remedy was evaluated based on its function in accordance with decision documents, its adherence to valid risk data and scenarios, its adherence to Applicable or Relevant and Appropriate Requirements (ARARs), and any other information that could have affected the remedy’s protectiveness.

QUESTION A: Is the Remedy Functioning as Intended by the Decision Documents?

Question A Summary:

Yes, the remedy is functioning as intended; however, not as rapidly as was contemplated in the ROD. A review of relevant documentation, ARARs, risk assumptions, and the result of the Site Inspection suggest that the remedy is functioning as intended. Landfill operations and maintenance were initiated shortly after completion of the NTCRA, and have since been continued. Long-term groundwater monitoring was initiated in 2003 and continued on an annual or semi-annual basis since that time. Between 2003 and 2004, ELURs were placed on several parcels on and near the landfill property. The ELURs remain in-effect.

Remedial Action Performance

The selected remedy for the Site relies on MNA and long-term monitoring. Since initiation of the monitoring program, groundwater contaminant concentrations have generally decreased, and the plume limits have retracted; however, groundwater contaminant concentrations exceeding cleanup goals extend beyond the limit of the landfill (i.e., the ROD-specified compliance boundary). The ROD-anticipated cleanup time was approximately 16 years after the ROD, or approximately 2017. The effectiveness of natural attenuation processes at the Site was evaluated using the techniques published by EPA in Wilson (2011). The 2011 guidance details the use of statistical methods for projecting whether long-term remedial goals (i.e., RAOs) will be met and

when. The results of the recent December 2016 Arcadis analysis (Appendix G) indicate that for some COCs (primarily inorganic and frequently naturally-occurring metals), groundwater cleanup goals will be attained in >100 years.

In October 2017, Arcadis (on behalf of the RRDD) petitioned EPA to consider modifying the compliance boundary for the Site from the limit of the landfill to a point down gradient of the landfill toe as presented on Figures 9 and 10, and adjusting the monitoring program. The technical memorandum is included in Appendix G. EPA is reviewing this request. Further discussion regarding the compliance boundary and modified monitoring program is included in Section VII.

The remedy has achieved some RAOs; however, additional reductions in groundwater COC concentrations are needed before groundwater RAOs are achieved. The estimated time to reach cleanup goals originally anticipated in the ROD (i.e., 16 years) was not achieved for several COCs in several monitoring locations. Although the remedy is functioning and the environmental conditions continue to favor the continued natural attenuation of COCs, it is estimated to be >100 years until all groundwater COCs attain cleanup goals. The inorganic constituents, arsenic and manganese, will likely continue to remain above cleanup goals until the organic contaminant mass has been exhausted, and the groundwater geochemistry promotes precipitation of these two substances. Refer to the MNA analyses included in Appendix G.

System Operations/O&M

Operation and maintenance costs relating to the remedy for calendar year 2016 consisted of \$30,760, and for calendar year 2017 those costs consisted of \$46,542. These costs are comprised of lawn cutting, periodic fence repair work, in kind services, RRDD administrative office expenses, as well as fees for lawn cutting, staff weeding, edge mowing, on-site inspections, and storm water testing.

Implementation of Institutional Controls and Other Measures

The ELURs attached to the property deeds of four parcels are summarized in Section 2.4 of this report. No unauthorized uses of any of these properties were observed during the Site visit or documented during interviews of local and state officials with knowledge of the Site.

Based upon the December 2017 groundwater sample analytical results, the limit of COC-contaminated groundwater in the overburden and bedrock aquifers is within the boundaries of the ELURs and is therefore considered in compliance with the remedy.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial RAOs used at the time of the remedy selection still valid?

Question B Summary:

No. There have been changes in exposure assumptions (pathways) and toxicity values used at the time of the remedy selection; however, the RAOs and cleanup levels selected for the Site remain valid. In some cases, specific pathways were not considered in the original human health risk assessment. However, the changes described in this section are unlikely to impact the current protectiveness of the remedy as discussed below.

Toxicity values, exposure pathways, and methods of evaluating risk have changed since the time of the remedy selection. Potential inhalation of VOCs during household water use, ingestion of and dermal contact with surface water and sediment, and inhalation of dust have not been evaluated previously. Vapor intrusion was not evaluated at the time of the RI, but the location of nearby occupied structures is upgradient or cross gradient and at some distance from the Site. The Second FYR evaluation of vapor intrusion for the on-Site office building reviewed data from wells near this building and concluded that the vapor intrusion pathway was not of concern. This conclusion was reached again during the Third FYR (2008) after a formal vapor intrusion evaluation. Although toxicity values and methods of evaluating risk have changed since the time of the remedy selection and the newly identified potential pathways of inhalation of VOCs during household water use, ingestion of and dermal contact with surface water and sediment, and inhalation of dust have not been evaluated previously. These changes do not impact the protectiveness of the remedy, as described below.

Under a NTCRA, contaminated soils (landfill waste) located at the Site were identified as the primary source of contaminants. The NTCRA responded to the limits of waste as demonstrated visually in test pits/borings. Soil clean-up values were not established as the waste materials were capped.

The groundwater clean-up levels presented in the ROD remain valid. The ROD established background concentrations as groundwater cleanup levels for the Site, per Connecticut

Remediation Standard Regulations (RSRs), Section 22a-133k-3(a) and compliance with federal MCLs, federal maximum contaminant level goals (MCLGs), Connecticut RSRs, and Connecticut Water Quality Standards as ARARs. Each of the background concentrations selected as groundwater cleanup levels in the ROD are less than or equal to the listed ARARs. Use of background concentrations below both risk-based goals and analytical reporting limits as regulatory limits is an extremely conservative approach and may not be achievable.

The RAOs used at the time of the remedy selection are still valid. The RAOs established in the ROD are to protect benthic invertebrates and mammals ingesting contaminated prey from direct contact with, or ingestion of, contaminated sediment, prevent releases of constituents from sediments that would result in contaminated surface water, prevent the ingestion of or dermal contact with contaminated groundwater, and restore groundwater beyond the compliance boundary (limits of the landfill).

The remedial actions at this site address these RAOs through the landfill cap and leachate collection system, which prevents contact with contaminated soil/waste and prevents migration of leachate; institutional controls (ELURs) that prevent contact with contaminated soil/waste and groundwater; and MNA, which is demonstrating progress in reducing the area of the plume.

Changes in Standards and to be Considered (TBCs)

As part of this FYR, ARARs for the Site presented in the 2001 ROD were reviewed, and a review of current ARARs and To Be Considered (TBCs) was conducted.

The 2001 ROD set forth the following chemical-specific ARARs for the selected remedy.

- Safe Drinking Water Act (SDWA);
 - federal maximum contaminant levels (MCLs)
 - non-zero maximum contaminant level goals (MCLGs)
- Connecticut Water Quality Standards;
- Connecticut RSRs; and
- Connecticut Standards for Quality and Adequacy of Public Drinking Water.

There have been no changes to the ARARs requirements identified in the 2001 ROD that affect the cleanup standards for the remedy. Although the MCLs were updated in 2017, Connecticut Water Quality Standards were updated in 2014, revised Connecticut RSRs were promulgated in 2013, and the Connecticut Standards for Quality and Adequacy of Public Drinking Water were revised in 2015; the changes therein do not affect cleanup action or levels at the Site. The ROD established background concentrations as groundwater cleanup levels for the Site, per Connecticut RSRs, Section 22a-133k-3(a). Each of the background concentrations selected as cleanup levels in the ROD were less than or equal to the identified ARARs.

Safe Drinking Water Act

The Safe Drinking Water Act is the legislation that enabled the establishment of MCLs, which are the relevant and appropriate regulations for groundwater located outside of the point of compliance. No new or modified MCLs have been established for the COCs or other Site indicator compounds since the last FYR, so the protectiveness of the remedy is not affected.

Federal Maximum Contaminant Levels (MCLs)

The ROD identified federal MCLs as RAOs. The MCL for arsenic has changed since the signing of the ROD from 50 µg/L to 10 µg/L, effective in January 2006. There have been no further changes to the MCLs for COCs since the 2001 ROD.

Connecticut Water Quality Standards

In 2013 the Commissioner of the CTDEEP completed the rulemaking process in accordance with state law and codified Connecticut's established Water Quality Standards into regulations. The new regulations are the Connecticut Water Quality Standards Regulations Sections 22a-426-1 to 22a-426-9. These regulations are applicable because the groundwater classification of the Site is GA, and the state's goal is to restore the groundwater to a quality consistent with its use for drinking water without treatment. There have been no changes to the chemical specific Water Quality Standards since the 2013 FYR.

Connecticut RSRs

These regulations are applicable because any substance that is part of a release at a site must be remediated. The regulations require clean-up of groundwater within the GA-classified area to background or the Groundwater Protection Criteria. These regulations also establish the Volatilization Criteria for Groundwater, although this criterion was not specifically mentioned in the ROD. There have been no changes to the chemical specific RSRs since the Third FYR.

Connecticut Standards for Quality and Adequacy of Public Drinking Water

These regulations are relevant and appropriate because, like the SDWA, the regulations have established standards for water quality in private water supply systems and standards for quality of public drinking water. The Connecticut Standards for Quality and Adequacy of Public Drinking Water were revised in 2015; however, no changes to water quality criteria impact the remedy.

Federal Ambient Water Quality Criteria (AWQC)

AWQC protect aquatic life and human health. AWQCs are now referred to as the National Recommended Water Quality Criteria (NRWQCs). The NRWQCs were not listed previously as ARARs NRWQCs that are applicable to the Site as TBCs include fresh water Criteria Maximum Concentrations (CMCs) and fresh water Criteria Continuous Concentrations (CCCs). EPA updated the NRWQCs in 2017. The NRWQCs are used to evaluate whether sediment is impacting surface water in the Unnamed Brook. No changes to NRWQCs have impacted the protectiveness of the remedy.

Changes in Toxicity and Other Contaminant Characteristics

EPA toxicity values including reference doses (RfDs) and cancer slope factors (CSFs) are routinely re-evaluated and updated. Reference concentrations (RfCs) and inhalation unit risk factors (URFs) are also available for evaluation of risks via the inhalation pathway. Currently, the primary source of toxicity values is the EPA Integrated Risk Information System (IRIS) database. These toxicity values are used in the calculations of risk in the Human Health Risk Assessment (HHRA) and the development of site-specific and more generic risk-based screening values or clean-up goals. Changes have occurred to toxicity values used for the HHRA (e.g., TCE, methylene chloride, etc.). These changes would not alter the protectiveness of the remedy under

current site-use conditions because the remedy relies on a landfill cap and leachate collection system, which prevents contact with contaminated soil, prevents migration of contamination, ELURs that prevent contact with contaminated soil and groundwater; and MNA. There is no current exposure to the Site impacted groundwater. These changes do not impact the short-term protectiveness of the remedy. Because the remedy relies on background, MCLs, MCLGs, and Connecticut RSRs as cleanup goals and continuing prevention of exposures through ELURs, these changes do not impact the long-term protectiveness of the remedy.

Since the time of the 1995 HHRA in the RI, new toxicological studies and information have become available for many chemicals. EPA has updated toxicity information for several contaminants evaluated for the Site (changes to toxicity values for hexavalent chromium, methylene chloride, TCE, vinyl chloride, and others were noted in the Third FYR. More recent changes to toxicity values for COCs and detected analytes are noted below. At the time of the 1995 HHRA, oral CSFs and RfDs were used to evaluate ingestion and dermal exposures. EPA continues to use CSFs and RfDs for evaluating ingestion and dermal exposures. However, the oral values for several of the contaminants evaluated for the Site have been updated since 1995 and EPA has issued the *Risk Assessment Guidance for Superfund (RAGS): Volume I Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*, which provided guidance on developing dermal toxicity factors. In addition, there has been a decrease in the blood lead level associated with adverse health effects of lead.

Since 1995, EPA has issued guidance recommending use of inhalation unit risk factors and reference concentrations as inhalation toxicity factors for evaluating inhalation exposures, rather than inhalation cancer slope factors and inhalation reference doses. However, no inhalation pathways were evaluated in the HHRA. The Second and Third FYRs indicated that vapor intrusion was not a concern. Further review of 2013 through 2017 monitoring well data in comparison to 2018 Vapor Intrusion Screening Levels (VISLs), which incorporate current toxicity values, concludes that vapor intrusion is not currently a concern.

Background concentrations were used as the basis for establishing clean-up goals for protection of exposures through ingestion of groundwater as drinking water, rather than using the risk evaluation to develop site-specific goals. Therefore, changes in toxicity or other contaminant concentrations would not impact the protectiveness of the remedy for these potential exposures since a site-specific risk evaluation was not used to develop the concentration threshold.

Tables H-1 and H-2 in Appendix H provide lists of current oral toxicity values for COCs from the HHRA and any contaminants detected during the most recent groundwater, drinking water, surface water, and sediment monitoring versus those in effect at the time of the 2013 FYR. Those chemicals with changes in toxicity values are highlighted. Of note are changes to 1,2-dichloropropane (RfD has decreased and cancer slope factor has increased, indicating it is more toxic as both a non-carcinogen and as a carcinogen than previously thought).

Although 1,4-dioxane was not evaluated in the 1995 HHRA, it is included in the tables and in discussions below because of its status as an emerging contaminant at sites with chlorinated VOCs. In addition, although per- and poly-fluoroalkyl substances (PFAS) were not evaluated in the 1995 HHRA, these are included in the discussions below because of their status as emerging contaminants at landfill sites.

Although re-calculation of risks using current toxicity factors may differ from those previously estimated, the remedy, by preventing exposures, remains protective for the pathways evaluated in the HHRA.

- **2010 cis-1,2-DCE** - non-cancer toxicity values: In January 2010, EPA revised the non-cancer toxicity value for cis-1,2-dichloroethene (DCE) and determined that there are currently no available cancer values and no inhalation values. It is now not possible to quantify cancer risk and inhalation risk from exposure to cis-1,2-DCE. The new non-cancer toxicity value indicates that cis-1,2-DCE is more toxic from non-cancer health effects. These toxicity changes would result in increased non-cancer hazard from exposure to cis-1,2-DCE. cis-1,2-DCE was not identified as a COC in the ROD and was not discussed during the 2013 Five-Year Review; however, it has been detected during recent long-term monitoring.
- **2012 PCE** - cancer and non-cancer toxicity values: On February 10, 2012, EPA finalized the cancer and non-cancer toxicity values for tetrachloroethene (PCE). These new values indicate that PCE is now more toxic from cancer health effects but less toxic from non-cancer hazard effects. Although cancer risks and non-cancer hazards from these contaminants may change due to the changes in toxicity values. These toxicity changes would result in an increased cancer risk and a decreased non-cancer hazard from exposure to PCE. PCE was not identified as a COC in the ROD and was not discussed

during the 2013 FYR; however, it has been detected (at concentrations of less than 1 µg/L) during recent long-term monitoring.

- **2017 Ammonia** - non-cancer toxicity value: In June 2017, EPA revised the non-cancer inhalation reference concentration (RfC) for ammonia based on an updated IRIS value. The revised value indicates that ammonia is less toxic from non-cancer health effects. This change would result in decreased non-cancer risk from inhalation exposure to ammonia. Ammonia was not identified as a COC in the ROD; however, it has been detected in groundwater during recent long-term monitoring. The maximum groundwater concentration reported is 220 milligrams per liter (mg/L), which is well below the target groundwater VISL concentration.
- **2017 1,3,5- Trimethylbenzene** - non-cancer toxicity value: In June 2017, EPA finalized an inhalation RfC for 1,3,5-trimethylbenzene based on a new IRIS value. Previously, there was no RfC value for 1,3,5-trimethylbenzene. Trimethylbenzenes were not identified as COCs in the ROD; however, 1,3,5-trimethylbenzene has been detected in groundwater during recent long-term monitoring. The maximum groundwater concentration reported is 2.4 µg/L, well below EPA Regional Screening Level for tap water.
- **2017 1,2,3- Trimethylbenzene** - non-cancer toxicity values: In June 2017, EPA finalized a non-cancer RfD for 1,2,3-trimethylbenzene. Previously, there was no RfD for 1,2,3-trimethylbenzene. Additionally, EPA revised the inhalation RfC for 1,2,3-trimethylbenzene based on a new IRIS value. This new IRIS value replaces a provisional peer-reviewed toxicity value (PPRTV) that was used previously, and indicates that 1,2,3-trimethylbenzene is less toxic from non-cancer health effects. Trimethylbenzenes were not identified as COCs in the ROD. 1,2,3-trimethylbenzene has not been included in the groundwater monitoring analytical list; however, given the low concentrations exhibited by similar compounds detected in groundwater samples, it is unlikely that this represents a concern.
- **2017 1,2,4-Trimethylbenzene** - non-cancer toxicity value: In June 2017, EPA finalized a new inhalation RfC for 1,2,4-trimethylbenzene. The new IRIS value replaces a PPRTV that was used previously and indicates that 1,2,4-trimethylbenzene is less toxic from non-cancer health effects. This change would result in decreased non-cancer risk from inhalation exposure to 1,2,4-trimethylbenzene. Trimethylbenzenes were not identified as

COCs in the ROD; however, 1,2,4-trimethylbenzene has been detected in groundwater during recent long-term monitoring. The maximum groundwater concentration reported is 7.5 µg/L, well below EPA Regional Screening Level for tap water.

- **2016 PFOA/PFOS** - non-cancer toxicity values: In May 2016, EPA issued final lifetime drinking water health advisories for Perfluorooctanoic Acid (PFOA) and Perfluorooctanesulfonic Acid (PFOS), which identified a chronic oral RfD of 2E-05 mg/kg-day for PFOA and PFOS. These RfD values should be used when evaluating potential risks from ingestion of contaminated groundwater at Superfund sites where PFOA and PFOS might be present based on-site history. Potential estimated health risks from PFOA and PFOS, if identified, would likely increase total site risks due to groundwater exposure. Further evaluation of potential risks from exposure to PFOA and PFOS in other media at the Site might be needed based on site conditions and can also affect total site risks.

Analysis and evaluation of risks from PFAS compounds in groundwater are recommended to determine if this emerging contaminant class is an issue at this site.

- **2014 PFBS** - non-cancer toxicity value: Perfluorobutanesulfonate (PFBS) has a chronic oral RfD of 2E-02 mg/kg-day based on an EPA PPRTV. This RfD value should be used when evaluating potential risks from ingestion of contaminated groundwater at Superfund sites where site history suggests that PFBS might be present. Potential estimated health risks from PFBS, if identified, would likely increase total site risks due to groundwater exposure. Further evaluation of potential risks from exposure to PFBS in other media at the Site may be needed based on site conditions and can also affect total site risks. Analysis and evaluation of risks from PFBS in groundwater are recommended to determine if this emerging contaminant class is an issue at this site.

PFOA, PFOS, and PFBS belong to a group of compounds known as PFAS, which are used in a variety of industrial applications. PFAS sampling has not yet been done at the site. Given the site history, including disposal of industrial and chemical waste, PFAS will be included as analytes in an upcoming sampling round.

- **2010 1,4-dioxane** - non-cancer toxicity value and 2013 cancer toxicity values: In 2010 and 2013, EPA finalized the toxicity assessment for 1,4-dioxane. The new values indicate

that 1,4-dioxane is more toxic from both cancer and non-cancer health effects. 1,4-dioxane was not identified as a COC in the ROD. 1,4-dioxane has not been analyzed for at Barkhamsted-New Hartford Landfill, but is a common contaminant found at sites with chlorinated VOC contaminants (such as this site), particularly where 1,1,1-trichloroethane is present. 1,1,1-trichloroethane has not been reported in recent long-term monitoring of groundwater, drinking water, surface water, and sediment at the Site. Analysis and evaluation of risks from 1,4-dioxane in groundwater are recommended to determine if this emerging contaminant is a concern at this site.

- **2016 Lead in Soil Cleanups** - EPA's 2016 Office of Land and Emergency Management (OLEM) memorandum "Updated Scientific Considerations for Lead in Soil Cleanups" (OLEM Directive 9200.2-167) indicates that adverse health effects are associated with blood lead levels (BLLs) at less than 10 µg/dL. The memo mentioned that several studies have observed "clear evidence of cognitive function decrements in young children with mean or group BLLs between 2 and 8 µg/dL." Any soil screening, action or cleanup level developed based on previous BLL of 10 µg/dL may not be protective.

EPA's approach to evaluate potential lead risks is to limit exposure to residential and commercial soil lead levels such that a typical (or hypothetical) child or group of similarly exposed children would have an estimated risk of no more than 5% of the population exceeding a 5 microgram per decaliter (µg/dL) BLL. This is based on updated scientific information and agrees with the Lead Technical Review Workgroup's current support for using a BLL of 5 µg/dL as the level of concern in the Integrated Exposure Uptake Biokinetic Model (IEUBK) and Adult Lead Methodology (ALM). A target BLL of 5 µg/dL reflects current scientific literature on lead toxicology and epidemiology that provides evidence that the adverse health effects of lead exposure do not have a threshold.

EPA's 2017 OLEM memorandum "Transmittal of Update to the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters" (OLEM Directive 9285.6-56) provides updates on the default baseline blood lead concentration and default geometric standard deviation input parameters for the Adult Lead Methodology. These updates are based on the analysis of the NHANES 2009-2014 data, with recommended updated values for baseline blood lead concentration being 0.6 µg/dL and geometric standard deviation being 1.8.

Using updated default IEUBK and ALM parameters at a target BLL of 5 µg/dL, site-specific lead soil screening levels of 200 parts per million (ppm) and 1,000 ppm are developed for residential and commercial/industrial exposures, respectively. Lead was detected in soil at the Site at concentrations exceeding 200 ppm. It appears most or possibly all the samples exceeding 200 ppm are from locations now covered by the cap. Lead has not been detected at the Site at concentrations exceeding 1,000 ppm. Because there is an ELUR on the Site preventing future residential use, the remedy remains effective even considering EPA's changes described above.

- **2017 Polycyclic Aromatic Hydrocarbons (PAHs)** - cancer and non-cancer toxicity values: On January 19, 2017, EPA issued revised (less toxic) cancer toxicity values and new non-cancer toxicity values for benzo(a)pyrene. Benzo(a)pyrene did not have non-cancer toxicity values prior to January 19, 2017. Benzo(a)pyrene is now considered to be carcinogenic by a mutagenic mode of action; therefore, cancer risks must be evaluated for different human developmental stages using age dependent potency adjustment factors (ADAFs) for different age groups. The cancer potency of other carcinogenic PAHs is adjusted using relative potency factors (RPFs), which are expressed relative to the potency of benzo(a)pyrene. The non-cancer effects of benzo(a)pyrene were not evaluated in the past due to the absence of non-cancer values. PAHs, including benzo(a)pyrene, have not been identified as contaminants of concern for this Site.

Because the remedy relies on the cap and leachate collection system and ELURs to prevent exposures of contaminants by direct contact with soils, these changes to the toxicities for soil contaminants do not impact the short-term or long-term protectiveness of the remedy regarding potential soil exposures.

Changes to the toxicities for known groundwater contaminants (including the COCs) do not impact the short-term protectiveness of the remedy because it relies on the cap and leachate collection system and ELURs to prevent exposures to groundwater as drinking water within the ELURs. The potential presence/concentrations in groundwater of the emerging contaminants PFAS and 1,4 dioxane in groundwater beyond the limits of the ELURs should be further evaluated.

Because the remedy relies on background, MCLs, MCLGs, and Connecticut RSRs as RAOs for groundwater COCs, these changes do not impact the long-term protectiveness of the remedy for the known COCs.

Changes in Risk Assessment Methods

Since the 2013 FYR the following changes have occurred in recommended risk assessment methods:

- *2014 OSWER Directive Determining Groundwater Exposure Point Concentrations, Supplemental Guidance*

In 2014, EPA finalized a Directive to determine groundwater exposure point concentrations (EPCs) <http://www.epa.gov/oswer/riskassessment/pdf/superfund-hh-exposure/OSWER-Directive-9283-1-42-GWEPC-2014.pdf>. This Directive provides recommendations to develop groundwater EPCs. The recommendations to calculate the 95 percent (%) upper control limit (UCL) of the arithmetic mean concentration for each contaminant from wells within the core/center of the plume, using the statistical software ProUCL could result in lower groundwater EPCs than the maximum concentrations routinely used for EPCs as past practice in risk assessment, leading to changes in groundwater risk screening and evaluation. In general, this approach could result in slightly lower risk or lower screening levels. Because no one is currently using the groundwater as potable water and the long-term remedy relies on background, MCLs, MCLGs, and Connecticut RSRs as cleanup goals, this change does not impact the remedy.

- *2014 OSWER Directive on the Update of Standard Default Exposure Factors*

In 2014, EPA finalized a Directive to update standard default exposure factors and frequently asked questions associated with these updates. <https://www.epa.gov/risk/oswer-directive-92001-120>. Many of these exposure factors differ from those used in the risk assessment supporting the ROD. These changes in general would result in a slight decrease of the risk estimates for most chemicals.

Since the changes in exposure assumptions would lower risk, no revision to the human health risk assessment for soil and groundwater is necessary at this time. The groundwater is not currently used as drinking water and an IC has been placed on the

property to prevent future use of the contaminated groundwater. Because the remedy relies on a cap and leachate collection system to prevent exposures of contaminants by direct contact with soils and ELURs and background, MCLs, MCLGs, and Connecticut RSRs as cleanup goals for groundwater, the changes to exposure assumptions do not impact the remedy for these media.

- *2012 OSWER Directive on Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil*

Based on a compilation and review of data on relative bioavailability of arsenic in soil in 2012, arsenic was found to be less bioavailable via soil ingestion relative to other analytes. A default value of relative bioavailability (RBA) of 60% is now applied during soil/sediment ingestion calculations of risk/cleanup levels. This default RBA value reduces arsenic contribution to soil risk. Under a NTCRA, contaminated soils (landfill waste) located at the Site were identified as the primary source of contaminants. The NTCRA responded to the limits of waste as demonstrated visually in test pits/borings and the limits of the waste were capped. No soil clean-up values were set. Therefore, although risk from arsenic in soil may have been overestimated, this change does not impact the protectiveness of the remedy.

- *2015 OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*

EPA VISLs provide groundwater and soil gas screening levels to assist in determining whether the vapor intrusion pathway has the potential to pose unacceptable risk and whether site-specific evaluations/actions should be considered. The VISLs were not listed previously as ARARs or TBCs. EPA introduced the VISLs in 2012 as a tool to evaluate the vapor intrusion pathway. The VISLs are updated periodically, most recently in May 2018. The most up-to-date VISLs are available at <https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator>.

The groundwater cleanup levels (background, MCLs, MCLGs, and Connecticut Groundwater Protection Criteria) are not designed to be protective of the vapor intrusion pathway. Because the VISLs (both residential and commercial VISLs, based on cancer risk of 1E-6 and hazard quotient (HQ) of 1) for some of the detected volatile contaminants at the Site are less than the background, MCLs, MCLGs, and Connecticut Groundwater Protection Criteria for some contaminants, the cleanup goals may not be sufficiently

protective should occupied buildings be built over contaminated groundwater beyond the limits of the ELUR preventing all future construction or if the edge of the plume migrated beneath occupied buildings. Any planned redevelopment activities over the groundwater plume should consider the potential for vapor intrusion in the redevelopment plans to ensure protectiveness.

Because ELURs are in place to prevent future building construction over the cap area, the vapor intrusion pathway is incomplete for this area and will remain so. Therefore, changes to the VISLs do not impact the short-term or long-term protectiveness of the remedy for the capped area. ELURs prevent future residential use of the Site beyond the landfill cap; however, an office building is located on Site and no restrictions prevent future construction of commercial buildings on-site beyond the landfill cap. The Town Garage is located down-gradient of the Site. No restrictions prevent future construction of residential buildings in this area. All detected contaminants from the 2016 and 2017 sampling rounds were reported below the commercial worker VISLs. Changes to VISLs may impact the long-term protectiveness of areas beyond the cap and downgradient of the Site. Monitoring results for these areas should continue to be compared to commercial VISLs to assure long-term protectiveness.

The most recent update of the VISLs was in May 2018.

- *EPA Regional Screening Levels (RSLs)*

EPA regional screening levels (RSLs) provide soil, groundwater, and indoor air screening levels protective of human health exposures based on the latest toxicity values and accepted default exposure assumptions for direct contact exposures. The RSLs were not listed previously as ARARs or TBCs; but, should be included as TBCs. RSLs are used to identify contaminants of potential concern (COPCs) to be evaluated quantitatively in the HHRA. The RSLs are updated twice each year, most recently in May 2018. The most up-to-date tables are available at http://www.epa.gov/reg3hwm/risk/human/rb-concentration_table/. Because the remedy relies on capping and ELURs to prevent exposures of contaminants by direct contact with soils and there is no current exposure to the Site impacted groundwater, these changes do not impact the short-term protectiveness of the remedy. Because the remedy relies on ELURs and background,

MCLs, MCLGs, and Connecticut RSRs as cleanup goals, these changes do not impact the long-term protectiveness of the remedy.

Although using current risk assessment methods may result in higher estimated risks from exposures to contaminants at the Site than risks previously estimated in the 1995 HHRA, the remedy remains protective for the pathways evaluated in the HHRA by preventing exposures.

Changes in Exposure Pathways

The human health exposure pathways considered in the 1995 HHRA performed during the RI included: (1) ingestion and dermal contact with soil and (2) ingestion and dermal contact with groundwater as drinking water.

Soils

The HHRA identified cancer risks and non-cancer health hazards at levels exceeding EPA and state risk management criteria based on future on-site residential exposures to soil. Under a NTCRA, contaminated soils (landfill waste) located at the Site were identified as the primary source of contaminants. The NTCRA responded to the limits of waste as demonstrated visually in test pits/borings and the limits of the waste were capped. With the completion of the NTCRA cap and leachate collection system, all human health risks from soil were addressed. Potential inhalation of dust was not evaluated previously in the RI. The presence of the properly maintained cap precludes this exposure pathway.

Groundwater

The HHRA identified cancer risks and non-cancer health hazards at levels exceeding EPA and state risk management criteria based on residential exposures to groundwater as drinking water on-site. Potential inhalation of volatiles during household water use was not evaluated previously in the RI. No one on-site is currently exposed to contaminated groundwater. Nearby commercial and residential areas that use off-Site wells for potable water are being monitored. Results from these findings are provided under Section IV FIVE YEAR REVIEW PROCESS, Subjection Drinking Water. These off-Site potable wells are not within the zone of Site-related groundwater

plumes. See Figures 4 through 7. Groundwater at the Site is estimated to flow to the northeast. Downgradient of the Site, groundwater flow is more easterly toward the Farmington River.

Institutional Controls

Because of the affected groundwater at the Site, an ELUR was placed on the Site to document the groundwater contamination, which was recorded at the Barkhamsted Land Record on February 24, 2004. In addition, the ELUR noted that groundwater is not to be used for drinking or other purposes, that there is to be no building on or disturbance of the cap, that the cap shall be maintained to provide sufficient protection, and there shall be no residential use throughout the property.

Additional ELURs were recorded on the property deeds of several downgradient parcels (see Section 2.4) to prevent the use of groundwater for drinking or other purposes. Based upon the most-recent dataset (2017), the limit of VOC-contaminated groundwater in the shallow aquifer was within the boundaries of the ELURs, and is considered in compliance with the remedy.

Surface Water and Sediment

The HHRA did not evaluate ingestion of and dermal contact with surface water and sediment. However, there was no evidence of human activity along the Unnamed Brook or at the Unnamed Pond. Trespasser presence is unlikely because the area is not easily accessible as it is remote with the only access through the landfill.

Vapor Intrusion

The vapor intrusion pathway was not evaluated in the HHRA. Groundwater clean-up goals for the Site (background, MCLs, MCLGs, and Connecticut RSRs) are based on drinking water exposures. Drinking water standards used as clean-up levels are not designed to be protective of the vapor intrusion pathway. No occupied buildings currently exist on the landfill itself. Institutional controls are in place preventing construction of new buildings on the landfill cap area and future residential use of the landfill area as well as the surrounding RRDD-owned property. The only enclosed structures located on-Site, or downgradient of the landfill, are the on-Site office building of the recycling area and the Town Garage office. The nearest homes are located cross-gradient from the Site. The Second FYR evaluation of vapor intrusion for the on-Site office building

reviewed data from wells near this building and concluded that the vapor intrusion pathway was not of concern. This conclusion was reached again during the Third FYR.

VISLs for the primary volatile COCs have not changed since the Third FYR. However, a re-evaluation comparing current VISLs obtained from the *Vapor Intrusion Screening Level Calculator* and current overburden groundwater data collected from wells located outside the landfill cap area was performed for this FYR. Comparison of 2013 through 2017 overburden monitoring well data outside the areas of the ELURs restricting future residential use (MW-111S, MW-104S, MW-103S, and MW-120S) and along the boundary of the ELURs restricting future residential use (MW-5S and MW-102S) to VISLs for residential exposures indicates that current vapor intrusion is not a concern beyond the areas of the ELURs. The 2013 through 2017 overburden monitoring well data near the on-Site office building from areas within the ELURs restricting future residential use, but outside the ELUR restricting all future construction, were compared to VISLs for commercial exposures. All detected contaminants from the 2016 and 2017 sampling rounds were reported below the commercial worker VISLs. In the two rounds prior (2013/2014), benzene and ethylbenzene were detected at MW-101S exceeding the VISL. Based on the most recent sampling rounds, current vapor intrusion is not a concern for these areas. These comparisons indicate that the remedy is protective for the short-term regarding the vapor intrusion pathway for these areas.

Continued monitoring of shallow monitoring wells near the on-Site office building from areas within the ELURs restricting future residential use, but outside the ELUR restricting all future construction, with comparison to commercial VISLs is recommended. Monitoring of shallow monitoring wells outside the areas and along the boundary of the ELURs restricting future residential use (where future residential use is not restricted) including the area of the Town Garage office to VISLs for residential exposures is also recommended.

None of the VOCs detected in groundwater samples collected between 2013 and 2017 exceeded the Connecticut RSR Residential Volatilization Criteria for Groundwater.

Changes in Land Use

Land use near the Site is still residential in nature. This land use is consistent with prior zoning and the assumptions of the ROD. No one is currently exposed to contaminated groundwater, soil,

sediment, or surface water. With the construction of the landfill cap, leachate collection system, security fence, establishment of institutional controls prohibiting groundwater use as drinking water on-site, and institutional controls prohibiting residential use, these exposure pathways are incomplete. The risk assessment did not include evaluation of residential exposures to groundwater via inhalation of volatiles during household water use (e.g. during showering or bathing). The HHRA did not include evaluation of exposures to soil contaminants through inhalation of dust or volatiles in outdoor air. These pathways are generally minimal relative to the pathways evaluated; however, their omission tends to result in an underestimate of risk. Although volatile contaminants were included in the groundwater COPCs in the HHRA, the HHRA did not evaluate a vapor intrusion pathway. However, this pathway is not a concern at this Site at this time. If land use changes, vapor intrusion may require further evaluation.

Although these potential exposure pathways were not included in the risk assessment used at the time of the remedy selection, all pathways of past, current, or future concern regarding the Site have been eliminated by the remedy. The landfill cap, leachate collection system, security fence, and institutional controls all address both the exposure scenarios identified in the HHRA and the additional pathways identified above, apart from potential future vapor intrusion exposures, beyond the capped area. The evaluation within this FYR indicates the vapor intrusion pathway is not a concern at this time. Therefore, there is no basis to develop or consider additional exposure pathways or risk evaluations.

Ecological Receptors

The Baseline Ecological Risk Assessment in the RI evaluated risks posed to wildlife and aquatic organisms from exposures to sediment and surface water in the Unnamed Brook and Unnamed Pond as well as soil in seeps. Receptors included fish, benthic invertebrates, amphibians, mammals, birds, and soil invertebrates. After completion of the Baseline Ecological Risk Assessment, in 1998 the landfill cap and leachate collection system were completed as a NTCRA. In 2000, EPA updated the ecological risk assessment using post-NTCRA sampling data. The assessment concluded that ecological risks had been reduced and that the only possible remaining ecological risk was to benthic invertebrates from potential exposures to sediment. During the 2018 Site visit, there was some evidence of iron-stained seeps beyond the limits of the landfill cap, suggesting that the leachate collection system is not 100% effective in preventing contaminant migration.

In 2014, RRDD-contractor Arcadis completed an Ecological Screen using sediment sampling data collected from the Unnamed Brook between 2003 and 2014. The Screen included a comparison to ecological benchmarks and calculation of hazard quotients. Benchmarks were exceeded for manganese (HQ = 2.2), selenium (HQ = 3.5), and bis(2-Ethylhexyl)phthalate (HQ = 3.0). While historical results (i.e., 2003-2012) for manganese, selenium, and bis(2-Ethylhexyl)phthalate exceeded benchmarks, results from the most recently available round of data (i.e., October 2013) were either non-detect (however, some reporting limits exceeded screening benchmarks) or below screening benchmarks. All other analytes were detected in sediments at average concentrations below their respective benchmarks. Results from 11 years of sediment data indicate that the RAOs for sediment are being met and that there are no potential ecological risks to benthic invertebrates associated with sediment in the Unnamed Brook. Sediment sampling can likely be discontinued because RAOs have been met. Remedial actions have reduced concentrations of sediment COCs to levels below those which may cause adverse effects to benthic organisms. EPA concurs with Arcadis' conclusions that the sediment RAOs have been met.

No additional exposure pathways for human or environmental receptors have been identified.

New Contaminant Sources

No new contaminant sources have been identified since the remedy was established.

Expected Progress Towards Meeting RAOs

Monitoring of groundwater, drinking water, seeps, surface water, and sediment has intermittently continued during the period covered by this review (2013 - 2017). Results of monitoring indicate the following:

- Organic compound contamination in groundwater has been reduced; however, groundwater concentrations of some COCs are not expected to achieve cleanup goals until approximately 2030;
- Inorganics, arsenic and manganese, continue to exceed cleanup levels, and are expected to remain above the acceptance criteria for at least 100 years;

- Drinking water samples revealed one disparate MCL exceedance of lead in a duplicate sample. One of the recommendations identified for this FYR is to collect quarterly samples from the drinking water monitoring locations (for one year) for metals analysis. All four wells are located outside the boundaries of the Site's ELURs where drinking water use is allowed.
- Surface water samples have contained metals (including manganese) at concentrations exceeding screening benchmarks and appears consistent with prior monitoring;
- Seep samples contain sporadic organic contaminant detections above ROD groundwater cleanup levels, but more consistent detections of metals including arsenic, chromium, lead, and manganese above cleanup levels; and
- None of the sediment sample results for COCs significantly exceeded screening benchmark criteria.

The remedial actions at this Site address these RAOs through the landfill cap and leachate collection system, which when combined with ELURs, prevent contact with contaminated soil and groundwater, prevent migration of contamination; and monitored natural attenuation, which is demonstrating progress in reducing the area of the plume.

As noted in Question A, although monitored natural attenuation is demonstrating reducing concentrations and receding extent of the plume, the time to reach the cleanup goals along the compliance boundary (limits of the landfill) is longer than expected at the time of the ROD. Based on the MNA analyses included in Appendix G, several compliance wells will require at least 10 additional years of MNA prior to achieving cleanup goals. The inorganic constituents, arsenic and manganese, will likely continue to remain above cleanup goals until the organic contaminant mass has been exhausted, and groundwater geochemistry becomes more oxidative.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI ISSUES/RECOMMENDATIONS

In conclusion, the physical conditions of the landfill remain essentially unchanged from those observed during the previous FYRs; however, off-landfill improvements (solar array construction) have been made. The RRDD does not currently have plans to modify the Site conditions.

This FYR has identified several issues presented in the following table. Recommendations for addressing the issues are also presented.

Table 6-1
Issues and Recommendations Identified in the Five-Year Review

OU(s): 1	Issue Category: Operations and Maintenance			
	Issue: Small animal burrows noted in the northern portion of the landfill cap, wet/soft area possibly resulting from settlement noted along benched area in the western portion of the cap			
	Recommendation: Make minor repairs to the landfill cap.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	9/27/2019
OU(s): 1	Issue Category: Monitoring			
	Issue: Consistent inability to attain reporting limits low enough to demonstrate achievement of ROD cleanup goals (groundwater/drinking water) or screening benchmark (surface water/sediment).			
	Recommendation: Evaluate selected analytical methods to ensure that the laboratory reporting limits meet the groundwater cleanup goals.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	9/27/2019
OU(s): 1	Issue Category: Monitoring			
	Issue: Sporadic elevated concentrations of metals (i.e. lead and copper) at several drinking water locations. The source of these sporadic detections is not known. It could be due to plumbing or other sources.			
	Recommendation: For a period of one full year, collect quarterly samples from each of the drinking water monitoring locations for metals analysis. Evaluate and present the results to EPA and CTDEEP, and provide recommendations as necessary.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	12/31/2019

OU(s): 1	Issue Category: Monitoring			
	Issue: Emerging contaminants 1,4-dioxane, PFAS (including PFOS/PFOA and PFBS), may be associated with past waste disposal at the landfill. No sampling has yet been done to identify the presence/absence of these emerging contaminants.			
	Recommendation: Include 1,4-dioxane and PFAS analyses in the groundwater and drinking water monitoring program to determine if these contaminants are associated with the site.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	1/1/2019

Notes:

EPA – U.S. Environmental Protection Agency
OU – Operable Unit
PRP – Potentially responsible party

OTHER FINDINGS

The following findings were identified during the FYR that may accelerate site closeout and/or reduce cost, but do not affect current and/or future protectiveness.

- Compliance point evaluation and modification to the long-term monitoring program
 - In an October 13, 2017 memorandum to EPA, Arcadis proposed a modification to the “compliance boundary”. The compliance boundary defined in the ROD was wherever waste was left in place. Arcadis (on behalf of RRDD) would like to address areas affected by residual organics derived from leachate, as well as locations with significant landfill-related reducing conditions. In sum, Arcadis recommends that the compliance points recognize the area of reducing conditions beyond the edge of the landfill.
 - In the same memorandum, Arcadis proposes modifications to the long-term monitoring program to account for the adjustment in the compliance point definition.
 - EPA and CTDEEP are reviewing the proposed modifications.
- Reevaluation of the background levels used as the basis for the ROD cleanup levels
 - Table 11 of the ROD presented the Groundwater Cleanup Levels. A footnote to the table states that “the cleanup level established for each chemical is the background concentration, per Connecticut RSRs, Section 23a-133k-3(a). During

the RA Phase, USEPA in consultation with CTDEP will determine whether these concentrations represent background for this Site and will change these values, if necessary, through an ESD.” Based on the revised estimated time to achieve RAOs, the overall stability of the groundwater contaminant plume, and difficulty in obtaining conventional laboratory analytical reporting limits sensitive enough to achieve the ROD cleanup levels, an evaluation of these background conditions is recommended.

VII PROTECTIVENESS STATEMENTS

Protectiveness Statement	
<i>Operable Unit: 1</i>	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The remedy at the Barkhamsted-New Hartford Landfill Site is protective in the short-term because it currently protects human health and the environment because there are no current exposures to contaminated groundwater originating from the site; the landfill cap and leachate management system continue to be an effective remedy; a long-term monitoring and operation & maintenance program is in place; and institutional controls have been recorded. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: fill in animal burrows and repair soft and wet areas on the cap; select analytical methods to ensure laboratory reporting limits meet all COC cleanup goals for groundwater and ecological benchmarks for surface water and sediment; perform quarterly monitoring for one year for metal analysis in drinking water wells to assess if lead and copper are consistently present and their source; and collect groundwater/drinking water samples for 1,4-dioxane, and PFAS.	

Sitewide Protectiveness Statement
<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The Sitewide remedy currently protects human health and the environment because there are no current exposures to contaminated groundwater originating

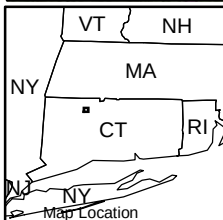
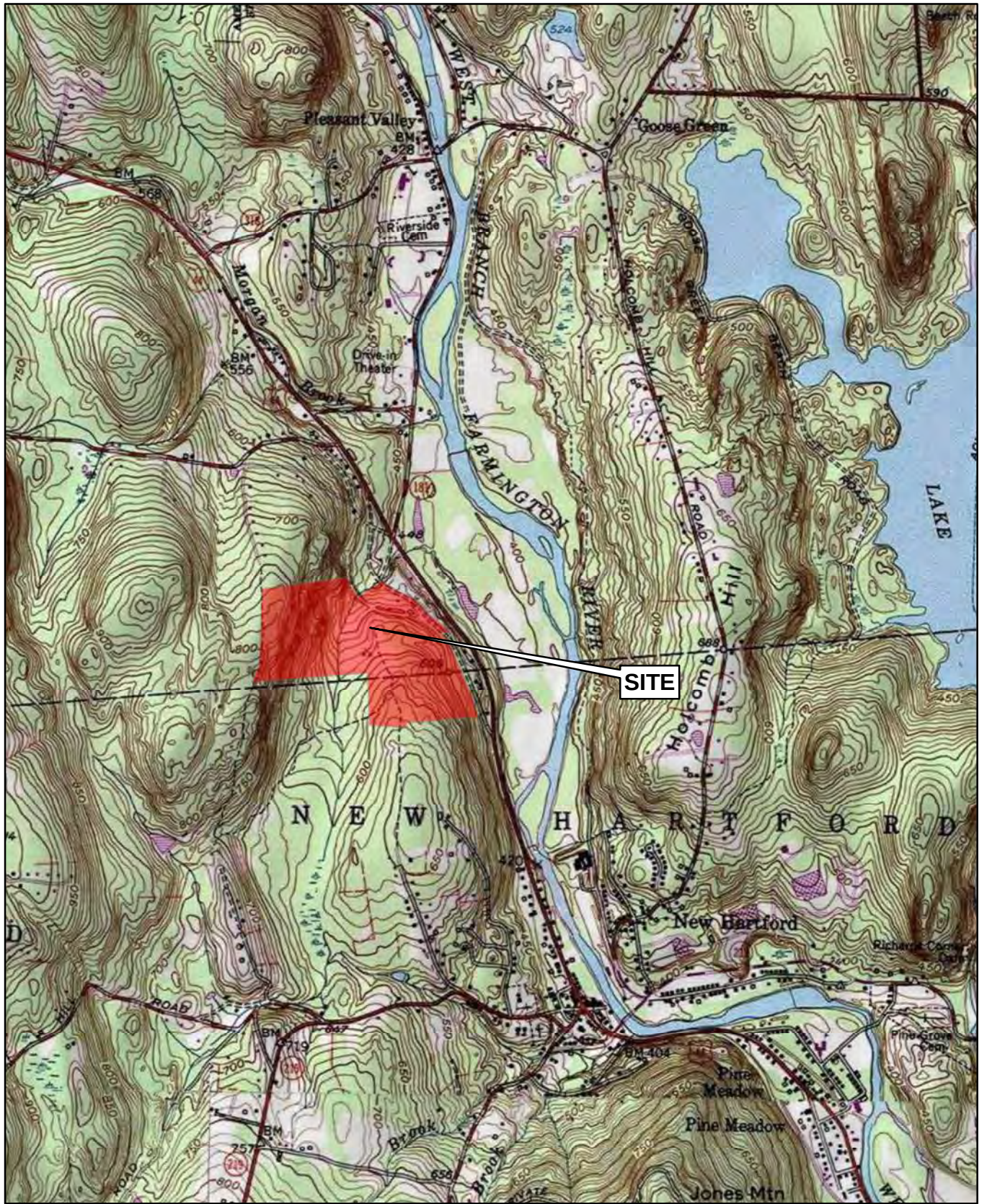
from the Site; the landfill cap and leachate management system continue to be an effective remedy; a long-term monitoring and operation & maintenance program is in place; and institutional controls have been recorded. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: fill in animal burrows and repair soft and wet areas on the cap; select analytical methods to ensure laboratory reporting limits meet all COC cleanup goals for groundwater and ecological benchmarks for surface water and sediment; perform quarterly monitoring for one year for metal analysis in drinking water wells to assess if lead and copper are consistently present and their source; and collect groundwater/drinking water samples for 1,4-dioxane, and PFAS to ensure the remedy remains protective.

VIII NEXT REVIEW

The next FYR report for the Barkhamsted-New Hartford Landfill Superfund Site is required five years from the completion date of this review.

FIGURES

Path: R:\00000 Task Orders\00097 Five Year Review\Barkhamsted_Landfill\Technical_Docs\GIS\Map_Figures\Draft_FYR\Figure_01_Site_Locus.mxd Date Printed: 5/11/2018



USGS Topographic Map
New Hartford, Connecticut
1956; Photorevised 1984

0 500 1,000 2,000
Feet
1 inch = 2,000 feet



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FIGURE 1

SITE LOCUS
BARKHAMSTED LANDFILL
BARKHAMSTED, CONNECTICUT

PREPARED BY: DFM

PROJECT NO. 80097.09

DATE: MAY, 2018



Legend

— · — Unnamed Stream [Yellow Dashed Line] Regional Refuse Disposal District Property Boundary

0 250 500 1,000
Feet

1 inch = 500 feet



Notes:

1. Location of all features is approximate. Map is for reference purposes only. Nobis Engineering, Inc. makes no claims, warranties, representations, expressed or implied, relating to the completeness, accuracy, or reliability of the data shown.

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FIGURE 2

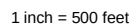
**SITE PLAN
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD
CONNECTICUT**

PREPARED BY: DFM

CHECKED BY: BA

PROJECT NO. 80086

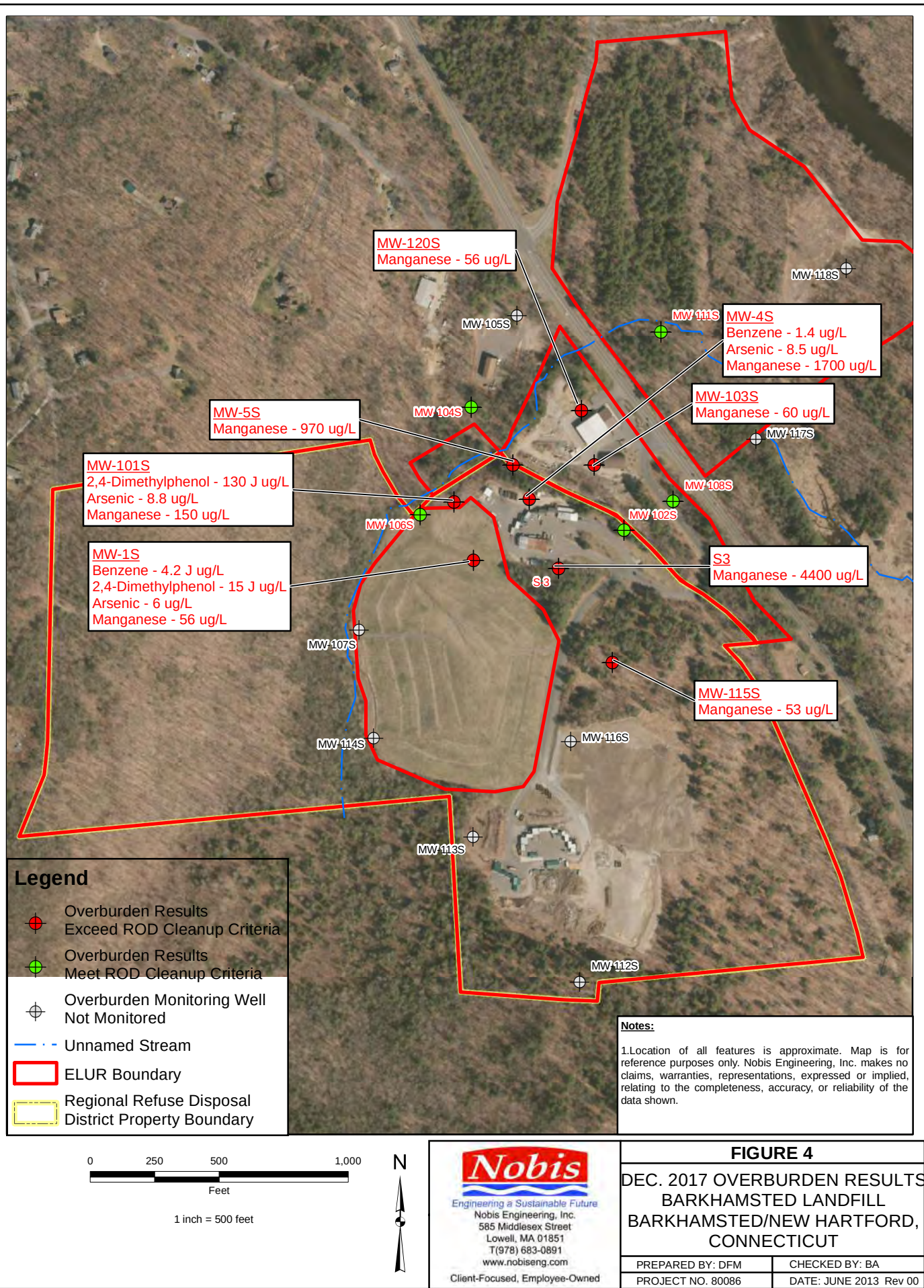
DATE: JUNE 2013 Rev 00

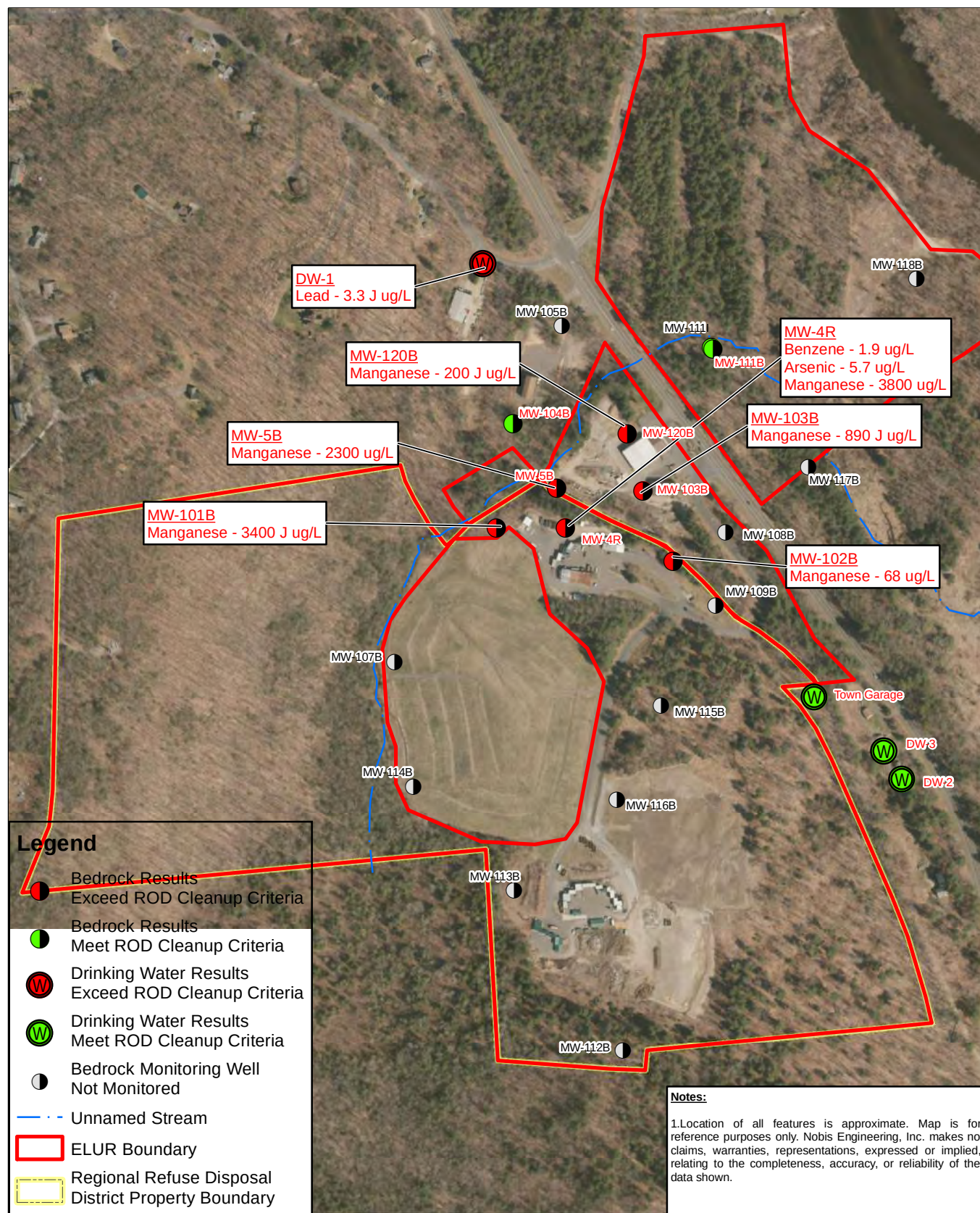


ELUR & MONITORING LOCATIONS
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD,
CONNECTICUT

CHECKED BY: BA

DATE: JUNE 2013 Rev 00





0 250 500 1,000
Feet
1 inch = 500 feet



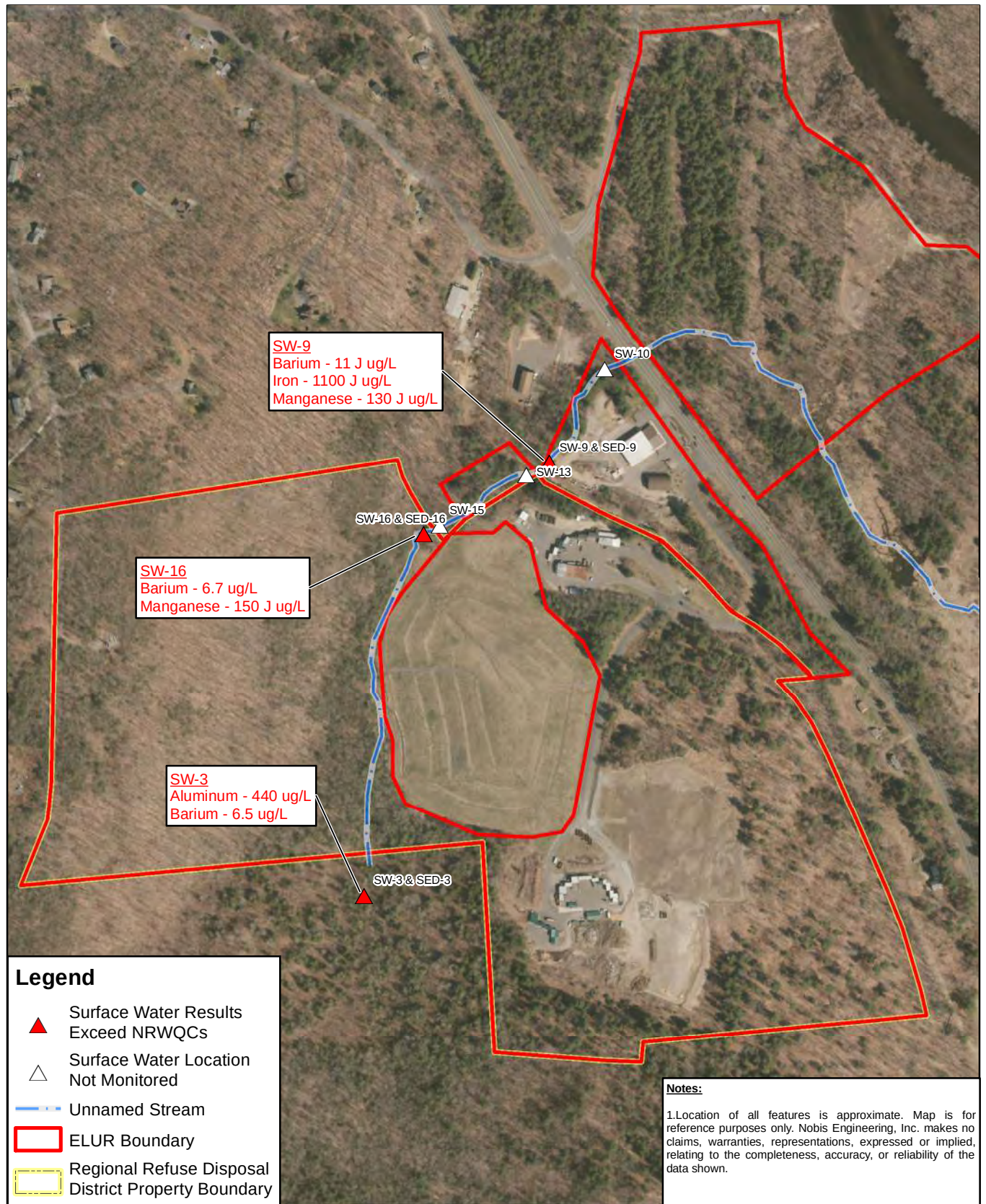
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FIGURE 5

**DEC. 2017 BEDROCK RESULTS
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD,
CONNECTICUT**

PREPARED BY: DFM
PROJECT NO. 80086

CHECKED BY: BA
DATE: JUNE 2013 Rev 00



0 250 500 1,000
Feet

1 inch = 500 feet



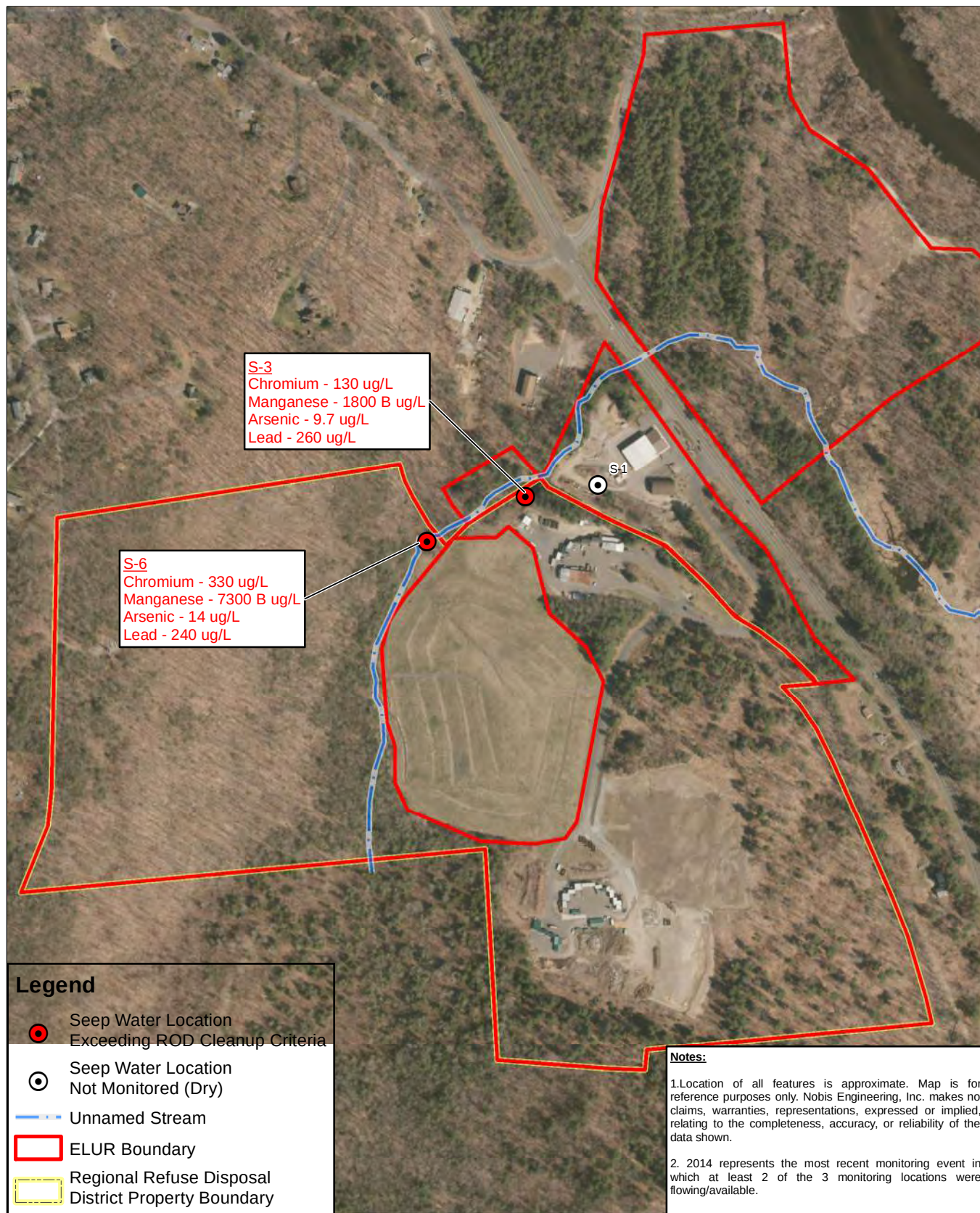
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FIGURE 6

**2017 SURFACE WATER RESULTS
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD,
CONNECTICUT**

PREPARED BY: DFM
PROJECT NO. 80086

CHECKED BY: BA
DATE: JUNE 2013 Rev 00



0 250 500 1,000
Feet

1 inch = 500 feet



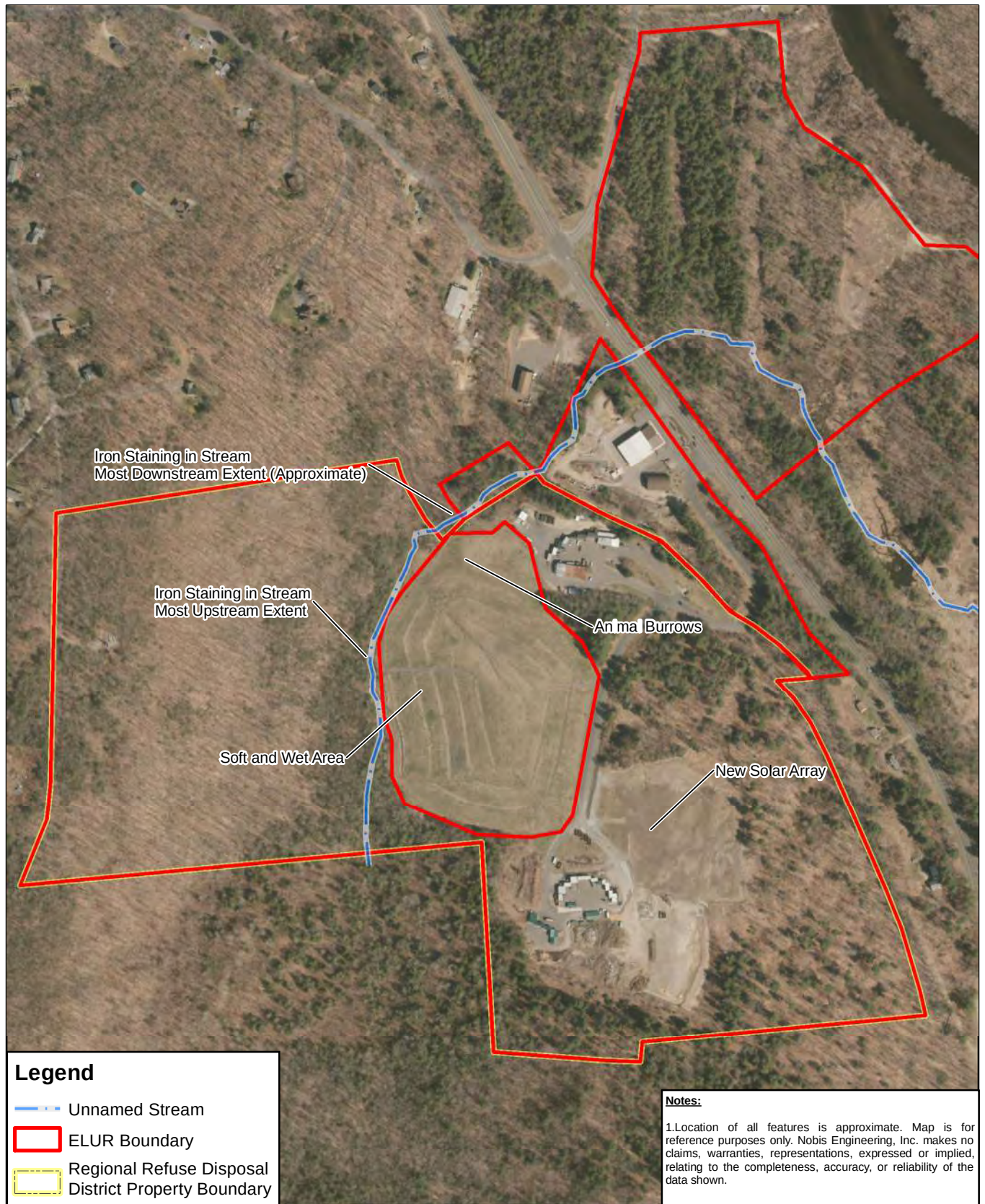
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FIGURE 7

2014 SEEP WATER RESULTS BARKHAMSTED LANDFILL BARKHAMSTED/NEW HARTFORD, CONNECTICUT

PREPARED BY: DFM
PROJECT NO. 80086

CHECKED BY: BA
DATE: JUNE 2013 Rev 00



0 250 500 1,000
Feet

1 inch = 500 feet



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FIGURE 8

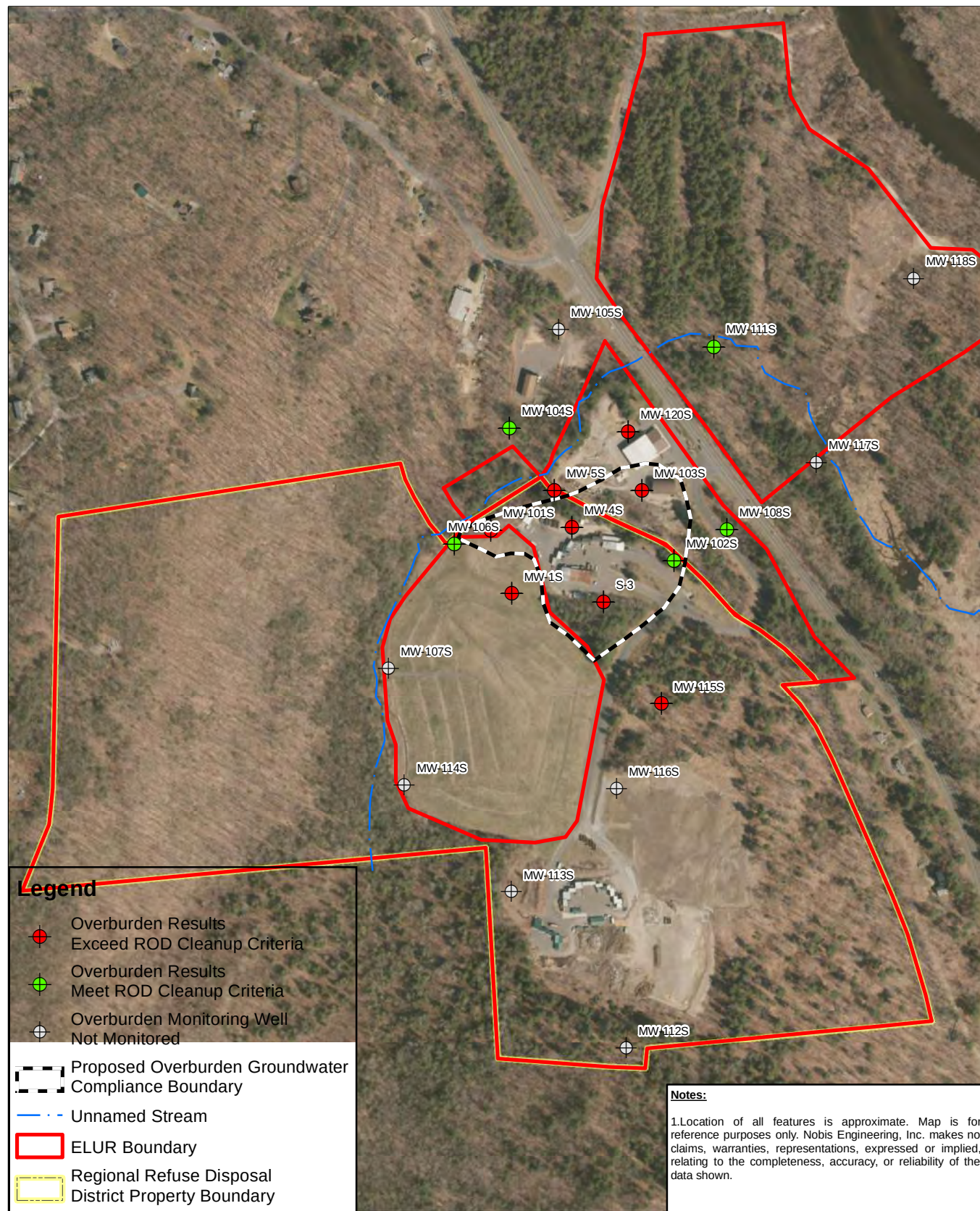
2018 FIVE-YEAR REVIEW VISIT
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD,
CONNECTICUT

PREPARED BY: DFM

CHECKED BY: BA

PROJECT NO. 80086

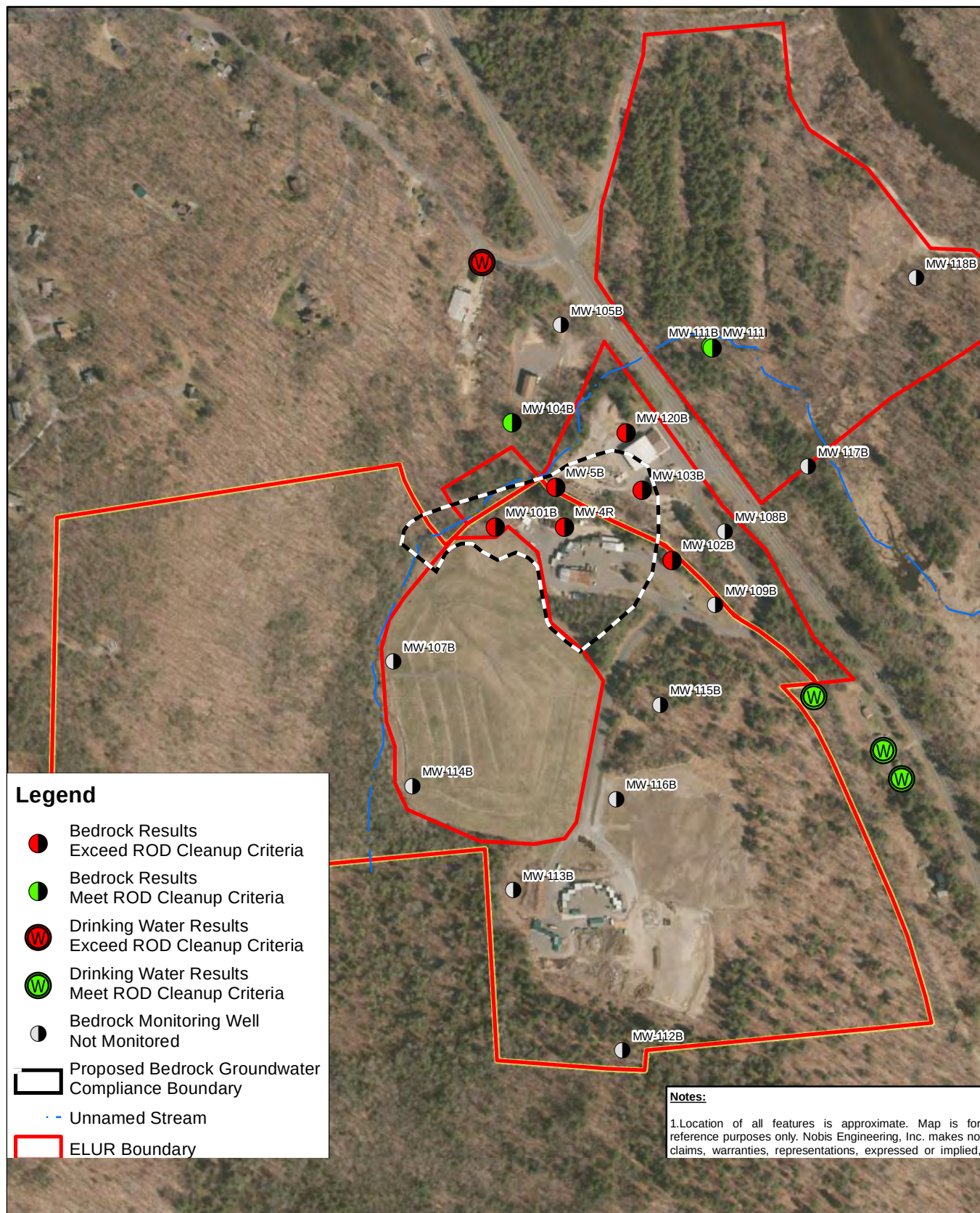
DATE: JUNE 2013 Rev 00



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FIGURE 9
PROPOSED OVERBURDEN COMPLIANCE POINT
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD, CONNECTICUT

PREPARED BY: DFM	CHECKED BY: BA
PROJECT NO. 80086	DATE: JUNE 2013 Rev 00



0 250 500 1,000
Feet

1 inch = 500 feet



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FIGURE 10

PROPOSED BEDROCK
COMPLIANCE POINT
BARKHAMSTED LANDFILL
BARKHAMSTED/NEW HARTFORD,
CONNECTICUT

PREPARED BY: DFM

CHECKED BY: BA

PROJECT NO. 80086

DATE: JUNE 2013 Rev 00

A P P E N D I C E S

APPENDIX A

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A P P E N D I X B

Land Use History

In April 1974, the RRDD began landfilling operations on the site. The landfill accepted municipal solid waste and industrial wastes for disposal until August 1988, at which point the landfill received only bulky non-processable waste. Between November and December 1988, the landfill again accepted municipal solid waste due to operational problems at a nearby waste-to-energy plant. Between December 1988 and October 1993, the landfill reverted to accepting only bulky wastes. During this time, sewage sludge generated by the Winstead Publicly Owned Treatment Works (POTW) was incorporated into cover material.

In 1993, the RRDD established a waste transfer station and recycle center at the Site. The transfer station and recycle center continue to operate at the Site. A Non-Time-Critical Response Action (NTCRA) was initiated in 1994 which included among other items the installation of a landfill cap and a leachate collection system.

In January 1998, the Connecticut Department of Environmental Protection (CTDEP), now known as the Connecticut Department of Energy and Environmental Protection (CTDEEP) approved landfill closure.

Current Land and Resource Use

The Site is currently used as a waste transfer station and recycling area, which consists of waste repositories and maintenance/office buildings. The capped landfill is fenced. The current use for the surrounding area is residential, commercial and recreational. The Metropolitan District Commission (MDC) owns undeveloped land along the Farmington River, which is used for recreational purposes, including fishing, swimming and boating.

Because of the contaminated groundwater at the Site, Environmental Land Use Restrictions (ELURs) were placed on the Site and nearby parcels to prohibit groundwater use for drinking or other purposes (see Figure 3). The aquifer underlying the Site is not currently used as a drinking water source. Nearby commercial and residential properties (including a well installed in late 2012 to supply the RRDD and Town garage) use both the overburden and bedrock aquifer as a potable water supply.

Reasonably Anticipated Future Land and Resource Use

The Site is will likely continue to be used as a waste transfer station and recycling area. The capped landfill will remain fenced. The reasonable anticipated future use for the surrounding area is residential, commercial and recreational.

History of Contamination

The Site was used for the disposal of solid waste (including municipal and industrial wastes) between April 1974 and August 1988.

Historical wastes accepted at the landfill included the following:

- Municipal solid waste;
- Industrial wastes, including metal grinding waste, oily sludge with metal grinding and degreasers; barrels containing unspecified amounts of chlorinated hydrocarbons and methyl-ethyl-ketone (MEK or 2-butanone) and keratin; and
- Dry metal grinding waste.

In 1981, EPA conducted a Site inspection, based on previous findings by Connecticut officials. EPA's 1981 inspection included collection and analysis of Site groundwater samples. Laboratory analytical results of Site groundwater indicated concentrations of xylenes, toluene, 1,1-dichloroethane (1,1-DCA), 4-methyl-2-pentanone and vinyl chloride (VC). The EPA inspection report also indicated the presence of metals at the Site (including cadmium, chromium, copper, lead, manganese, nickel and zinc) attributed to the historical disposal of oily metal grinding sludges. Additionally, leachate was observed discharging from the landfill into the Unnamed Brook.

Subsurface investigations conducted from 1992 to 2000 are documented in the 1996 Remedial Investigation (RI) and the 2001 Feasibility Study (FS) reports. These investigations indicated the following:

- Soil sampling analytical results indicated concentrations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated

biphenyls (PCBs). The 2001 FS Report identifies contaminants of potential concern (COPCs), including VOCs, SVOCs and inorganics.

- Surface water sampling and leachate seep sediment sampling results indicated concentrations of SVOCs, pesticides and PCBs. Sediment samples collected from hydrogeologically downgradient locations (relative to the landfill) and leachate seep sediment samples indicated concentrations of VOCs, SVOCs, metals, pesticides and PCBs.

A P P E N D I X C



An official website of the United States government.



We've made some changes to EPA.gov. If the information you are looking for is not here, you may be able to find it on the EPA Web Archive or the January 19, 2017 Web Snapshot.

Close X



News Releases from Region 01

EPA Begins Reviews of 24 New England Site Cleanups during Current Fiscal Year

02/16/2018

Contact Information:

Emily Bender (bender.emily@epa.gov)

617-918-1037

Boston – EPA plans to conduct comprehensive reviews of site cleanups at 24 National Priorities List Sites (Superfund Sites), including two Federal Facilities, across New England by performing required Five-Year Reviews of sites. The Superfund program, a federal program established by Congress in 1980, investigates and cleans up the most complex, uncontrolled or abandoned hazardous waste sites in the country and endeavors to facilitate activities to return them to productive use.

"Under Administrator Pruitt, EPA has a renewed focus to make progress on Superfund sites across the country," said EPA regional administrator Alexandra Dunn. "We are dedicated to addressing risk at sites, which is why it's important for us to conduct these regular reviews of previously completed cleanups to make sure these remedies remain protective of human health and the environment."

EPA is actively involved in Superfund studies and cleanups at 123 sites across New England. There are many phases of the Superfund cleanup process including considering future use and redevelopment at sites and conducting post cleanup monitoring of sites. EPA must ensure the remedy is protective of public health and the environment and any redevelopment will uphold the protectiveness of the remedy into the future.

The Superfund Sites and Federal Facilities where EPA will begin work on Five- Year Reviews in 2018 are below. Please note, the web links listed below provide detailed information on site status and past assessment and cleanup activity. Once the Five-Year Review is complete, a

report of its findings will be posted to this website. The web link also provides contact information for the EPA Project Manager and Community Involvement Coordinator at each site. Community members and local officials are invited to contact EPA with any comments or concerns about a Superfund site.

Five-Year Reviews being initiated in FY18

Superfund Sites:

Barkhamsted- New Hartford Landfill: Barkhamsted, CT (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100255>)

Beacon Heights Landfill: Beacon Falls, CT (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100180>)

Laurel Park, Inc: Naugatuck Borough, CT (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100232>)

Yaworski Waste Lagoon: Canterbury, CT (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100125>)

Industri-Plex: Woburn, MA (to be completed in Fiscal Year 2019) (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100580>)

Iron Horse Park: Billerica, MA (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100524>)

Nyanza Chemical Waste Dump: Ashland, MA (to be completed in Fiscal Year 2019) (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100948>)

Plymouth Harbor/Cannon Engineering Corporation: Plymouth, MA (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100726>)

Re-Solve, Inc: Dartmouth, MA (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100682>)

Sullivan's Ledge: New Bedford, MA (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100744>)

McKin Co: Gray, ME (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101027>)

West Site/Hows Corners: Plymouth, ME (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101800>)

Kearsarge Metallurgical Corp: Conway, NH (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101105>)

Keefe Environmental Services: Epping, NH (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101114>)

Mottolo Pig Farm: Raymond, NH (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101123>)

Ottati & Goss/ Kingston Steel Drum: Kingston, NH (to be completed in Fiscal Year 2019) (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101210>)

South Municipal Water Supply Well: Peterborough, NH (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101146>)

Tibbetts Road: Barrington, NH (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101208>)

Central Landfill: Johnston, RI (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101277>)

Picillo Farm: Coventry, RI (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101284>)

Western Sand & Gravel: Burrillville, RI (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101233>)

Old Springfield Landfill: Springfield, VT (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101437>)

Federal Facilities:

Otis Air National Guard Base: Falmouth, MA (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0100960>)

Davisville Naval Construction Battalion Center: North Kingstown, RI (<https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0101430>)

LAST UPDATED ON FEBRUARY 16, 2018

A P P E N D I X D

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:18-May-18

Facility Name:Barkhamsted Landfill

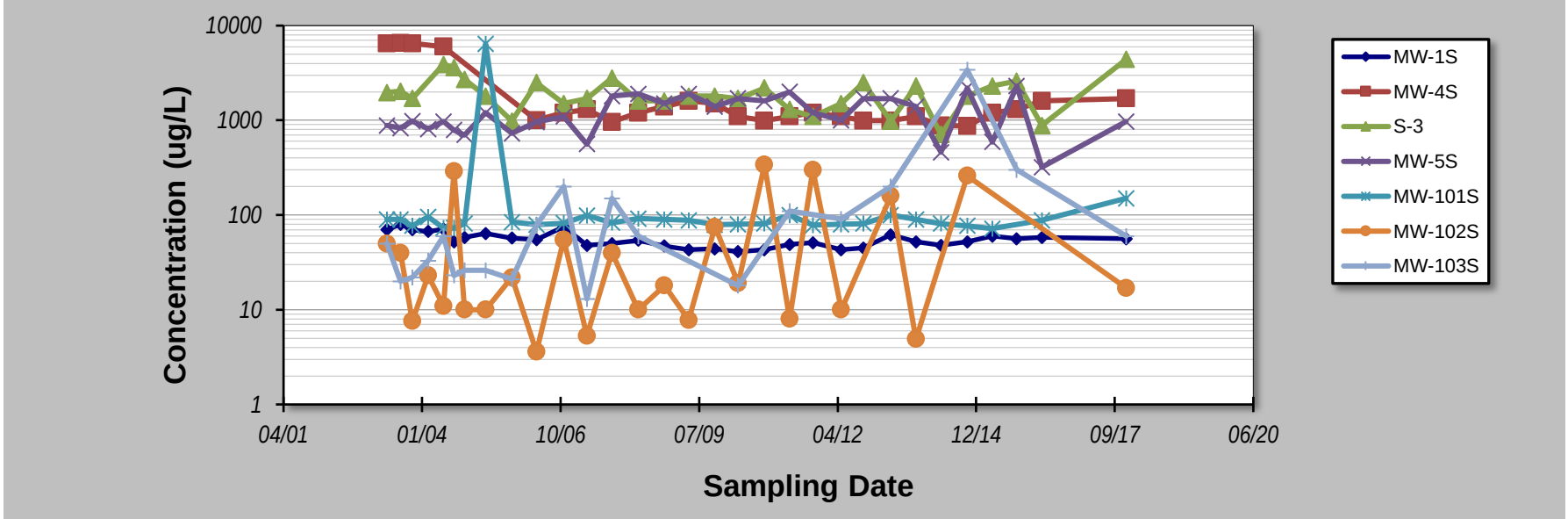
Conducted By:Denis McGrath

Job ID:80097.09

Constituent:Manganese

Concentration Units:ug/L

Sampling Point ID:		MW-1S	MW-4S	S-3	MW-5S	MW-101S	MW-102S	MW-103S
Sampling Event	Sampling Date	MANGANESE CONCENTRATION (ug/L)						
1	5/5/2003	70	6460	1970	880	90	50	50
2	8/12/2003	80	6550	2030	830	90	40	20
3	11/4/2003	70	6500	1700	980	77	7.6	22
4	2/26/2004	67			810	96	23	33
5	6/16/2004	71	6000	3900	970	73	11	60
6	9/1/2004	52		3600	790	73	290	23
7	11/16/2004	58		2700	700	81	10	26
8	4/18/2005	64		1800	1200	6400	10	26
9	10/24/2005	57		980	730	84	22	21
10	4/18/2006	55	1000	2500	960	79	3.6	78
11	10/31/2006	75	1200	1500	1100	82	55	200
12	4/17/2007	48	1300	1700	560	99	5.3	13
13	10/16/2007	50	960	2800	1800	83	40	150
14	4/22/2008	54	1200	1600	1900	92	10	60
15	10/28/2008	47	1400	1600	1500	90	18	
16	4/21/2009	43	1600	1800	1900	88	7.8	
17	10/27/2009	44	1500	1800	1400	79	75	
18	4/13/2010	41	1100	1700	1700	80	19	18
19	10/20/2010	43	990	2200	1600	81	340	
20	4/21/2011	49	1100	1300	2000	100	8	110
21	10/6/2011	51	1200	1100	1200	78	300	
22	4/26/2012	43	1100	1500	1000	80	10	91
23	10/4/2012	45	990	2500	1700	81		
24	4/19/2013	62	990	980	1700	100	160	200
25	10/17/2013	52	1100	2300	1400	90	4.9	
26	4/16/2014	48	880	710	460	81		
27	10/23/2014	52	870	1800	2200	77	260	3400
28	4/22/2015	60	1200	2300	590	72		
29	10/15/2015	56	1300	2600	2300			300
30	4/15/2016	58	1600	880	320	88		
31	12/13/2017	56	1700	4400	970	150	17	60
32								
33								
34								
35								
Coefficient of Variation:		0.18	0.96	0.43	0.44	3.88	1.52	3.09
Mann-Kendall Statistic (S):		131	86	57	90	-3	14	83
Confidence Factor:		98.7%	97.0%	84.0%	93.5%	51.4%	61.2%	99.4%
Concentration Trend:		Decreasing	Decreasing	Stable	Prob. Increasing	No Trend	No Trend	Increasing



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:18-May-18

Facility Name:Barkhamsted Landfill

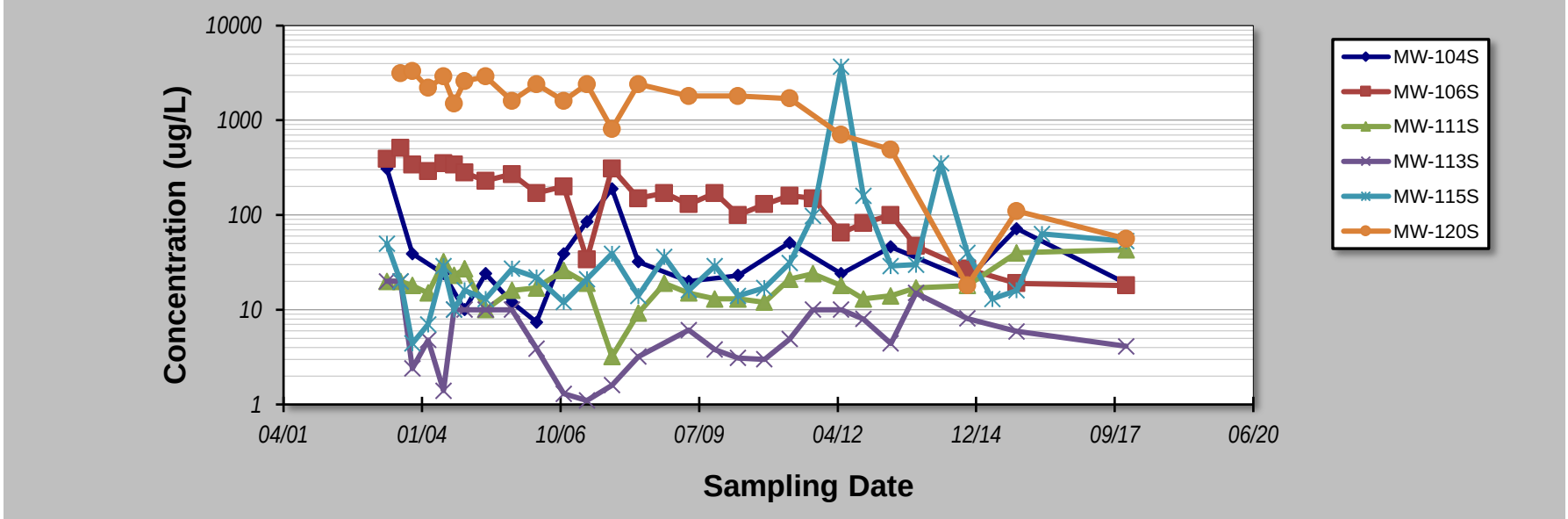
Conducted By:Denis McGrath

Job ID:80097.09

Constituent:Manganese

Concentration Units:ug/L

Sampling Point ID:		MW-104S	MW-106S	MW-111S	MW-113S	MW-115S	MW-120S	
Sampling Event	Sampling Date	MANGANESE CONCENTRATION (ug/L)						
1	5/5/2003	310	390	20	20	50		
2	8/12/2003		510	20	20	20	3150	
3	11/4/2003	39	340	18	2.4	4.4	3300	
4	2/26/2004		290	15	4.8	7	2200	
5	6/16/2004	24	350	32	1.4	29	2900	
6	9/1/2004		340	23	10	10	1500	
7	11/16/2004	10	280	27	10	16	2600	
8	4/18/2005	24	230	10	10	13	2900	
9	10/24/2005	12	270	16	10	27	1600	
10	4/18/2006	7.4	170	17	3.9	22	2400	
11	10/31/2006	39	200	26	1.3	12	1600	
12	4/17/2007	85	34	19	1.1	21	2400	
13	10/16/2007	190	310	3.2	1.6	39	810	
14	4/22/2008	32	150	9.2	3.2	14	2400	
15	10/28/2008		170	19		36		
16	4/21/2009	20	130	15	6.1	16	1800	
17	10/27/2009		170	13	3.8	29		
18	4/13/2010	23	100	13	3.1	14	1800	
19	10/20/2010		130	12	3	17		
20	4/21/2011	51	160	21	4.9	31	1700	
21	10/6/2011		150	24	10	98		
22	4/26/2012	24	65	18	10	3700	700	
23	10/4/2012		82	13	8	160		
24	4/19/2013	46	100	14	4.4	29	490	
25	10/17/2013		47	17	15	30		
26	4/16/2014					350		
27	10/23/2014	21	27	18	8.1	40	18	
28	4/22/2015					13		
29	10/15/2015	72	19	40	5.9	16	110	
30	4/15/2016					63		
31	12/13/2017	19	18	43	4.1	53	56	
32								
33								
34								
35								
Coefficient of Variation:		1.35	0.68	0.45	0.75	4.11	0.60	
Mann-Kendall Statistic (S):		-5	293	-6	-3	163	134	
Confidence Factor:		55.5%	>99.9%	53.9%	51.6%	99.7%	>99.9%	
Concentration Trend:		No Trend	Decreasing	Stable	Stable	Increasing	Decreasing	



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:18-May-18

Facility Name:Barkhamsted Landfill

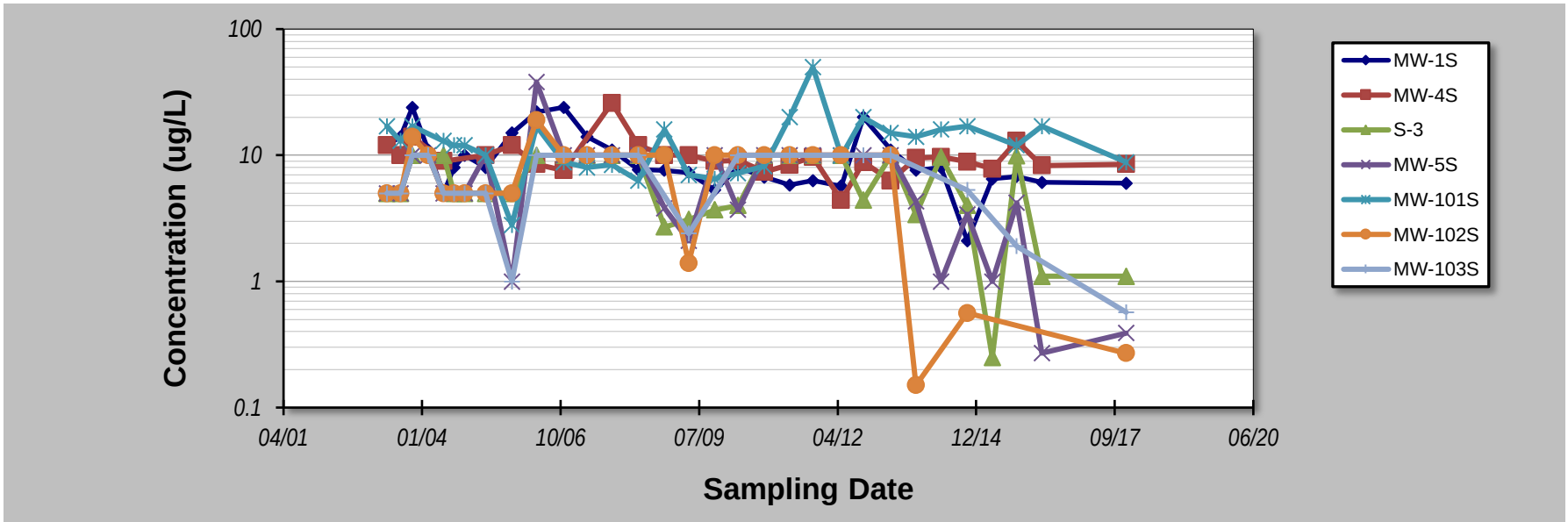
Conducted By:Denis McGrath

Job ID:80097.09

Constituent:Arsenic

Concentration Units:ug/L

Sampling Point ID:		MW-1S	MW-4S	S-3	MW-5S	MW-101S	MW-102S	MW-103S
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (ug/L)						
1	5/5/2003	12	12	5	5	17	5	5
2	8/12/2003	14	10	5	5	13	5	5
3	11/4/2003	24	14	10	10	17	14	10
4	2/26/2004	11			10		10	10
5	6/16/2004	5	9	10	5	13	5	5
6	9/1/2004	8		5	5	12	5	5
7	11/16/2004	10		5	5	12	5	5
8	4/18/2005	8	10	5	10	10	5	5
9	10/24/2005	15	12	5	1	2.8	5	1
10	4/18/2006	22	8.5	10	38	17	19	10
11	10/31/2006	24	7.6	10	10	8.8	10	10
12	4/17/2007	14		10	10	8	10	10
13	10/16/2007	11	26	10	10	8.4	10	10
14	4/22/2008	7.7	12	10	10	6.3	10	10
15	10/28/2008	7.6	10	2.7	3.8	16	10	
16	4/21/2009	7.3	10	3.1	2.1	7	1.4	2.4
17	10/27/2009	5.3	9	3.7	10	6.5	10	
18	4/13/2010	8	9.1	4	3.7	7.2	10	10
19	10/20/2010	6.7	7.4	10	10	8.2	10	
20	4/21/2011	5.8	8.4	10	10	20	10	10
21	10/6/2011	6.3	9.7	10	10	50	10	
22	4/26/2012	5.7	4.4	10	10	9.9	10	
23	10/4/2012	20	8.8	4.4	10	20		10
24	4/19/2013	11	6.3	10	10	15	10	10
25	10/17/2013	7.6	9.5	3.4	4.3	14	0.15	
26	4/16/2014	8	9.7	9.7	1	16		
27	10/23/2014	2.1	8.9	4	3.4	17	0.56	5.3
28	4/22/2015	6.5	7.8	0.25	1			
29	10/15/2015	6.8	13	9.9	4.2	12		1.9
30	4/15/2016	6.1	8.3	1.1	0.27	17		
31	12/13/2017	6	8.5	1.1	0.39	8.8	0.27	0.57
32								
33								
34								
35								
Coefficient of Variation:		0.56	0.38	0.52	0.92	0.62	0.57	0.50
Mann-Kendall Statistic (S):		189	115	92	115	23	14	1
Confidence Factor:		99.9%	99.2%	94.8%	97.4%	65.9%	61.2%	50.0%
Concentration Trend:		Decreasing	Decreasing	Prob. Decreasing	Decreasing	No Trend	Stable	No Trend



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:18-May-18

Facility Name:Barkhamsted Landfill

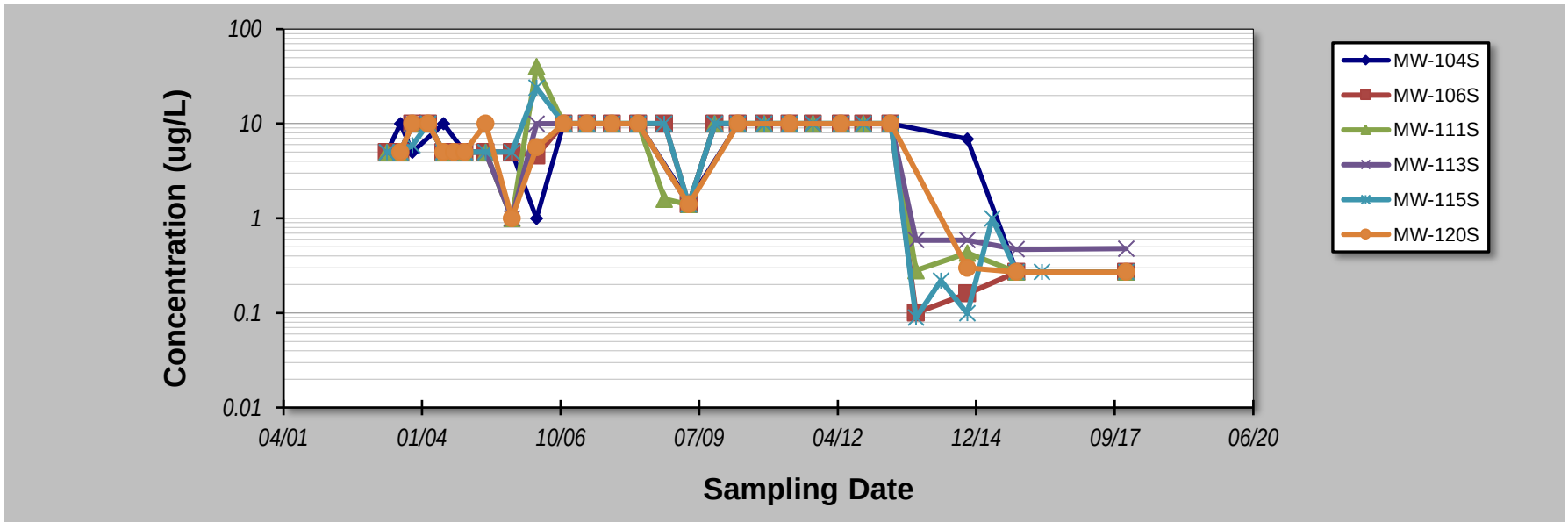
Conducted By:Denis McGrath

Job ID:80097.09

Constituent:Arsenic

Concentration Units:ug/L

Sampling Point ID:		MW-104S	MW-106S	MW-111S	MW-113S	MW-115S	MW-120S	
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (ug/L)						
1	5/5/2003	5	5	5	5	5		
2	8/12/2003	10	5	5	5	5	5	
3	11/4/2003	5	10	10	10	5.9	10	
4	2/26/2004		10	10	10	10	10	
5	6/16/2004	10	5	5	5	5	5	
6	9/1/2004		5	5	5	5	5	
7	11/16/2004	5	5	5	5	5	5	
8	4/18/2005	5	5	5	5	5	10	
9	10/24/2005	5	5	1	1	5	1	
10	4/18/2006	1	4.6	40	10	24	5.6	
11	10/31/2006	10	10	10	10	10	10	
12	4/17/2007	10	10	10	10	10	10	
13	10/16/2007	10	10	10	10	10	10	
14	4/22/2008	10	10	10	10	10	10	
15	10/28/2008		10	1.6		10		
16	4/21/2009	1.5	1.4	1.4	1.4	1.4	1.4	
17	10/27/2009		10	10	10	10		
18	4/13/2010	10	10	10	10	10	10	
19	10/20/2010		10	10	10	10		
20	4/21/2011	10	10	10	10	10	10	
21	10/6/2011		10	10	10	10		
22	4/26/2012	10	10	10	10	10	10	
23	10/4/2012		10	10	10	10		
24	4/19/2013	10	10	10	10	10	10	
25	10/17/2013		0.1	0.28	0.59	0.089		
26	4/16/2014					0.22		
27	10/23/2014	6.9	0.16	0.43	0.59	0.099	0.3	
28	4/22/2015					1		
29	10/15/2015	0.27	0.27	0.27	0.47	0.27	0.27	
30	4/15/2016					0.27		
31	12/13/2017	0.27	0.27	0.27	0.48	0.27	0.27	
32								
33								
34								
35								
Coefficient of Variation:		0.55	0.55	0.97	0.57	0.76	0.60	
Mann-Kendall Statistic (S):		-8	-9	39	20	70	20	
Confidence Factor:		58.9%	56.2%	77.2%	65.3%	87.9%	71.5%	
Concentration Trend:		Stable	Stable	Stable	Stable	Stable	Stable	



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:18-May-18

Facility Name:Barkhamsted Landfill

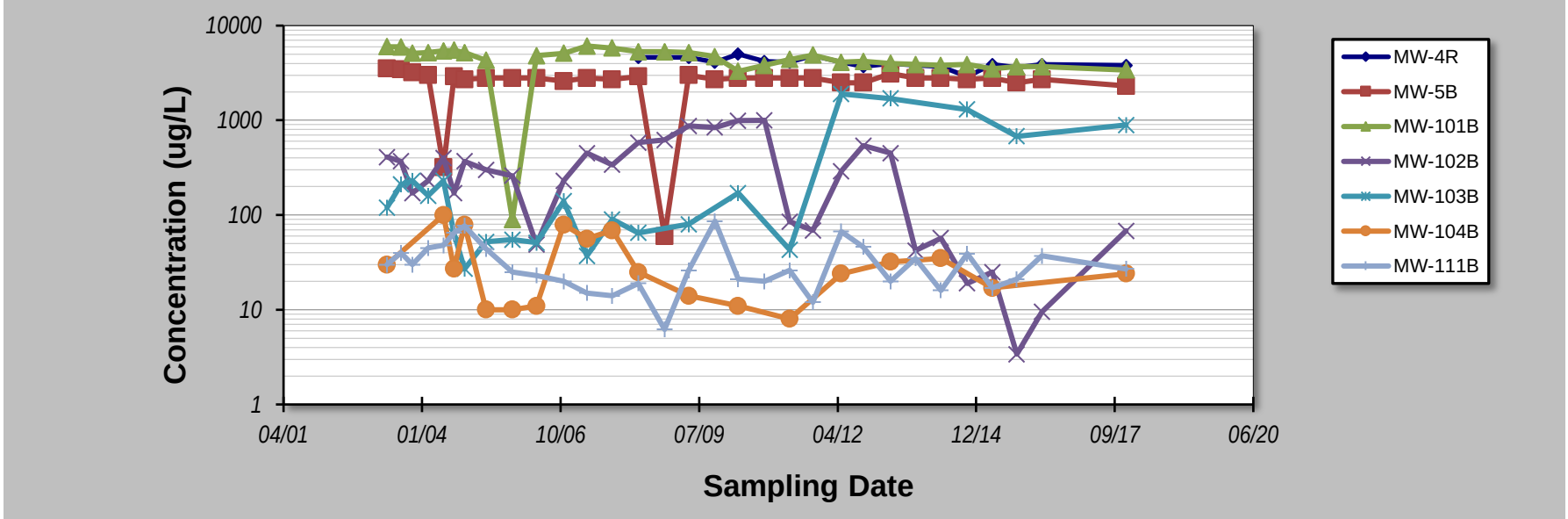
Conducted By:Denis McGrath

Job ID:80097.09

Constituent:Manganese

Concentration Units:ug/L

Sampling Point ID:		MW-4R	MW-5B	MW-101B	MW-102B	MW-103B	MW-104B	MW-111B
Sampling Event	Sampling Date	MANGANESE CONCENTRATION (ug/L)						
1	5/6/2003		3540	6000	410	120	30	30
2	8/14/2003		3440	5950	370	210		40
3	11/6/2003		3200	5100	170	230		30
4	2/26/2004		3000	5200	230	160		45
5	6/17/2004		320	5400	400	230	100	48
6	9/2/2004		2900	5500	170	63	27	65
7	11/17/2004		2700	5200	370	27	79	77
8	4/19/2005		2800	4300	300	52	10	44
9	10/26/2005		2800	90	260	55	10	25
10	4/19/2006		2800	4800	49	51	11	23
11	11/1/2006		2600	5100	230	140	79	20
12	4/19/2007		2800	6100	450	37	56	15
13	10/17/2007		2700	5800	340	90	69	14
14	4/22/2008	4600	2900	5300	580	65	25	19
15	10/29/2008		60	5300	620			6.2
16	4/21/2009	4600	3000	5200	870	80	14	26
17	10/27/2009	4100	2700	4700	840			86
18	4/13/2010	5000	2800	3300	990	170	11	21
19	10/20/2010	4200	2800	3800	1000			20
20	4/19/2011	4100	2800	4400	85	43	8	26
21	10/4/2011	4800	2800	4900	69			12
22	4/26/2012	4100	2500	4100	290	1900	24	67
23	10/3/2012	3700	2500	4200	540			46
24	4/18/2013	4000	3100	4000	450	1700	32	20
25	10/16/2013	3800	2800	3900	42			35
26	4/15/2014	3700	2800	3800	57		35	16
27	10/22/2014	2900	2700	3900	19	1300		39
28	4/21/2015	3900	2800	3500	25		17	17
29	10/15/2015	3600	2500	3700	3.4	680		21
30	4/14/2016	3900	2700	3700	9.5			37
31	12/12/2017	3800	2300	3400	68	890	24	27
32								
33								
34								
35								
Coefficient of Variation:		0.12	0.27	0.26	0.88	1.49	0.80	0.59
Mann-Kendall Statistic (S):		79	147	265	105	44	29	73
Confidence Factor:		>99.9%	99.4%	>99.9%	96.2%	88.6%	83.4%	88.8%
Concentration Trend:		Decreasing	Decreasing	Decreasing	Decreasing	No Trend	Stable	Stable



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
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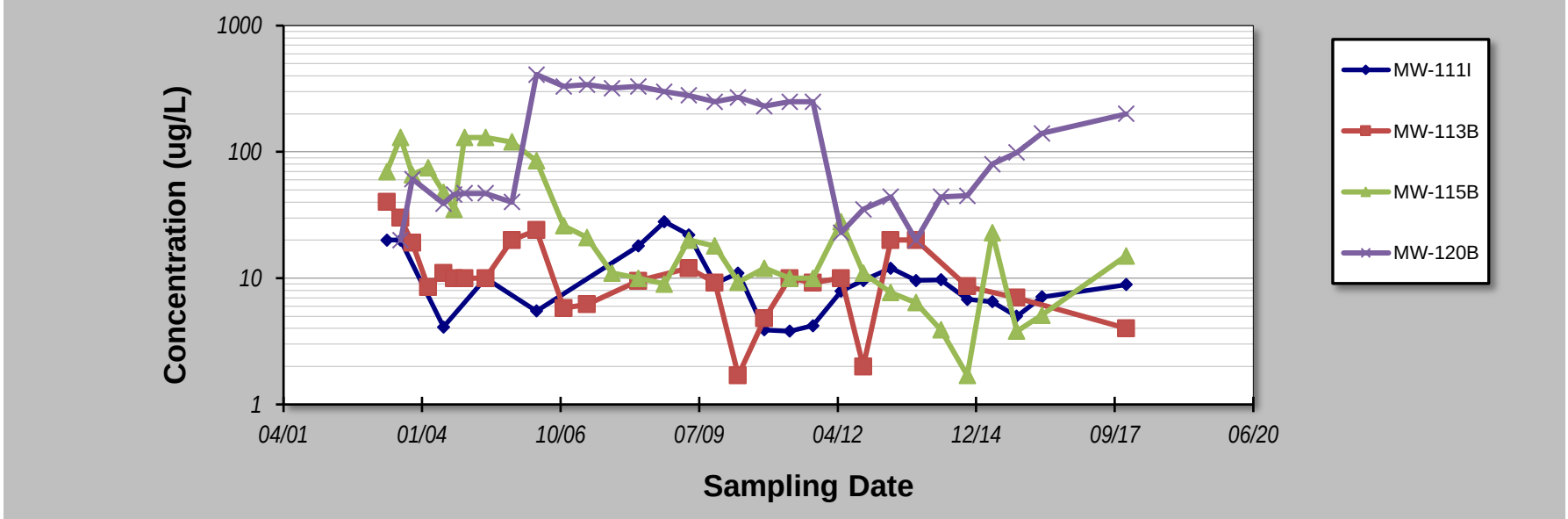
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GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date:	18-May-18	Job ID:	80097.09
Facility Name:	Barkhamsted Landfill	Constituent:	Manganese
Conducted By:	Denis McGrath	Concentration Units:	ug/L
Sampling Point ID:	MW-111I	MW-113B	MW-115B
		MW-120B	

Sampling Event	Sampling Date	MANGANESE CONCENTRATION (ug/L)					
1	5/5/2003	20	40	70			
2	8/12/2003	20	30	130	20		
3	11/4/2003		19	66	61		
4	2/26/2004		8.5	75			
5	6/16/2004	4.1	11	48	39		
6	9/1/2004		10	35	46		
7	11/16/2004		10	130	47		
8	4/18/2005	10	10	130	47		
9	10/24/2005		20	120	40		
10	4/18/2006	5.5	24	85	410		
11	10/31/2006		5.8	26	330		
12	4/17/2007		6.2	21	340		
13	10/16/2007			11	320		
14	4/22/2008	18	9.5	10	330		
15	10/28/2008	28		9	300		
16	4/21/2009	22	12	20	280		
17	10/27/2009	9.1	9.2	18	250		
18	4/13/2010	11	1.7	9.3	270		
19	10/20/2010	3.9	4.8	12	230		
20	4/21/2011	3.8	10	10	250		
21	10/6/2011	4.2	9.2	10	250		
22	4/26/2012	7.9	10	28	23		
23	10/4/2012	9.6	2	11	35		
24	4/19/2013	12	20	7.7	44		
25	10/17/2013	9.6	20	6.4	20		
26	4/16/2014	9.7		3.9	44		
27	10/23/2014	6.8	8.6	1.7	45		
28	4/22/2015	6.5		23	80		
29	10/15/2015	5	7	3.8	99		
30	4/15/2016	7.1		5.1	140		
31	12/13/2017	8.9	4	15	200		
32							
33							
34							
35							
Coefficient of Variation:		0.63	0.72	1.13	0.81		
Mann-Kendall Statistic (S):		59	109	284	37		
Confidence Factor:		93.7%	99.2%	>99.9%	74.9%		
Concentration Trend:		Prob. Decreasing	Decreasing	Decreasing	Stable		



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:**18-May-18**

Facility Name:**Barkhamsted Landfill**

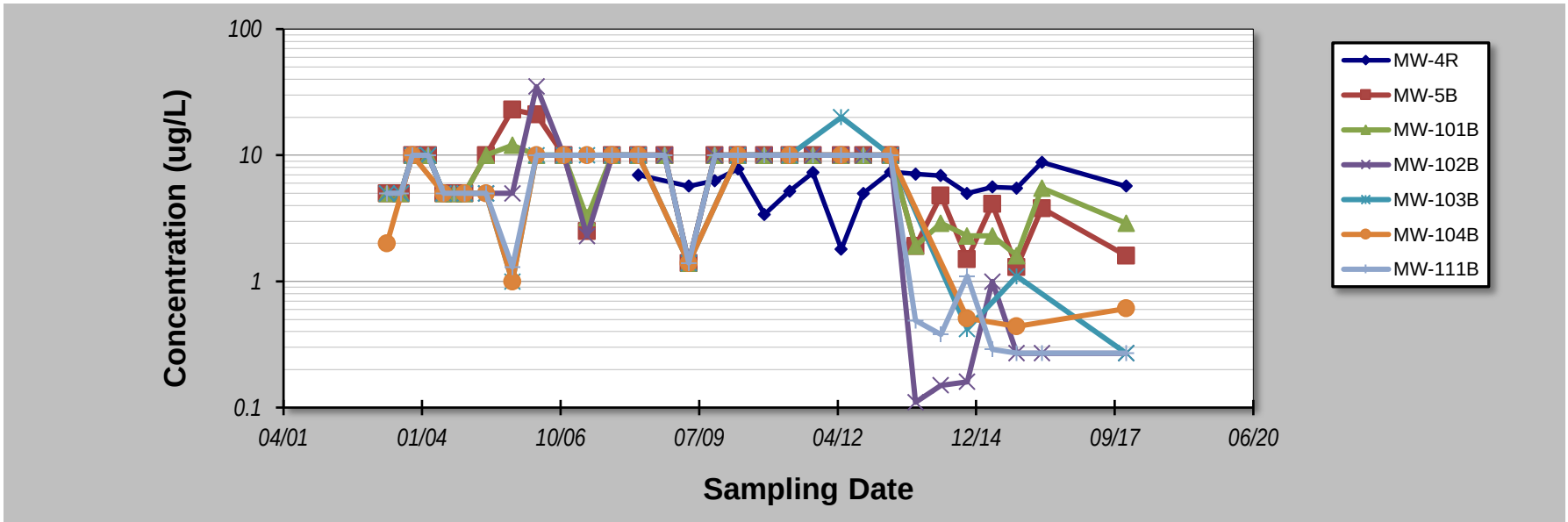
Conducted By:**Denis McGrath**

Job ID:**80097.09**

Constituent:**Arsenic**

Concentration Units:**ug/L**

Sampling Point ID:		MW-4R	MW-5B	MW-101B	MW-102B	MW-103B	MW-104B	MW-111B
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (ug/L)						
1	5/6/2003		5	5	5	5	2	5
2	8/14/2003		5	5	5	5		5
3	11/6/2003		10	10	10	10	10	10
4	2/26/2004		10	10	10	10		10
5	6/17/2004		5	5	5	5	5	5
6	9/2/2004		5	5	5	5		5
7	11/17/2004		5	5	5	5	5	5
8	4/19/2005		10	10	5	5	5	5
9	10/26/2005		23	12	5	1	1	1.3
10	4/19/2006		21	10	35	10	10	10
11	11/1/2006		10	10	10	10	10	10
12	4/19/2007		2.5	3.2	2.3	10	10	10
13	10/17/2007		10	10	10	10	10	10
14	4/22/2008	7	10	10	10	10	10	10
15	10/29/2008		10	10	10			10
16	4/21/2009	5.7	1.4	1.4	1.4	1.4	1.4	1.4
17	10/27/2009	6.3	10	10	10			10
18	4/13/2010	7.8	10	10	10	10	10	10
19	10/20/2010	3.4	10	10	10			10
20	4/19/2011	5.2	10	10	10	10	10	10
21	10/4/2011	7.3	10	10	10			10
22	4/26/2012	1.8	10	10	10	20	10	10
23	10/3/2012	5	10	10	10			10
24	4/18/2013	7.4	10	10	10	10	10	10
25	10/16/2013	7.1	1.9	1.9	0.11			0.49
26	4/15/2014	6.9	4.8	2.9	0.15			0.38
27	10/22/2014	5	1.5	2.3	0.16	0.42	0.51	1.1
28	4/21/2015	5.6	4.1	2.3	1			0.29
29	10/15/2015	5.5	1.3	1.6	0.27	1.1	0.44	0.27
30	4/14/2016	8.8	3.8	5.5	0.27			0.27
31	12/12/2017	5.7	1.6	2.9	0.27	0.27	0.61	0.27
32								
33								
34								
35								
Coefficient of Variation:		0.28	0.65	0.49	0.95	0.68	0.65	0.66
Mann-Kendall Statistic (S):		0	108	81	88	-5	11	101
Confidence Factor:		48.4%	96.6%	91.2%	93.0%	54.4%	63.5%	95.5%
Concentration Trend:		Stable	Decreasing	Prob. Decreasing	Prob. Decreasing	Stable	Stable	Decreasing



- Notes:
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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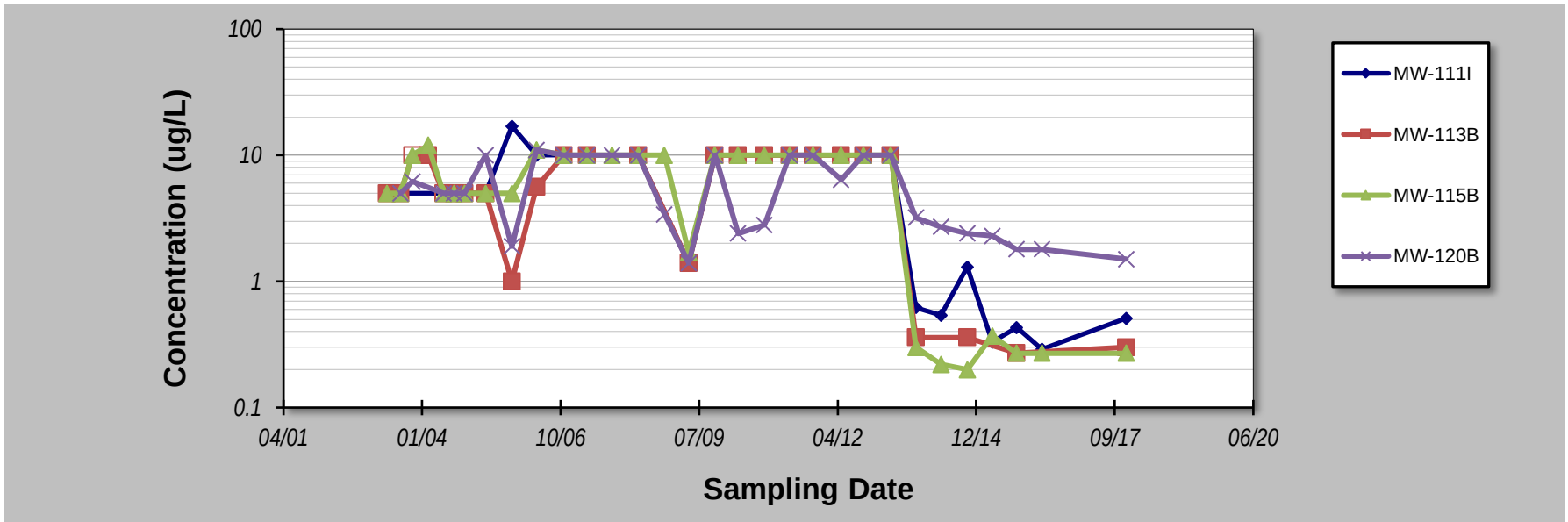
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GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date:	18-May-18	Job ID:	80097.09
Facility Name:	Barkhamsted Landfill	Constituent:	Arsenic
Conducted By:	Denis McGrath	Concentration Units:	ug/L

Sampling Point ID:		MW-111I	MW-113B	MW-115B	MW-120B			
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (ug/L)						
1	5/5/2003	5	5	5				
2	8/12/2003	5	5	5	5			
3	11/4/2003		10	10	6.2			
4	2/26/2004		10	12				
5	6/16/2004	5	5	5	5			
6	9/1/2004		5	5	5			
7	11/16/2004		5	5	5			
8	4/18/2005	5	5	5	10			
9	10/24/2005	17	1	5	1.9			
10	4/18/2006	10	5.6	11	11			
11	10/31/2006		10	10	10			
12	4/17/2007		10	10	10			
13	10/16/2007			10	10			
14	4/22/2008	10	10	10	10			
15	10/28/2008			10	3.4			
16	4/21/2009	1.4	1.4	1.7	1.4			
17	10/27/2009	10	10	10	10			
18	4/13/2010	10	10	10	2.4			
19	10/20/2010	10	10	10	2.8			
20	4/21/2011	10	10	10	10			
21	10/6/2011	10	10	10	10			
22	4/26/2012	10	10	10	6.4			
23	10/4/2012	10	10	10	10			
24	4/19/2013	10	10	10	10			
25	10/17/2013	0.62	0.36	0.3	3.2			
26	4/16/2014	0.54		0.22	2.7			
27	10/23/2014	1.3	0.36	0.2	2.4			
28	4/22/2015	0.33		0.37	2.3			
29	10/15/2015	0.43	0.27	0.27	1.8			
30	4/15/2016	0.29		0.27	1.8			
31	12/13/2017	0.51	0.3	0.27	1.5			
32								
33								
34								
35								
Coefficient of Variation:		0.78	0.60	0.65	0.61			
Mann-Kendall Statistic (S):		86	13	108	119			
Confidence Factor:		98.8%	60.3%	96.6%	98.7%			
Concentration Trend:		Decreasing	Stable	Decreasing	Decreasing			



- Notes:**
- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
 - Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
 - Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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A P P E N D I X E

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION	
Site Name: Barkhamsted Landfill	Date of Inspection: 5/2/18
Location and Region: Barkhamsted, CT	EPA ID: CTD980732333
Agency, office, or company leading the five-year review: EPA-Region I	Weather/temperature: Clear - 85°
Remedy Includes (Check all that apply)	
☒ Landfill cover/containment ☐ Access Controls ☒ Institutional Controls ☐ Groundwater pump and treatment ☐ Surface water collection and treatment	☒ Monitored Natural Attenuation ☐ Groundwater containment ☐ Vertical Barrier Walls ☐ Other
Attachments: ☐ Inspection team roster ☐ Site Map	
II. INTERVIEWS (Check all that apply)	
1. O&M Site Manager: Debbie Angell Administrator (Name) (Title) (Date) Interviewed Debbie Angell at site ☒ At office ☐ By phone Tel. No. _____ Problems, suggestions; ☐ Report attached	
2. O&M Site staff : (Name) (Title) (Date)	
3. Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply Agency Contact (Name) (Title) (Date) (Phone No.) Problems; suggestions; ☐ Report attached Agency Contact (Name) (Title) (Date) (Phone No.) Problems; suggestions; ☐ Report attached Agency Contact (Name) (Title) (Date) (Phone No.) Problems; suggestions; ☐ Report attached Agency Contact (Name) (Title) (Date) (Phone No.) Problems; suggestions; ☐ Report attached	
4. Other Interviews (optional) ☐ Report attached.	

Five-Year Review Site Inspection Checklist

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)			
1. O&M Documents			
☒ O&M Manual	☒ Readily Available	☐ Up to Date	☐ N/A
☒ As-built drawings	☒ Readily Available	☐ Up to Date	☐ N/A
☒ Maintenance Logs	☐ Readily Available	☒ Up to Date	☐ N/A
Remarks:			
2. Site-Specific Health and Safety Plan			
	☒ Readily Available	☐ Up to Date	☐ N/A
Contingency Plan/Emergency Response Plan	☒ Readily Available	☐ Up to Date	☐ N/A
Remarks:			
3. O&M and OSHA Training Records			
	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			
4. Permits and Service Agreements			
☐ Air Discharge Permit	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Effluent Discharge	☐ Readily Available	☐ Up to Date	☒ N/A
☒ Waste Disposal, POTW	☐ Readily Available	☒ Up to Date	☐ N/A
☐ Other permits	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			
5. Gas Generation Records			
	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			
6. Settlement Monument Records			
	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			
7. Groundwater Monitoring Records			
	☒ Readily Available	☒ Up to Date	☐ N/A
Remarks:			
8. Leachate Extraction Records			
	☒ Readily Available	☒ Up to Date	☐ N/A
Remarks:			
9. Discharge Compliance Records			
☐ Air	☐ Readily Available	☐ Up to Date	☒ N/A
	☐ Readily Available	☐ Up to Date	☒ N/A
☐ Water (effluent)	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			
10. Daily Access/Security Logs			
	☐ Readily Available	☐ Up to Date	☒ N/A
Remarks:			

Five-Year Review Site Inspection Checklist

IV. O&M COSTS				
1. O&M Organization				
☐ State in-house ☒ PRP in-house ☐ Federal Facility in-house ☐ Other O&M costs not provided.	☐ Contractor for State ☒ Contractor for PRP ☐ Contractor for Federal Facility			
2. O&M Cost Records				
☐ Readily Available ☐ Funding mechanism/agreement in place Original O&M cost estimate		☐ Up to date ☐ Breakdown attached		
Total annual cost by year for review period if available				
From _____	To _____	_____	☐ Breakdown attached	
(Date)	(Date)	(Total Cost)		
From _____	To _____	_____	☐ Breakdown attached	
(Date)	(Date)	(Total Cost)		
From _____	To _____	_____	☐ Breakdown attached	
(Date)	(Date)	(Total Cost)		
From _____	To _____	_____	☐ Breakdown attached	
(Date)	(Date)	(Total Cost)		
From _____	To _____	_____	☐ Breakdown attached	
(Date)	(Date)	(Total Cost)		
3. Unanticipated or Unusually High O&M Costs During Review Period				
Describe costs and reasons:				
V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A				
A. Fencing				
1. Fencing damaged	☐ Location shown on site map	☒ Gates secured	☐ N/A	
Remarks:				
B. Other Access Restrictions				
2. Signs and other security measures	☐ Location shown on site map	☒ N/A		
Remarks: Signs along perimeter warning to keep out				

Five-Year Review Site Inspection Checklist

C. Institutional Controls (IC)			
1. Implementation and enforcement			
Site conditions imply ICs not properly implemented	☐ Yes	☒ No	☐ N/A
Site conditions imply ICs being fully enforced	☒ Yes	☐ No	☐ N/A
Type of monitoring (e.g., self-reporting, drive-by)			
Frequency			
Responsible party/agency CTDEEP			
Contact	Maurice Hamel	Supervisor, Rem. Div.	6/19/2008 (860) 424-3787
	(Name)	(Title)	(Date) (Tel No.)
Reporting is up-to-date	☐ Yes	☐ No	☒ N/A
Reports are verified by the lead agency	☐ Yes	☐ No	☒ N/A
Specific requirements in deed or decision documents have been met	☒ Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	☐ No	☒ N/A
Other problems or suggestions: ☐ Report attached			
CTDEEP manages the Environmental Land Use Restrictions (ELURs) which are recorded on the deed.			
2. Adequacy			
	☒ ICs are adequate	☐ ICs are inadequate	☐ N/A
Remarks:			
D. General			
1. Vandalism/trespassing			
	☐ Location shown on site map	☒ No vandalism evident	
Remarks:			
2. Land use changes on site			
	☐ N/A		
Remarks: Solar array constructed and operating on the southeastern portion of the RRDD property.			
3. Land use changes off site			
	☒ N/A		
Remarks:			
VI. GENERAL SITE CONDITIONS			
A. Roads			
	☒ Applicable	☐ N/A	
1. Roads damaged			
	☐ Location shown on site map	☐ Roads Adequate	☐ N/A
Remarks: Good condition			
B. Other Site Conditions			
Remarks:			

Five-Year Review Site Inspection Checklist

VII. LANDFILL COVERS ☒ Applicable ☐ N/A			
A. Landfill Surface			
1. Settlement (Low spots) Areal Extent Relatively small Remarks: Area of soft wet topsoil appears to collect precipitation.	☒ Location shown on site map Depth Shallow	☐ Settlement not evident	
2. Cracks Lengths Widths Remarks:	☐ Location shown on site map ☒ Cracking not evident Depths		
3. Erosion Areal Extent Remarks:	☐ Location shown on site map Depth	☒ Erosion not evident	
4. Holes Areal Extent 3 inches across Remarks: Small burrows; not very deep and maybe just getting started; observed in two locations	☒ Location shown on site map Depth 3 to 4 inches	☐ Holes not evident	
5. Vegetative Cover ☒ Grass ☒ Cover properly established ☒ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram) Remarks:			
6. Alternative Cover (armored rock, concrete, etc.) ☐ Applicable ☒ N/A Remarks:			
7. Bulges Areal Extent Remarks:	☐ Location shown on site map Height	☒ Bulges not evident	
8. Wet Areas/Water Damage ☐ Wet Areas/water damage not evident ☒ Wet Areas ☒ Location shown on site map Areal Extent Minor ☐ Ponding ☐ Location shown on site map Areal Extent ☒ Seeps ☒ Location shown on site map Areal Extent ~ 40 ft with iron staining in channel ☐ Soft subgrade ☐ Location shown on site map Areal Extent Remarks:			
9. Slope Instability ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability Areal Extent: Remarks:			

Five-Year Review Site Inspection Checklist

B. Benches ☒ Applicable ☐ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1. Flows Bypass Bench Remarks:	☐ Location shown on site map	☒ N/A or okay
2. Bench Breached Remarks:	☐ Location shown on site map	☒ N/A or okay
3. Bench Overtopped Remarks:	☐ Location shown on site map	☐ N/A or okay
C. Letdown Channels ☒ Applicable ☐ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off the landfill cover without creating erosion gullies.)		
1. Settlement Areal extent Depth Remarks:	☐ Location shown on site map	☒ No evidence of settlement
2. Material Degradation Areal extent Depth Remarks:	☐ Location shown on site map	☒ No evidence of degradation
3. Erosion Areal extent Depth Remarks:	☐ Location shown on site map	☒ No evidence of erosion
4. Undercutting Areal extent Depth Remarks:	☐ Location shown on site map	☒ No evidence of undercutting
5. Obstructions ☐ Location shown on site map Remarks:	Type Areal extent	☒ No obstructions
6. Excessive Vegetative Growth ☒ No evidence of excessive growth ☒ Vegetation in channels does not obstruct flow ☐ Location shown on site map Remarks:		

Five-Year Review Site Inspection Checklist

D. Cover Penetrations ☒ Applicable ☐ N/A		
1. Gas Vents ☐ Active ☒ Passive ☐ Properly Secured/Locked ☐ Functioning ☐ Routinely sampled ☒ Good condition ☐ Evidence of leaking at penetration ☐ Needs maintenance ☐ N/A Remarks:		
2. Gas Monitoring Probes ☐ Properly Secured/Locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leaking at penetration ☐ Needs maintenance ☒ N/A Remarks:		
3. Monitoring Wells (within surface of landfill) ☒ Properly Secured/Locked ☒ Functioning ☒ Routinely sampled ☒ Good condition ☐ Evidence of leaking at penetration ☐ Needs maintenance ☐ N/A Remarks:		
4. Leachate Extraction Wells ☐ Properly Secured/Locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leaking at penetration ☐ Needs maintenance ☒ N/A Remarks:		
5. Settlement Monuments ☐ Located ☐ Routinely sampled ☒ N/A Remarks:		
E. Gas Collection and Treatment ☐ Applicable ☒ N/A		
1. Gas Treatment Facilities ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ☐ Needs maintenance Remarks:		
2. Gas Collection Wells, Manifolds and Piping ☐ Good condition ☐ Needs maintenance Remarks:		
3. Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings) ☐ Good condition ☐ Needs maintenance ☐ N/A Remarks:		

Five-Year Review Site Inspection Checklist

F. Cover Drainage Layer ☒ Applicable ☐ N/A			
1. Outlet Pipes Inspected ☒ Functioning ☐ N/A Remarks: Outlet pipes functioning and flow observed.			
2. Outlet Rock Inspected ☐ Functioning ☒ N/A Remarks:			
G. Detention/Sediment Ponds ☒ Applicable ☐ N/A			
1. Siltation		Areal Extent Depth	☒ Siltation not evident
Remarks:			
2. Erosion		Areal Extent Depth	☒ Erosion not evident
Remarks:			
3. Outlet Works ☒ Functioning ☐ N/A Remarks:			
4. Dam ☐ Functioning ☒ N/A Remarks:			
H. Retaining Walls ☐ Applicable ☒ N/A			
1. Deformations		☐ Location shown on site map ☐ Deformation not evident	
Horizontal displacement Vertical displacement			
Rotational displacement			
Remarks:			
I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A			
1. Siltation		☐ Location shown on site map ☐ Siltation not evident	
Areal extent Depth			
Remarks:			
2. Vegetative Growth		☐ Location shown on site map ☒ N/A	
☐ Vegetation does not impede flow			
Areal extent Type			
Remarks:			
3. Erosion		☐ Location shown on site map ☒ N/A	
Areal extent Type			
Remarks:			
4. Discharge Structure		☐ Functioning ☒ N/A	
Remarks:			

Five-Year Review Site Inspection Checklist

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A			
1. Settlement		☐ Location shown on site map	☐ Settlement not evident
Areal extent		Type	
Remarks:			
2. Performance Monitoring		Type of monitoring	
☐ Performance not monitored		Frequency	
☐ Evidence of breaching		Head differential	
Remarks:			
IX. GROUNDWATER/SURFACE WATER REMEDIES ☐ Applicable ☒ N/A			
A. Groundwater Extraction Wells, Pumps and Pipelines ☐ Applicable ☒ N/A			
1. Pumps, Wellhead Plumbing and Electrical			
☐ Good condition	☐ All required wells properly operating	☐ Needs maintenance	☐ N/A
Remarks:			
2. Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances			
☐ Good condition	☐ Needs maintenance		
Remarks:			
3. Spare Parts and Equipment			
☐ Readily Available	☐ Good condition	☐ Requires Upgrade	☐ Needs to be provided
Remarks:			
B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A			
1. Collection Structures, Pumps and Electrical			
☐ Good condition	☐ Needs maintenance		
Remarks:			
2. Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances			
☐ Good condition	☐ Needs maintenance		
Remarks:			
3. Spare Parts and Equipment			
☐ Readily Available	☐ Good condition	☐ Requires Upgrade	☐ Needs to be provided
Remarks:			

Five-Year Review Site Inspection Checklist

C. Treatment System ☐ Applicable ☒ N/A			
1. Treatment Train (Check components that apply)			
☐ Metals Removal	☐ Oil/water separation	☐ Bioremediation	
☐ Air stripping	☐ Carbon adsorbers		
☐ Filters			
☐ Additive (e.g., chelation agent, flocculent)			
☐ Others			
☐ Good condition	☐ Needs maintenance		
☐ Sampling ports properly marked and functional			
☐ Sampling/maintenance log displayed and up to date			
☐ Equipment properly identified			
Quantity of groundwater treated annually			
Quantity of surface water treated annually			
Remarks:			
2. Electrical Enclosures and Panels (properly rated and functional)			
☒ N/A	☐ Good condition	☐ Needs maintenance	
Remarks:			
3. Tanks, Vaults, Storage Vessels			
☐ N/A	☒ Good condition	☐ Proper Secondary containment	☐ Needs maintenance
Remarks:			
4. Discharge Structures and Appurtenances			
☒ N/A	☐ Good condition	☐ Needs maintenance	
Remarks:			
5. Treatment Building(s)			
☒ N/A	☐ Good condition (esp. roof and doorways)	☐ Needs repair	
☐ Chemicals and equipment properly stored			
Remarks:			
6. Monitoring Wells (pump and treat remedy)			
☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☐ Good condition
☒ All required wells located	☐ Needs maintenance	☐ N/A	
Remarks:			

Five-Year Review Site Inspection Checklist

D. Monitoring Data			
1. Monitoring Data			
☐ Is routinely submitted on time	☒ Is of acceptable quality		
2. Monitoring Data Suggests:			
☒ Groundwater plume is effectively contained	☒ Contaminant concentrations are declining		
Remarks:			
E. Monitoring Natural Attenuation (MNA)			
1. Monitoring Wells (MNA remedy)			
☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☐ Good condition
☒ All required wells located	☐ Needs maintenance	☐ N/A	
Remarks:			
X. OTHER REMEDIES			
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.			
XI. OVERALL OBSERVATIONS			
A. Implementation of the Remedy			
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).			
The ROD selected Monitored Natural Attenuation coupled with institutional controls, public education, and long-term monitoring as the remedy. The contractor performing the long-term monitoring has provided data and progress reports on-time, and of acceptable quality.			
For purposes of this Five-Year Review, the operations and maintenance of the Non-Time-Critical Response Action (NTCRA) is also considered part of the selected remedy. The NTCRA constructed the landfill cap and associated appurtenances. The operation and maintenance of this landfill was evaluated as part of this Five-Year Review. The landfill appears to be in good condition with minimal problems noted during the site visit.			
B. Adequacy of O&M			
Describe issues and observations related to the implementation and scope of the O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.			
The operations and maintenance of this landfill appears adequate. No significant damage was noted.			

PHOTODOCUMENTATION LOG
BARKHAMSTED-NEW HARTFORD LANDFILL SUPERFUND SITE
FIVE-YEAR REVIEW SITE VISIT - MAY 2, 2018
BARKHAMSTED, CONNECTICUT



SCENE: View facing southeast of the northern toe of the landfill cap and the leachate management tank.
DATE: May 2, 2018



SCENE: View facing east of a small animal burrow in the landfill vegetated layer.
DATE: May 2, 2018



SCENE: View facing south of the north-facing landfill slope. The remaining landfill slopes were in similar condition.
DATE: May 2, 2018



SCENE: View facing west of the western downchute and manhole MH-1. Water was noted flowing in the downchute.
DATE: May 2, 2018

PHOTODOCUMENTATION LOG
BARKHAMSTED-NEW HARTFORD LANDFILL SUPERFUND SITE
FIVE-YEAR REVIEW SITE VISIT - MAY 2, 2018
BARKHAMSTED, CONNECTICUT



SCENE: View facing north of a possible settlement area near gas vent No. 10 where cut vegetation and water have collected.
DATE: May 2, 2018



SCENE: View facing southeast the solar array and bulky waste management area..
DATE: May 2, 2018



SCENE: View facing northwest of the settlement pond and high-water overflow.
DATE: May 2, 2018



SCENE: View facing southwest of the unnamed stream with iron-colored staining entering the stream along its eastern bank.
DATE: May 2, 2018

A P P E N D I X F

INTERVIEW RECORD

Site Name: Barkhamsted Landfill		EPA ID No.: CTD980732333	
Subject: Third Five-Year Review		Time: 12:00	Date: 5/24/18
Type: Telephone Visit <u>Other - Email</u>		Incoming Outgoing	
Location of Visit:			
Contact Made By:			
Name: Denis McGrath	Title: Project Manager	Organization: Nobis Engineering, Inc.	
Individual Contacted:			
Name: Maurice Hamel	Title: Project Manager	Organization: CT DEEP	
Telephone No: 860-424-3787		Street Address: 79 Elm Street	
Fax No:		City, State, Zip: Hartford, Connecticut 01605	
E-Mail Address: maurice.hamel@po.state.ct.us			
Summary Of Conversation			
Q1: Are there changes to State laws/regulations that could impact the remedy's protectiveness? A1: No, the changes made to the RSRs will not likely impact the remedy's protectiveness Q2: Please describe any complaints or violations or other event requiring Departmental response. Has communication with those responsible for O&M been responsive? A2: CTDEEP is not aware of any complaints or concerns regarding the site. Q3: Does the Department have any comments, suggestions, or recommendations to EPA regarding the project? A3: The DEEP would provide comments on the potential changes made to the cleanup standards or other remedy modifying changes.			

INTERVIEW RECORD

Site Name: Barkhamsted Landfill		EPA ID No.: CTD980732333	
Subject: Third Five-Year Review		Time: 14:00	Date: 5/2/18
Type: Telephone <u>Visit</u> Other		Incoming Outgoing	
Location of Visit: On-Site			
Contact Made By:			
Name: Denis McGrath	Title: Project Manager	Organization: Nobis Engineering, Inc.	
Individual Contacted:			
Name: Debbie Angell	Title: District Administrator	Organization: Regional Refuse District No. 1	
Telephone No: 860-379-1972		Street Address:	
Fax No:		City, State, Zip:	
E-Mail Address: dangell@rrdd1.com			
Summary Of Conversation			
Q1 - Is the remedy functioning? A1 - Yes, the remedy appears to be functioning as intended. Q2 - Are there any development plans on-going? A2 - None at the moment Q3 - Has there been any O&M challenges recently? A3 - Vegetation buildup in the rip rap chutes has been occurring, but is addressed with herbicide application. The leachate tank has not been pumped in over two years, and is approximately half full. Q4 - Has there been notable trespassing/vandalism? A4 - No and there are now CCTV cameras throughout the area Q5 - Describe the solar array A5 - It is leased to Lodestar and consists of 4,800 panels. It went on-line in March 2016. Q6 - Have there been any optimization efforts? A6 - The transfer station operations have been optimized for better traffic flow. The facility takes in a significant amount of recycleables annually.			

INTERVIEW RECORD

Site Name: Barkhamsted Landfill		EPA ID No.: CTD980732333	
Subject: Third Five-Year Review		Time: 12:00	Date: 6/1/18
Type: Telephone Visit <u>Other</u>		Incoming Outgoing	
Location of Visit: N/A			
Contact Made By:			
Name: Denis McGrath	Title: Project Manager	Organization: Nobis Engineering, Inc.	
Individual Contacted:			
Name: Don Stein	Title: First Selectman	Organization: Town of Barkhamsted	
Telephone No: 860-379-8285		Street Address:	
Fax No:		City, State, Zip:	
E-Mail Address: dstein@barkhamsted.us			
Summary Of Conversation			
Q1 - What is your overall impression of the Barkhamsted-New Hartford Landfill Superfund Site project? A1 - I believe the remediation was done in an excellent manner and the mound has been maintained very well. Q2 - Does that Town have any concerns regarding the site? A2 - We do not have any concerns about the site. Q3 -Has there been any changes to municipal zoning, ordinances, etc. at or near the site that EPA should be made aware of? A3 - There have been no zoning or ordinance changes at or near the site. Q4 -Has the Town received any complaints regarding the Site? A4 - The Town has not received any complaints Q5 - Has the Town's health department received any requests to install private water supply wells near the site within the past 5 years? A5 - The only well that has been installed, with full approval by the Farmington Valley Health District, serves the RRDD office and the Town Highway Garage. Q6 - Does the Town feel informed enough about the site? A6 - Yes Q7 - Does the Town have any questions, comments, or recommendations to EPA regarding the site? A7 - We have no questions at this time, but are obviously interested in when the remediation will be considered to be complete.			

A P P E N D I X G

MEMO

To:

Almerinda Silva
Remedial Project Manager
EPA-New England, Region 1
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From:

Monica Heintz and Allen Walker
Arcadis

Date:

December 29, 2016

Arcadis Project No.:

BN012392.2014

Subject:

Revised Monitored Natural Attenuation Timeframe to Cleanup Assessment
Technical Memorandum

INTRODUCTION

Arcadis U.S., Inc. (Arcadis) has prepared this technical memorandum (memo) to summarize results from a revised monitored natural attenuation (MNA) timeframe to cleanup goals evaluation, and to summarize evidence that the MNA process remains on-going at the Barkhamsted-New Hartford Landfill in Barkhamsted, New Hartford, Connecticut (Site). This memo was prepared to fulfill a recommendation of the Third Five-Year Review Report (United States Environmental Protection Agency [USEPA] 2013).

Cleanup goals for Site constituents of concern (COC) were established in the 2001 Record of Decision (ROD; USEPA 2001b), and are generally the more stringent of state or federal standards. At the time of the Third Five-Year Review Report, MNA had not restored groundwater to below cleanup goals. COC that remained above the applicable cleanup goals included benzene, methylene chloride, toluene, trichloroethene (TCE), chloroethane, 2,4-dimethylphenol (2,4-DMP), 1,4-dichlorobenzene (1,4-DCB), arsenic and manganese. Based on attenuation rates during the period preceding the Third Five-Year Review Report, monitoring well and COC combinations were identified where it appeared that cleanup goals may not be achieved by December 31, 2017 (Table 1).

Monitoring wells where cleanup goals were not projected to be achieved are located within the landfill footprint and immediately downgradient, and not near identified human or ecological receptors. The original time estimate ROD for groundwater concentrations to reach applicable cleanup goals was based only on two COCs (4-methylphenol and 2-butanone). These COCs have achieved applicable cleanup goals; however, it has become evident that attenuation rates for these COCs are not necessarily applicable to other COCs remaining in groundwater. Therefore, revised estimates of the timeframe to achieve cleanup goals have been calculated. These revised estimates are based on updated and expanded analysis of COC concentration trends over time. The evaluation of the on-going progress of MNA is based on consideration of downgradient delineation of COCs and an assessment of geochemical conditions influencing attenuation processes. Monitoring well MW-1S was included in the Third-Five Year Review Report assessment. However, because this monitoring well is within the landfill footprint, and thus not required to achieve cleanup goals within the specified timeframe, it has been excluded from this updated analysis.

EVALUATION OF COC CONCENTRATION TRENDS AND TIMEFRAME TO CLEANUP

Methodology

Two trend analysis methods were used to assess MNA progress. First, to determine which monitoring well and COC combinations appear to be on track to achieve the December 2017 cleanup goals, groundwater monitoring data collected between spring 2008 and spring 2016 were reviewed using methods presented in *An Approach for Evaluating the Progress of Natural Attenuation in Groundwater* by John Wilson (2011), and used during the previous five-year review. Then, in cases where this analysis indicated that cleanup goals would not be achieved within the designated timeframe, a linear regression analysis was conducted over the full monitoring period to determine monitoring well and COC combination-specific attenuation timeframes. Screening criteria used to identify monitoring wells and COC combinations for consideration during the Third Five-Year Review Report were also used in this updated and expanded assessment, and include the following:

1. Duplicate samples, bottle blanks, equipment blanks, trip blanks, and other laboratory-related samples were excluded.
2. Only groundwater samples were considered; all other media were excluded.
3. Groundwater monitoring wells must have been sampled annually or semi-annually throughout the reporting period (spring 2008 through spring 2016).
4. The 2008 through 2016 COC data set at each groundwater monitoring well had at least 75 percent (%) of concentrations greater than the laboratory reporting limit and at least 50% of values measured over this period were greater than the applicable cleanup goals.

However, the final criteria was modified to include COC and monitoring well combinations where at least 70% of concentrations were greater than laboratory reporting limits. This modification was made to include additional COC and monitoring well combinations where COC concentrations have not yet achieved cleanup goals. For both trend evaluation methods, laboratory-qualified concentrations (J-flag, B-flag) were taken as the reported value and concentrations below laboratory reporting limits (U-flag) were taken at the reporting limit.

Assessment of Monitoring Well and COC Combinations Predicted to Achieve 2017 Cleanup

Following the methodology of Wilson (2011), an interim remedial goal was calculated and compared to a statistical confidence belt on the regression line fit to the data set. Confidence belts of 80% and 95% were

selected for this evaluation, and describe the rates of attenuation that are faster than the regression line. If the confidence belt is higher than the value of the interim goal, then the rate of natural attenuation over the time period represented by the regression is too slow to attain the cleanup goal by the time specified at that level of confidence (Wilson 2011). Charts illustrating the results of this evaluation are presented in Attachment A, and results are summarized in Table 1. The evaluation suggests that the following monitoring well and COC combinations will achieve cleanup goals by December 2017, as indicated by the interim goal falling above the regression line and both the 80% and 95% confidence bounds:

- Manganese at overburden monitoring wells MW-106S and MW-120S,
- Benzene at bedrock well MW-5B,
- Chloroethane at bedrock well MW-111I, and
- Manganese at bedrock monitoring wells MW-102B and MW-120B.

At overburden monitoring well MW-101S during two of the past three monitoring events, concentrations of 1,4-DCB were below the laboratory reporting limit; however, these laboratory reporting limits were abnormally elevated (20 micrograms per liter [µg/L] and 42 µg/L). With the exception of these monitoring events, between spring 2008 and spring 2016, concentrations of 1,4-DCB were between a laboratory reporting limit of 5 µg/L and a measured concentration of 16 µg/L. Therefore, setting the 1,4-DCB concentration equal to the laboratory reporting limit during these two recent events is not likely representative of true concentrations of 1,4-DCB in groundwater. When these monitoring dates are excluded from the evaluation, it is apparent that 1,4-DCB concentrations at monitoring well MW-101S are on track to achieve the cleanup goal by December 2017.

Revised Timeframe to Cleanup Estimates

For each monitoring well and COC combination where results of the Wilson (2011) method indicate that cleanup goals are not likely to be achieved by December 2017 (Table 1), a linear regression analysis was conducted to evaluate if the temporal trend in concentrations could be described via first-order decay, the trend direction, and to predict a timeframe to cleanup in the case of statistically significant decreasing trends. For this evaluation, data collected over the full monitoring history were evaluated. Additionally, measured concentrations were compared with federal maximum contaminant levels (MCLs).

Linear regression analyses were conducted using natural log-normalized concentration data (i.e., first-order decay). Trend directions were defined as decreasing if the slope of the best fit line was negative, and increasing if the slope was positive. The R^2 value is a measure of how well the linear regression line fits the site data; R^2 values less than 0.1 indicate a weak fit of the linear regression to the data, therefore, results with R^2 values less than 0.1 were designated as having no trend. In these cases, data were visually examined to determine if the poor fit of the linear regression to the data was due to stable concentrations (neither increasing or decreasing) or due to variability (changing through time, but not in a consistent direction). For data sets where the linear regression provided an adequate fit to the data, the p-value of the correlation provides a measure of the level of significance of the statistical test. Correlations were accepted as statistically significant for p-values less than or equal to 0.1 (90% confidence). The average estimated timeframe to cleanup for each monitoring well and COC combination was predicted based on the equation of the best fit line. Additionally, the upper and lower 90% confidence levels for the slope and the y-intercept of the best fit line were calculated, and a range of dates to achieve cleanup was calculated for each monitoring well and COC combination. Results of the linear regression analysis are summarized in Table 2. Linear regression analysis details are provided in Attachment B.

Overburden Monitoring Wells

Linear regression analysis results from overburden monitoring well and COC combinations where there is evidence that attenuation rates may not be sufficient to achieve the December 2017 cleanup goal indicate the following:

- **2,4-DMP** is present at overburden monitoring well MW-101S at a recent concentration of 160 µg/L, and show no trend over time. Concentrations are stable and between 160 and 510 µg/L over the past five monitoring events. The cleanup goal for 2,4-DMP is 10 ug/L, and there is not a MCL for this constituent.
- **Arsenic** is present at overburden monitoring wells MW-4S, and MW-101S at recent concentrations of 8.3 µg/L, and 17 µg/L, respectively. Concentrations of arsenic at monitoring well MW-4S show a statistically significant decreasing trend. At this monitoring well, arsenic concentrations are projected to achieve the cleanup goal between 2016 and 2106, with the line of best fit indicating an estimated date in the year 2030. The wide range in predicted dates for arsenic achieving the cleanup goal is attributable to variability in the data caused by measurement of a few relatively elevated concentrations over time. These concentrations are not characteristic of current conditions at this monitoring well, and therefore the timeframe predicted by the line of best fit is interpreted to be the best representation of the predicted timeframe to cleanup. At monitoring well MW-101S, concentrations of arsenic show no trend over time, and concentrations are stable and between 14 and 17 µg/L over the past five monitoring events. The cleanup goal for arsenic is 5 µg/L, and the MCL is 10 µg/L. Arsenic concentrations at monitoring well MW-4S have been less the MCL since October 2009.
- **Benzene** is present at overburden monitoring wells MW-4S, MW-5S, S-3 and MW-101S at recent concentrations between approximately 0.41 and 10 µg/L. Benzene concentrations are statistically significantly decreasing at monitoring wells MW-4S, MW-5S, and S-3, with predicted dates of achieving cleanup goals based on the best fit line between 2018 and 2026, and as late as 2057 when the 90% confidence range is considered. During the most recent monitoring event, benzene concentrations were below a detection limit of 0.41 µg/L at monitoring wells MW-5S and S-3. At monitoring well MW-101S, when all data is considered, elevated detection limits near the beginning and end of the monitoring period skew the trend line. Therefore, an additional analysis was conducted with these elevated detection limits excluded. Based on this analysis, there is no benzene concentration trend at this location, but concentrations are stable and between approximately 6 and 14 µg/L over the past five monitoring events. The cleanup goal for benzene is 0.5 µg/L, and the MCL is 5 µg/L. Benzene concentrations at monitoring well MW-4S have been less than the MCL since April 2009, and at monitoring wells MW-5S and S-3 benzene concentrations have been less than the MCL during each sampling event.
- **Manganese** is present at overburden monitoring wells MW-4S, MW-5S, S-3, MW-101S, and MW-103S at recent concentrations between approximately 88 and 3,400 µg/L. Manganese concentrations are statistically significantly decreasing at monitoring wells MW-4S and S-3, with timeframes to cleanup based on the best fit line estimated 2046 and 2062, and as late as 2121 when the 90% confidence range is considered. Manganese concentrations show no trend at monitoring wells MW-5S and MW-101S. At monitoring well MW-101S, manganese concentrations are stable between approximately 70 and 100 µg/L. At monitoring well MW-5S, manganese concentrations have historically been stable in the range of approximately 1,000 to 2,000 µg/L; however, concentrations between 320 and 590 µg/L were measured during three of the past four

sampling events. At monitoring well MW-103S, manganese concentrations are statistically significantly increasing, with a concentration of 3,400 µg/L measured most recently. Increasing manganese concentrations at this monitoring location are attributed to groundwater geochemical conditions, as discussed below. The cleanup goal and MCL for manganese is 50 µg/L.

- **Toluene** is present at overburden monitoring well MW-101S, most recently at a concentration of 26 µg/L. Toluene concentrations are statistically significantly decreasing, with a projected date to achieve the cleanup goal of 2019, and as late as 2023 when the 90% confidence range is considered. The cleanup goal for toluene is 0.5 µg/L, and the MCL is 1,000 µg/L. Toluene concentrations have been less than the MCL at monitoring well MW-101S since September 2004.

Bedrock Monitoring Wells

Linear regression analysis results from bedrock monitoring well and COC combinations where cleanup goals were not projected to be achieved by December 2017 indicate the following:

- **Arsenic** is present at monitoring well MW-4R, and shows no trend. Arsenic concentrations at this location are stable, between 1.8 and 8.8 µg/L over the full historical monitoring period. The cleanup goal for arsenic is 5 µg/L, and the MCL is 10 µg/L.
- **Benzene** is present at monitoring well MW-4R, and shows a statistically significant decreasing trend with a predicted timeframe to achieving the cleanup goal of 2026 to 2041, with the line of best fit indicating an estimated date in the year 2032. The cleanup goal for benzene is 0.5 µg/L, and the MCL is 5 µg/L. Benzene concentrations at MW-4R have been less than the MCL during each sampling event.
- **Manganese** is present at monitoring wells MW-4R, MW-5B, MW-101B, and MW-103B with recent concentrations between 1,300 and 3,900 µg/L. Manganese concentrations at monitoring well MW-4R show a statistically significant decreasing trend, with a predicted timeframe to achieving the cleanup goal of 2092 to 2213, with the line of best fit indicating an estimated date in the year 2128. Manganese concentrations at monitoring wells MW-5B and MW-101B show no trend. Manganese concentrations at these wells are stable between approximately 2,500 and 3,500 µg/L at MW-5B, and between approximately 3,300 and 6,100 µg/L at MW-101B. At monitoring well MW-103B, manganese concentrations are statistically significantly increasing, with a concentration of 1,300 µg/L measured most recently. Increasing manganese concentrations at this monitoring location are attributed to groundwater geochemical conditions, as discussed below. The cleanup goal and MCL for manganese is 50 µg/L.
- **TCE** is present at monitoring well MW-120B and shows a statistically significant decreasing trend. Although analysis using the method of Wilson (2011) indicated TCE concentrations at monitoring well MW-120B will not reliably reach the cleanup goal by December 2017, the best fit line of the linear regression analysis predicts that the cleanup goal will be achieved in 2017. Based on consideration of the 90% confidence levels of the slope and intercept, the cleanup goal may be achieved as late as 2021. TCE concentrations at this monitoring location have been less than or equal to 1.1 µg/L since 2007. The cleanup goal for TCE is 0.5 µg/L, and the MCL is 5 µg/L. TCE concentrations at MW-120B have been less than the MCL during each sampling event.

Summary

In summary, COCs that are not predicted to achieve cleanup goals by December 2017 at one or more monitoring wells include: 2,4-DMP, arsenic, benzene, manganese, toluene, and TCE, based on cleanup goals established in the ROD and evaluated in previous Five-Year Review Reports. Cleanup goals are

projected to be achieved by approximately 2030 for the majority of monitoring well and COC combinations where trend analyses indicate statistically significant decreasing concentrations, although some timeframes extend somewhat further when the most conservative case at 90% confidence is considered (Table 2).

Monitoring well and COC combinations that show no trend, a statistically significant decreasing trend with a predicted year to achieving cleanup goals substantially later than 2030, or an increasing concentration trend include the following (Table 2):

- 2,4-DMP at monitoring well MW-101S,
- Arsenic at monitoring wells MW-101S and MW-4R,
- Benzene at monitoring well MW-101S, and
- Manganese at each monitoring well where the December 2017 cleanup goal is not projected to be achieved (MW-4S, S-3, MW-5S, MW-101S, MW-103S, MW-4R, MW-5B, MW-101B, and MW-103B).

Importantly, as discussed in the Third Five-Year Review Report, arsenic and manganese are commonly found within subsurface soils, and elevated concentrations in groundwater may be related to landfill-associated processes, specifically strongly reducing geochemical conditions. As discussed in the 2001 site-specific review of arsenic attenuation, geochemical conditions are a strong control on the presence and persistence of this COC (USEPA 2001a). Each of the COCs above are recalcitrant under strongly reducing conditions, and, as discussed below, there is ongoing evidence that conditions in the localized area surrounding the monitoring wells listed above are strongly reducing. Downgradient delineation and oxidizing conditions provide evidence that although COCs may be long-lived at the landfill boundary, MNA processes mitigate risk to potential downgradient human and ecological receptors.

EVALUATION OF ONGOING PROGRESS OF MNA

Although COC concentrations remain above cleanup goals at a subset of monitoring wells within the landfill footprint and immediately downgradient, there is evidence that the MNA process remains ongoing and that MNA is effective in mitigating risk to identified human and ecological receptors. As discussed above, COC concentrations are generally decreasing over time where they remain present, although some COCs are recalcitrant in the area at the edge of the landfill boundary, between overburden monitoring wells MW-101S and MW-5S and between bedrock wells MW-101B and MW-5B. Geochemical indicator parameters indicate that in this area conditions are strongly reducing.

Downgradient COC Delineation

In overburden, COCs are delineated in the downgradient direction to concentrations less than cleanup goals by monitoring wells MW-104S, MW-105S, MW-111S, and MW-118S (Figure 1). These wells were sampled most recently in 2003 (MW-105S and MW-118S), and in 2014 (MW-104S and MW-111S). In bedrock, COCs are delineated in the downgradient direction to concentrations less than cleanup goals by monitoring wells MW-102B, MW-104B, MW-105B, MW-108B, MW-111B, and MW-117B (Figure 2). These wells were sampled most recently in 2003 (MW-105B, MW-108B, MW-117B), 2014 (MW-104B), and 2016 (MW-102B and MW-111B). Downgradient wells have not been sampled since 2003 or 2014 because they were optimized out of the sampling program. Delineation at these monitoring wells provides a line of evidence that MNA processes are effective at mitigating downgradient migration of COC concentrations remaining at the landfill boundary.

Evaluation of Geochemical Conditions

Microbial metabolism includes oxidation of an electron donating substrate coupled with the reduction of compounds that are able to serve as electron acceptors. Electron acceptors include oxygen, nitrate, manganese oxides, ferric iron (Fe^{3+}), sulfate, and carbon dioxide (CO_2). Depending on the electron acceptor used, the microbial processes are termed aerobic (i.e., with oxygen) or anaerobic (i.e., with nitrate, manganese, iron, sulfate, or carbon dioxide). The use of available electron acceptors during metabolic biodegradation typically occurs in the following order, from greater energy availability to lesser energy availability: oxygen, nitrate, manganese oxides, iron oxides, sulfate, and carbon dioxide (methanogenesis). The relative importance of the various electron acceptors utilized can be evaluated by assessing availability and changes in concentrations of electron acceptors and their reduced counterparts along generalized flow paths. Aerobic biodegradation and nitrate reduction result in decreased concentrations of dissolved oxygen and nitrate (respectively) in groundwater, relative to background concentrations. Reduction of iron and manganese oxides results in increased concentrations of dissolved iron and manganese in groundwater. Sulfate reduction results in decreased sulfate concentrations in groundwater, relative to background. Methanogenesis results in increased concentrations of methane in groundwater.

It is common for biodegradation of organic constituents within landfills to result in consumption of the highest energy electron acceptors (oxygen, nitrate, iron, and manganese oxides), resulting in generation of strongly reducing conditions, and production of dissolved iron and manganese. Based on a review of historical geochemical indicator parameter data, and on results presented in previous reports (USEPA 2001, 2013), background groundwater (i.e., upgradient and downgradient from monitoring wells where COCs remain present) is generally oxidizing to mildly reducing, while groundwater in areas where COCs remain present is reducing to strongly reducing.

The coupling of oxidation of organic materials to reduction of manganese oxides likely contributes to elevated concentrations of manganese in groundwater. Similarly, coupling of oxidation of organic materials to reduction of geologic iron oxides may release arsenic from these minerals, and inhibit sequestration of arsenic in these minerals. Finally, oxidation of organic COCs, including benzene and 2,4-DMP, is generally slower when paired to electron acceptors other than oxygen (i.e., under reducing conditions). Therefore, strongly reducing conditions created by landfill processes are interpreted to result in recalcitrance of COCs remaining in groundwater. However, as groundwater is transported further downgradient, the absence of organic carbon driving reducing conditions results in a return to background oxidizing conditions. As oxidizing conditions are restored, remaining COC rapidly attenuate, as evidenced by low to non-detect concentrations of COCs at downgradient monitoring points.

CONCLUSIONS AND RECOMMENDATIONS

Based on this assessment, MNA processes are ongoing and mitigate risk from landfill-related COCs in groundwater to potential human and ecological receptors. While current conditions indicate that cleanup goals will be achieved by December 2017 for a subset of monitoring well and COC combinations, most remaining impacts are not expected to reach cleanup goals within this timeframe. As discussed in the Third Five-Year Review Report, this is because the December 2017 cleanup target was based on only two COCs, and it is now apparent that attenuation rates for these COCs were not representative of attenuation rates for remaining COCs under current geochemical conditions. An undated evaluation of the timeframe to cleanup was conducted herein, and the majority of COCs remaining in groundwater are projected to achieve cleanup goals by approximately 2030. In cases where cleanup goals are not projected to be achieved by 2030, the recalcitrance of COCs (e.g., arsenic and manganese) are interpreted to be

attributable to reducing geochemical conditions, resulting from landfill processes. Oxidizing groundwater conditions outside of the area of the landfill and downgradient delineation of COCs provide evidence that although some COCs may be long-lived at the landfill boundary, these COCs do not pose a risk to potential receptors. As a result of the ongoing degradation of organic materials underneath the landfill, it is likely that in the future the constituents that are driving the depletion of high-energy electron acceptors will be exhausted, groundwater conditions will gradually become less reducing, and currently recalcitrant COCs will attenuate naturally.

Arcadis recommends a review of the compliance boundary with consideration of the reducing area to establish a more representative boundary where COCs are likely to persist. This boundary would need to remain protective of human health and the environment. A revised groundwater monitoring program would be implemented to assess the groundwater quality and ensure site conditions are protective of human health and the environment.

Table 1 – Summary of Evaluation of Likelihood of Achieving Current Cleanup Goal

Table 2 – Summary of Linear Regression Analysis of Groundwater Analytical Data

Attachment A – Charts Illustrating the 80% and 95% Confidence Interval of Regression Line

Attachment B - Linear Regression Analysis Details

REFERENCES

United States Environmental Protection Agency [USEPA]. 2001a. Review Comments on the “Geochemical Modeling for Assessing Natural Attenuation of Arsenic at the Barkhamsted New Hartford Landfill” Superfund Site, Barkhamsted, CT. March 22.

USEPA. 2001b. EPA Superfund Record of Decision: Barkhamsted-New Hartford Landfill OU1 Barkhamsted, CT. September 28.

USEPA. 2013. Five-Year Review Report Third Five-Year Review for Barkhamsted-New Hartford Landfill Barkhamsted, New Hartford, Connecticut. September.

Wilson, J.T. 2011. An Approach for Evaluating the Progress of Natural Attenuation in Groundwater. EPA/600/R-11/204.

TABLES



Table 1
Summary of Evaluation of Likelihood of Achieving Current Cleanup Goal
Revised Monitored Natural Attenuation Timeframe to Cleanup Assessment Technical Memorandum
Barkhamsted-New Hartford Landfill; Barkhamsted, New Hartford, Connecticut

	Well ID	Constituent	2013 Evaluation	2016 Evaluation
			Projected to meet 2017 goal?	Projected to meet 2017 goal? ¹
Overburden	MW-101S	1,4-dichlorobenzene	Yes	Yes (when elevated recent ND excluded)
	MW-101S	2,4-dimethylphenol	Yes	No
	MW-4S	Arsenic	Yes	No
	MW-101S	Arsenic	No	No
	MW-4S	Benzene	Yes	No
	MW-5S	Benzene	Yes	No (with less than 80% confidence)
	S-3	Benzene	Yes	No (between 80% and 95% confidence)
	MW-101S	Benzene	No	No
	MW-4S	Manganese	No	No
	S-3	Manganese	No	No
	MW-5S	Manganese	No	No
	MW-101S	Manganese	No	No
	MW-103S	Manganese	Yes	No
	MW-106S	Manganese	Yes	Yes
	MW-120S	Manganese	Yes	Yes
	MW-101S	Toluene	Yes	No
Bedrock	MW-4R	Arsenic	Yes	No
	MW-4R	Benzene	No	No
	MW-5B	Benzene	Yes	Yes
	MW-111I	Chloroethane	Yes	Yes
	MW-4R	Manganese	No	No
	MW-5B	Manganese	No	No
	MW-101B	Manganese	No	No
	MW-102B	Manganese	Yes	Yes
	MW-103B	Manganese	Yes	No
	MW-120B	Manganese	Yes	Yes
	MW-120B	Trichloroethene	No	No

Notes:

¹ Unless otherwise noted, where concentrations are not projected to achieve the 2017 cleanup goal, this result is at greater than 95% confidence.

% = percent

Monitoring Zone	Constituent	Well	Federal MCL (µg/L)	Cleanup Goal (µg/L) ¹	Data Range						Linear Regression Analysis											Notes
					Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Concentration Measured Most Recently (µg/L)	% of Data Above Laboratory Reporting Limit	Start Date	End Date	Coefficient of Determination, R-squared ²	p-value of Correlation (Significance of Slope)	Estimated Attenuation Rate (day ⁻¹) ³	Minimum Attenuation Rate (90% confidence) (day ⁻¹) ³	Attenuation Half-life (days)	Trend Direction	Significance of Trend ⁴	Projected Year to Cleanup Goal	Range in Projected Years to Cleanup Goal (90% Confidence) ⁵		Projected Year to MCL	
Overburden	2,4-dimethylphenol	MW-101S	--	10	9.5	1,300	160	89	5/7/2003	4/14/2016	<0.01	0.97	NA	NA	NA	No Trend	NA	NA	NA	NA	--	
	Arsenic	MW-4S	10	5	4.4	26	8.3	100	5/5/2003	4/14/2016	0.14	0.07	0.0001	0.0000	8,411	Decreasing	Significant	2030	2016	2106	Below MCL since October 2009	
	Arsenic	MW-101S	10	5	6.3	50	17	84	5/7/2003	4/14/2016	0.07	0.21	NA	NA	NA	No Trend	NA	NA	NA	NA	NA	
	Benzene	MW-4S	5	0.5	1	25	2.1	72	5/5/2003	4/14/2016	0.43	<0.01	0.0003	0.0002	2,108	Decreasing	Significant	2026	2018	2039	Below MCL since April 2009	
	Benzene	MW-5S	5	0.5	0.41	5	0.41	76	5/7/2003	4/14/2016	0.19	0.02	0.0002	0.0001	4,055	Decreasing	Significant	2025	2015	2057	Below MCL during each sampling event	
	Benzene	S-3	5	0.5	0.29	5	0.41	71	5/2/2003	4/13/2016	0.25	<0.01	0.0002	0.0001	3,275	Decreasing	Significant	2018	2012	2033	Below MCL during each sampling event	
	Benzene	MW-101S	5	0.5	5	100	21	78	5/7/2003	4/14/2016	0.10	0.10	0.0002	0.0000	NA	Decreasing	NS	NA	NA	NA	NA	Results influenced by elevated detection limits
	Benzene	MW-101S	5	0.5	5	14	10	95	9/2/2004	10/24/2014	0.01	0.63	NA	NA	NA	No Trend	NA	NA	NA	NA	NA	Additional analysis conducted with elevated detection limit results removed
	Manganese	MW-4S	50	50	770	6,550	1,600	100	5/5/2003	4/14/2016	0.32	<0.01	0.0002	0.0001	2,816	Decreasing	Significant	2046	2031	2082	--	
	Manganese	S-3	50	50	230	3,900	890	100	5/2/2003	4/13/2016	0.20	<0.01	0.0002	0.0001	3,867	Decreasing	Significant	2062	2041	2121	--	
	Manganese	MW-5S	50	50	320	2,200	320	100	5/7/2003	4/14/2016	<0.01	0.79	NA	NA	NA	No Trend	NA	NA	NA	NA	--	
	Manganese	MW-101S	50	50	73	6,400	88	100	5/7/2003	4/14/2016	0.03	0.40	NA	NA	NA	No Trend	NA	NA	NA	NA	--	
	Manganese	MW-103S	50	50	13	3,400	3,400	89	5/1/2003	10/22/2014	0.42	<0.01	-0.0007	-0.0010	NA	Increasing	Significant	NA	NA	NA	--	
	Toluene	MW-101S	1,000	0.5	3.4	12,000	26	93	5/7/2003	4/14/2016	0.72	<0.01	0.0014	0.0012	491	Decreasing	Significant	2019	2015	2023	Below MCL since September 2004	
Bedrock	Arsenic	MW-4R	10	5	1.8	8.8	8.8	100	4/22/2008	4/14/2016	<0.01	0.73	NA	NA	NA	No Trend	NA	NA	NA	NA	Below MCL during each sampling event	
	Benzene	MW-4R	5	0.5	2	5	2.1	87	4/22/2008	4/14/2016	0.71	<0.01	0.0002	0.0002	2,931	Decreasing	Significant	2032	2026	2041	Below MCL during each sampling event	
	Manganese	MW-4R	50	50	2,900	5,000	3,900	100	4/22/2008	4/14/2016	0.46	<0.01	0.0001	0.0001	6,664	Decreasing	Significant	2128	2092	2213	--	
	Manganese	MW-5B	50	50	60	3,540	2,700	100	5/6/2003	4/14/2016	0.01	0.57	NA	NA	NA	No Trend	NA	NA	NA	NA	--	
	Manganese	MW-101B	50	50	90	6,100	3,700	100	5/7/2003	4/14/2016	<0.01	0.99	NA	NA	NA	No Trend	NA	NA	NA	NA	--	
	Manganese	MW-103B	50	50	27	1,900	1,300	100	5/1/2003	10/22/2014	0.39	<0.01	-0.0006	-0.0009	NA	Increasing	Significant	NA	NA	NA	--	
	TCE	MW-120B	5	0.5	0.6	3.35	0.6	100	8/14/2003	4/15/2016	0.71	<0.01	0.0003	0.0002	2,674	Decreasing	Significant	2017	2014	2021	Below MCL during each sampling event	

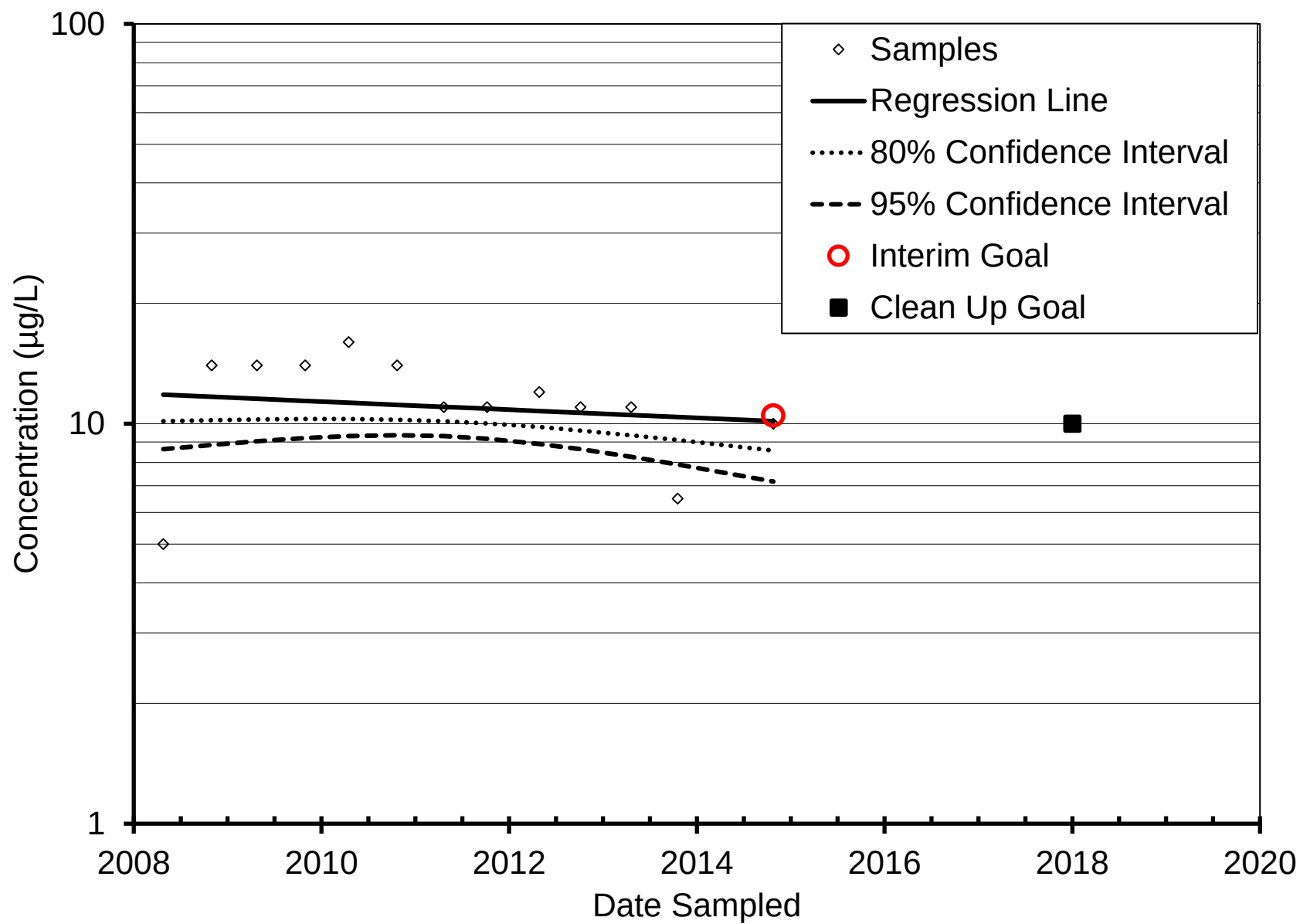
Notes, Abbreviations and Assumptions:
Data in *italics* ND taken at reporting limit/reported value
Data is underlined Qualified data converted to reported value
MCL = maximum contaminant level
µg/L = micrograms per liter
NS = not significant
NA = not applicable due to increasing trend or non-significant trend
-- = no MCL or MCL is same as cleanup goal
¹ Cleanup goals are background concentrations as defined in the Record of Decision (2001)
² Linear regression analysis with R² values <0.1 and no statistically significant trend were defined as having no apparent trend (No Trend).
³ Positive attenuation rates are associated with decreasing trends and negative attenuation rates are associated with increasing trends
⁴ Statistically significant trend defined as having p-value ≤ 0.10
⁵ Based on the upper and lower 90% confidence levels on the linear regression slope (attenuation rate) and y-intercept

ATTACHMENT A

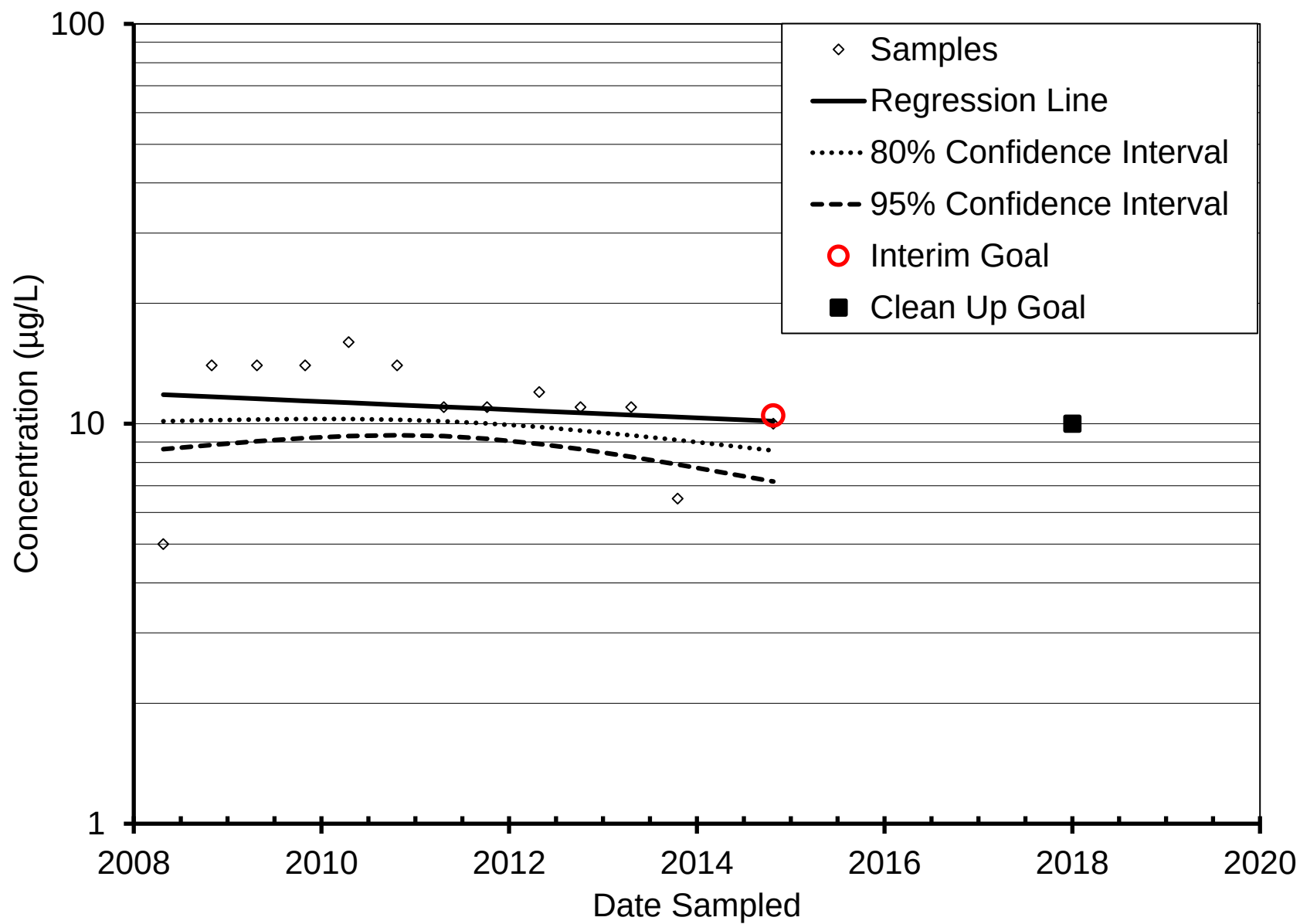
Charts Illustrating the 80% and 95% Confidence Interval of Regression Line



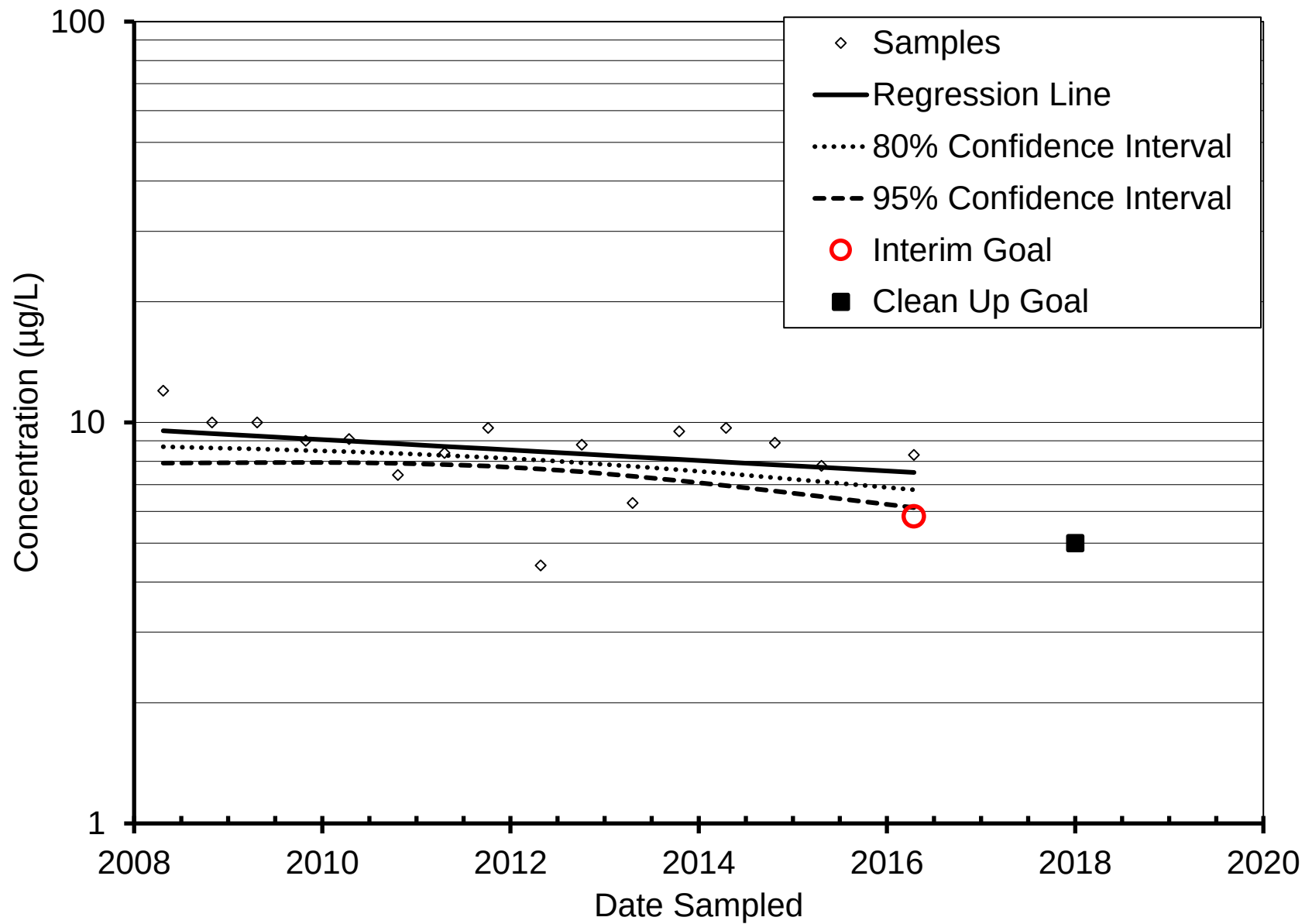
1,4-Dichlorobenzene in MW-101S



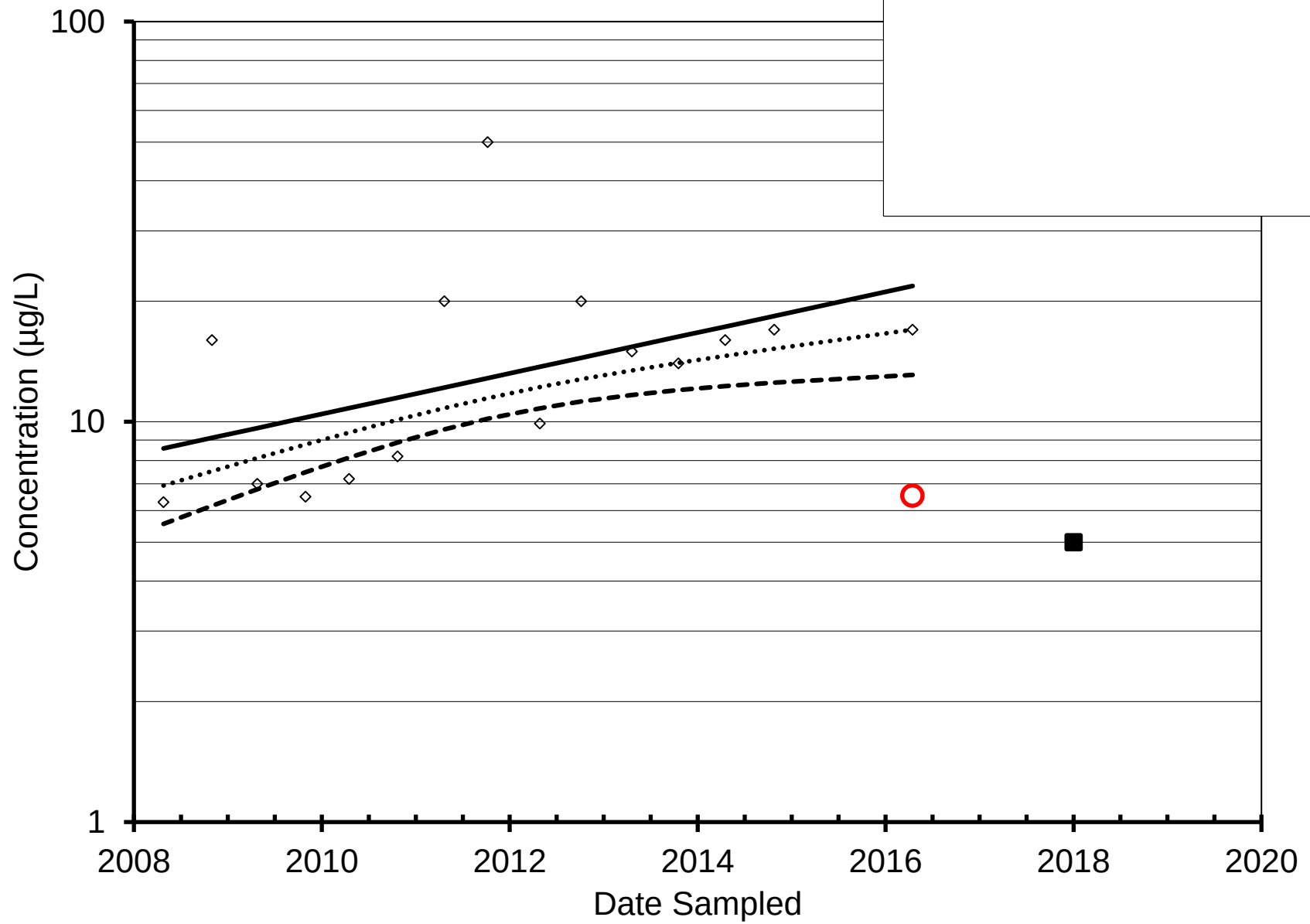
1,4-Dichlorobenzene in MW-101S



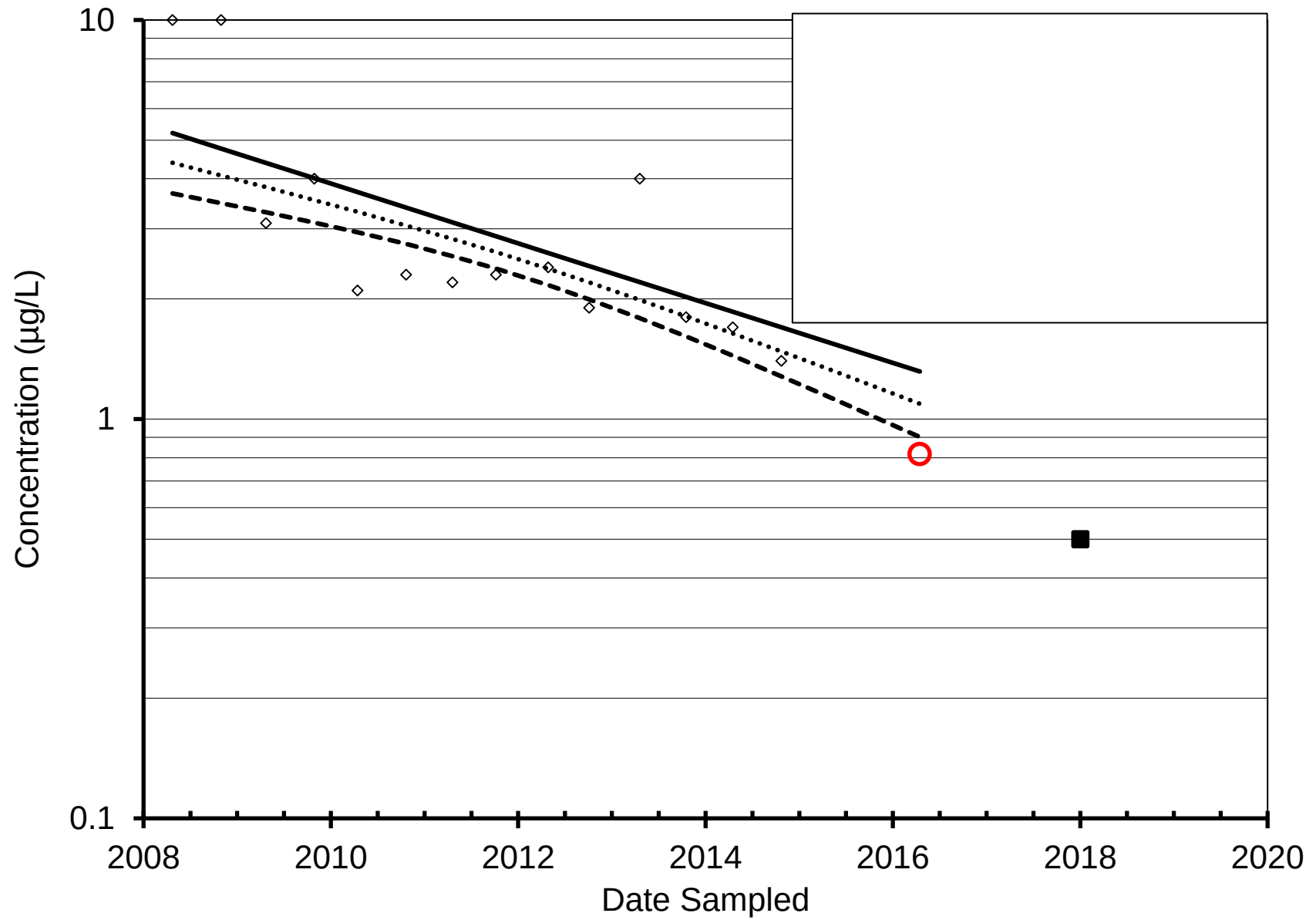
Arsenic in MW-4S



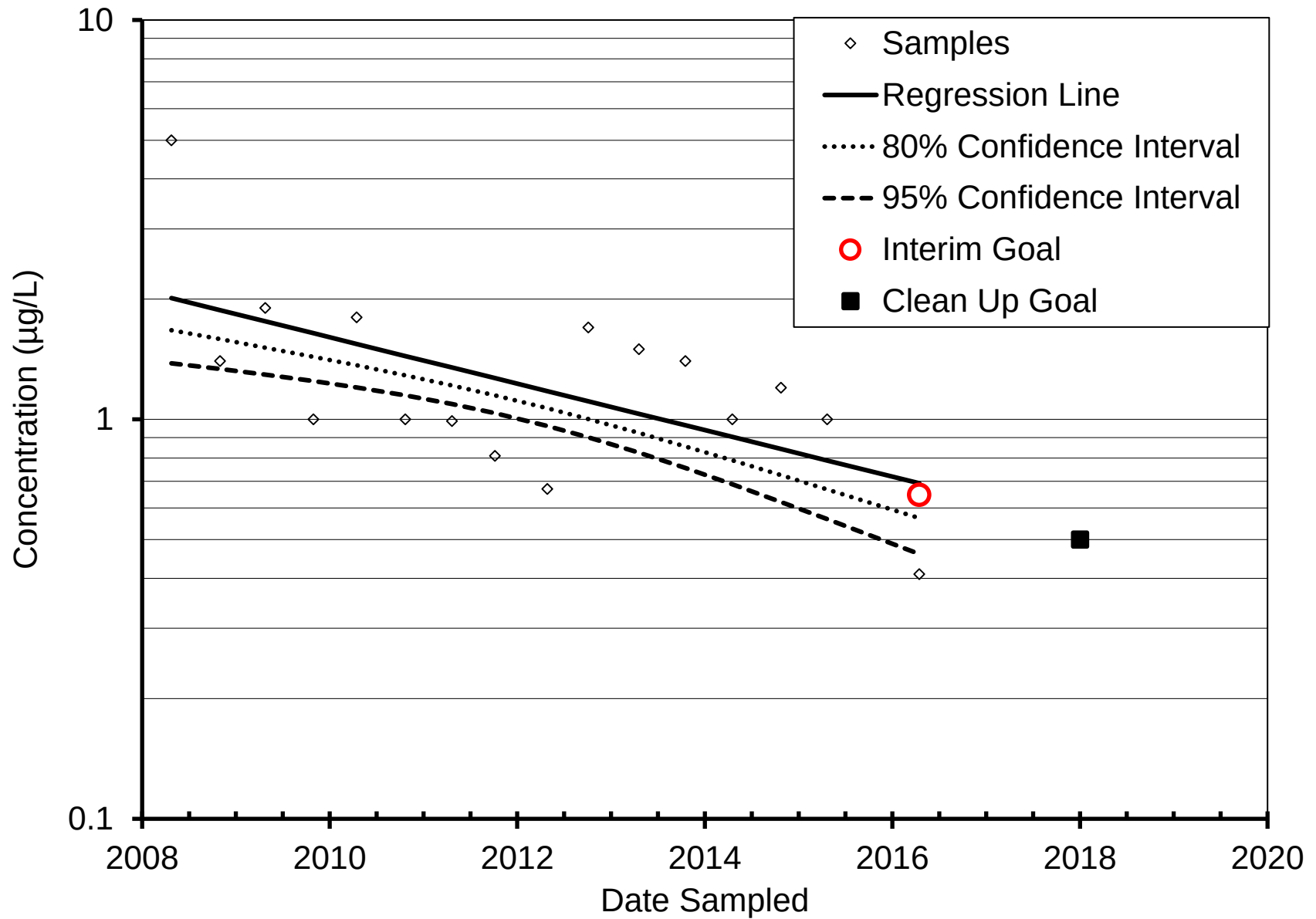
Arsenic in MW-101S



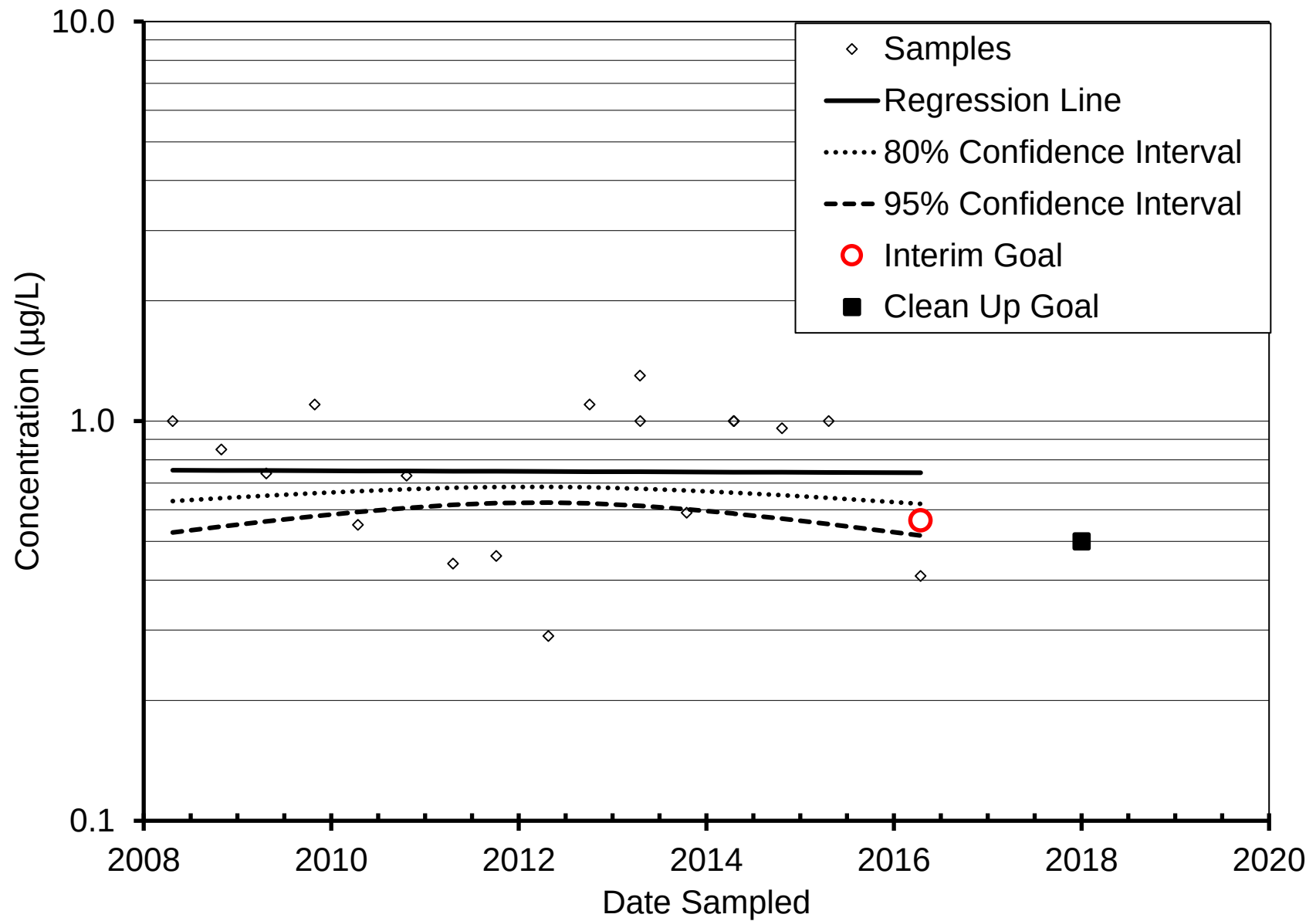
Benzene in MW-4S



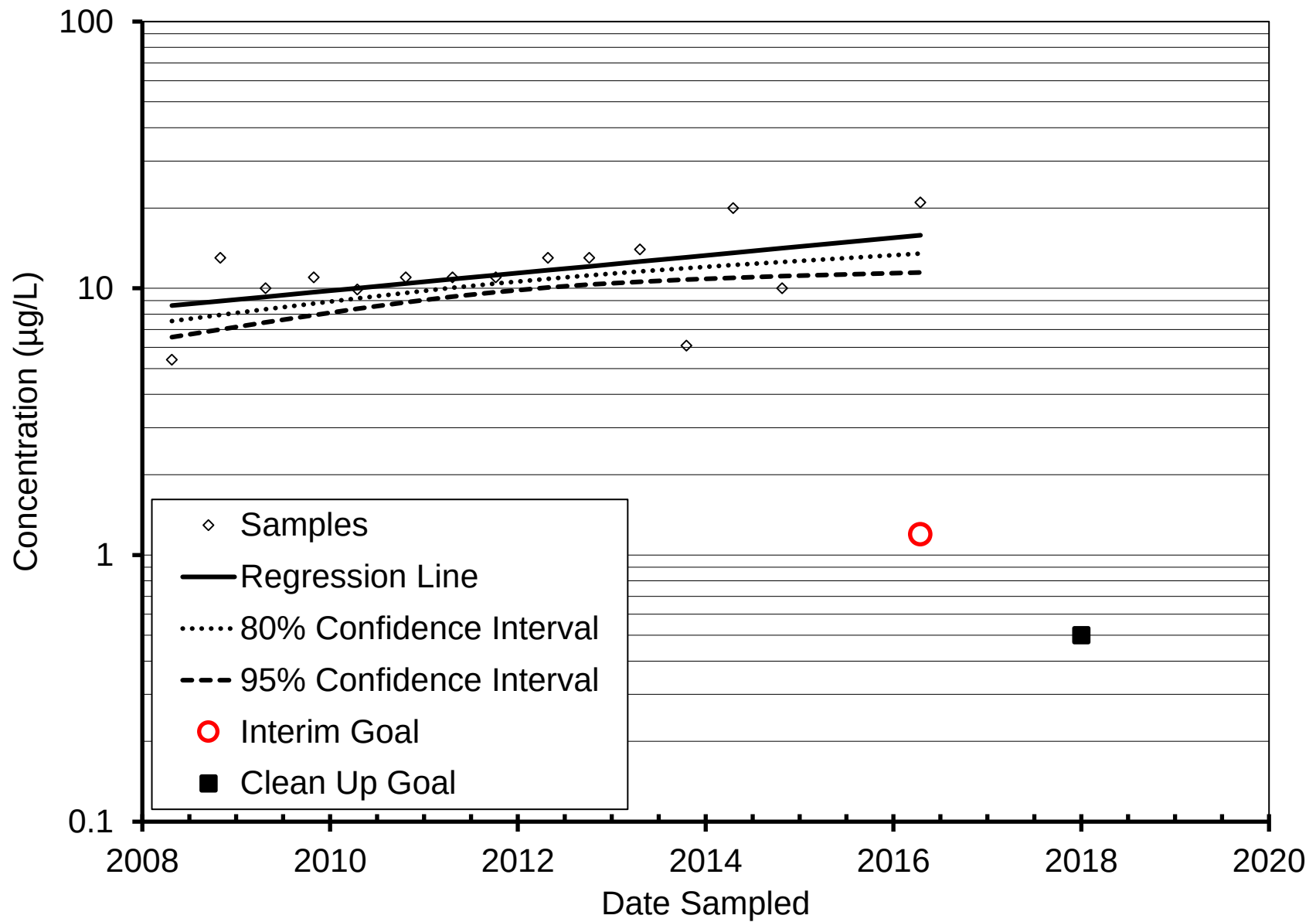
Benzene in MW-5S



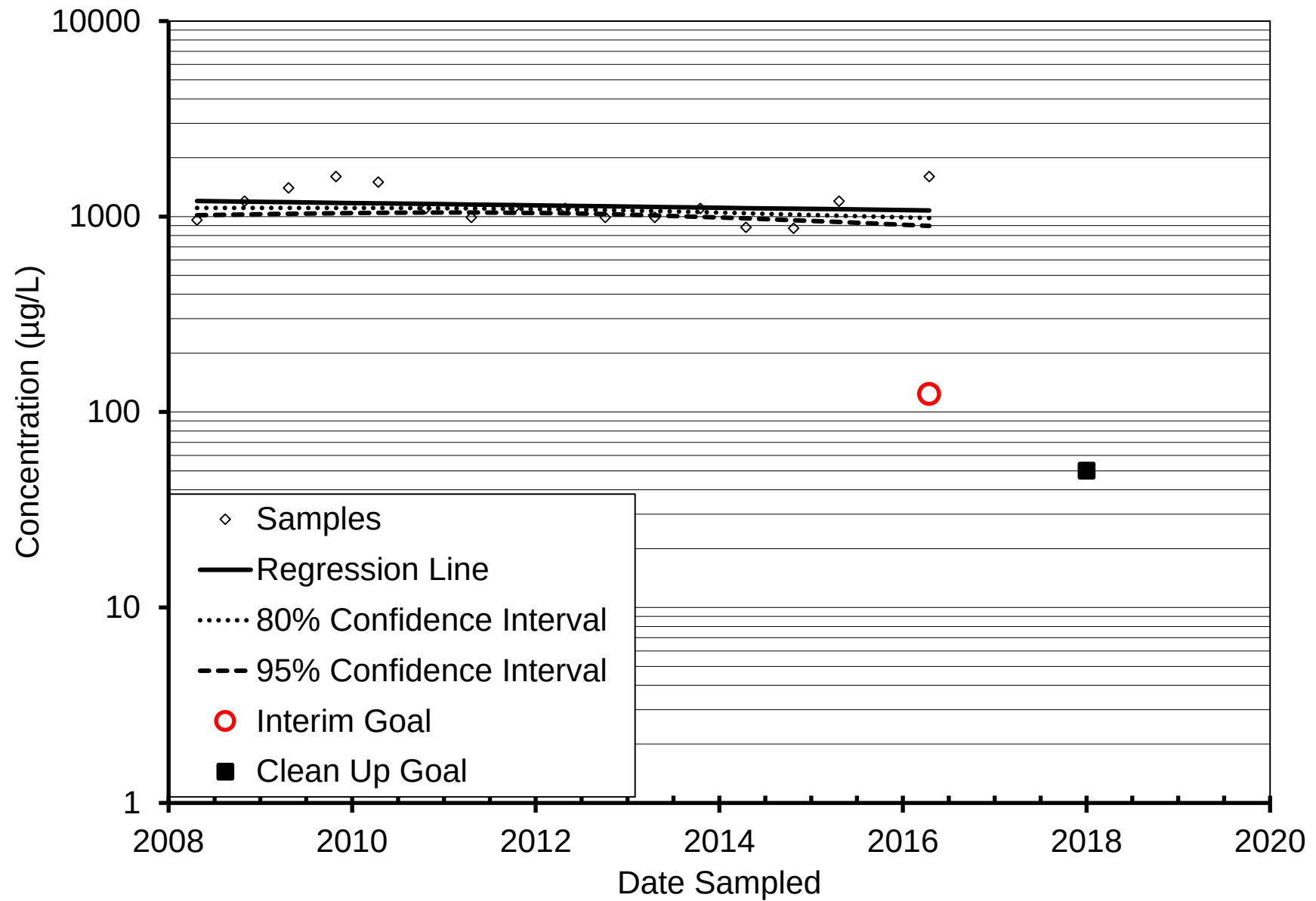
Benzene in S-3



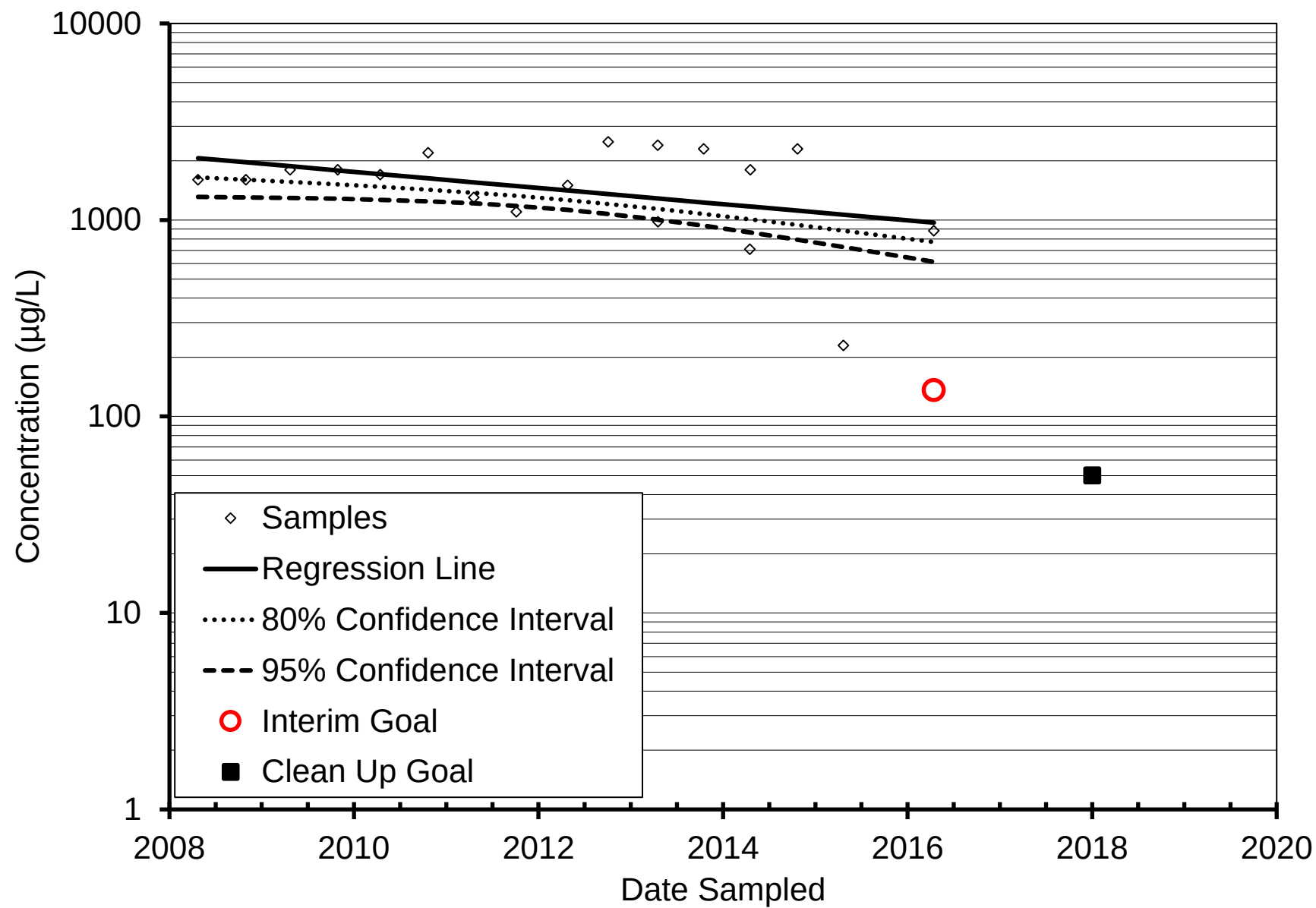
Benzene in MW-101S



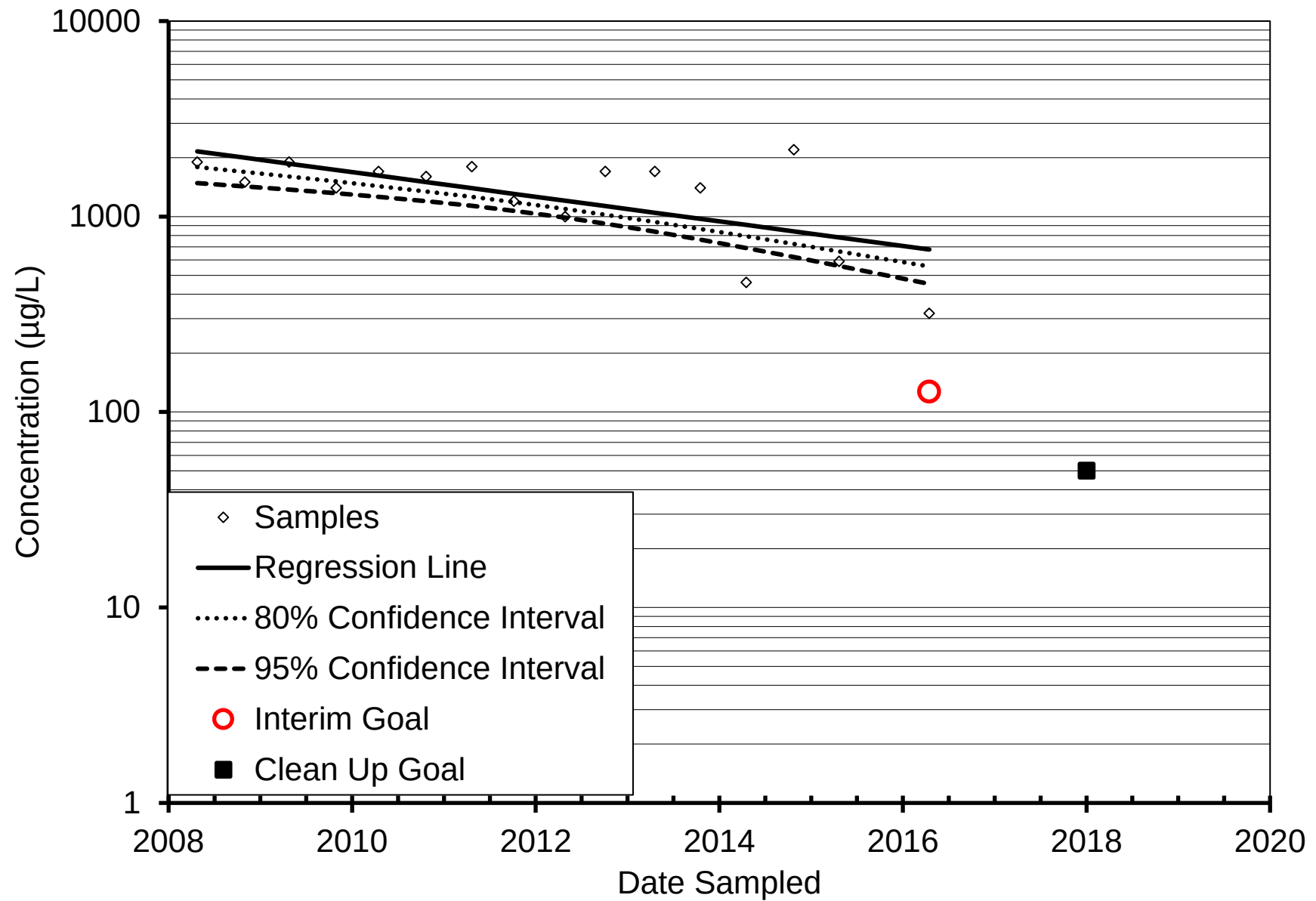
Manganese in MW-4S



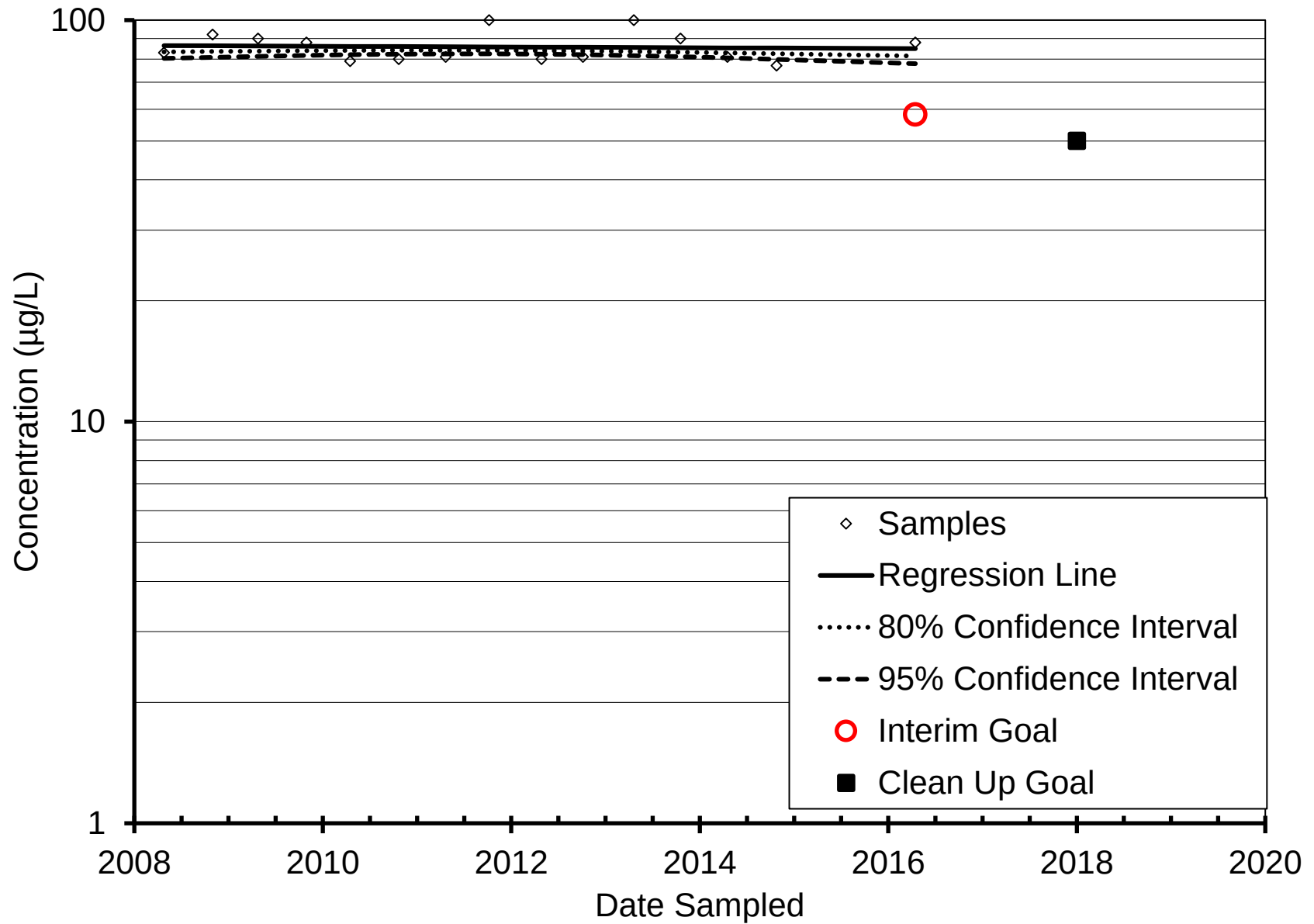
Manganese in S-3



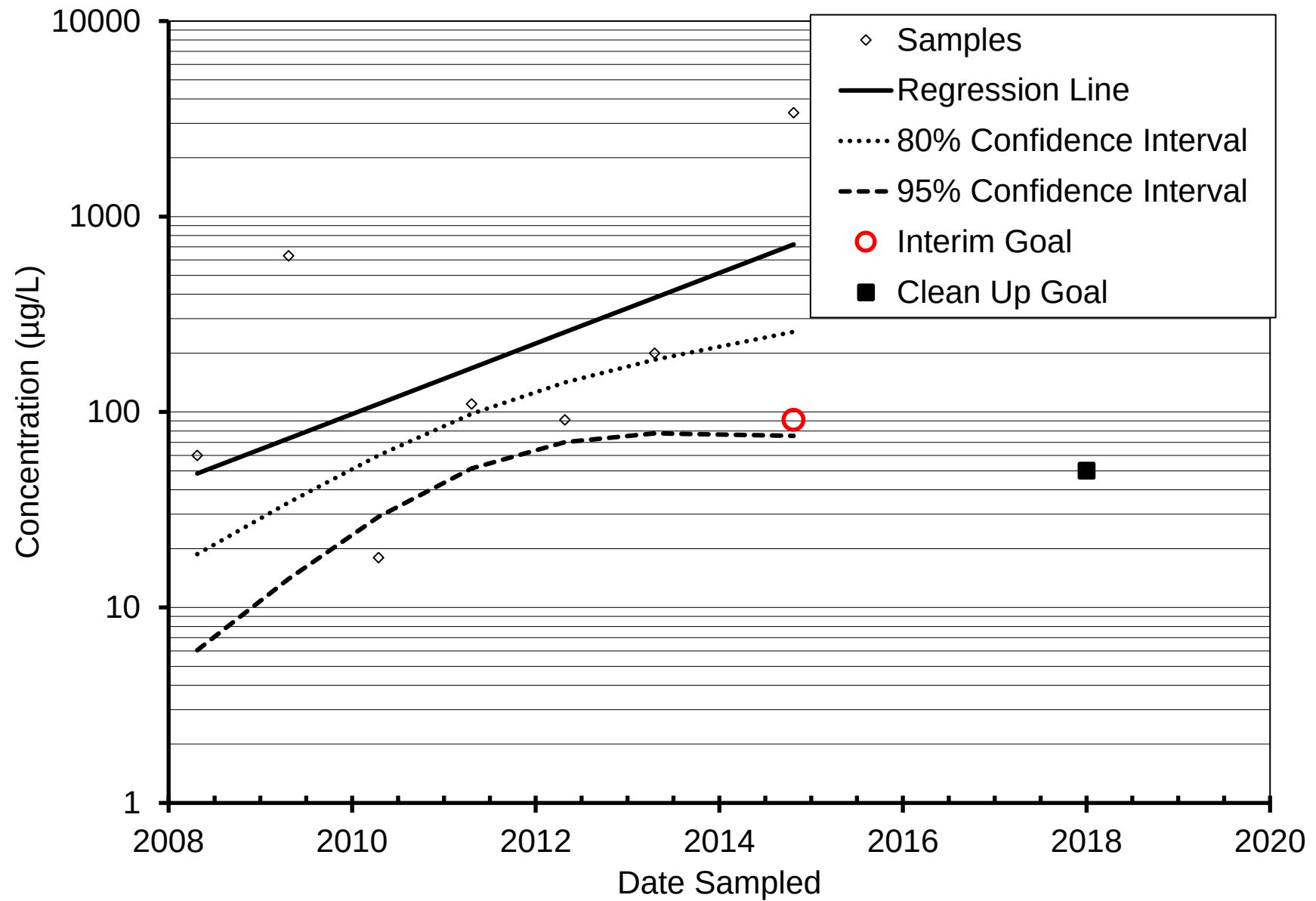
Manganese in MW-5S



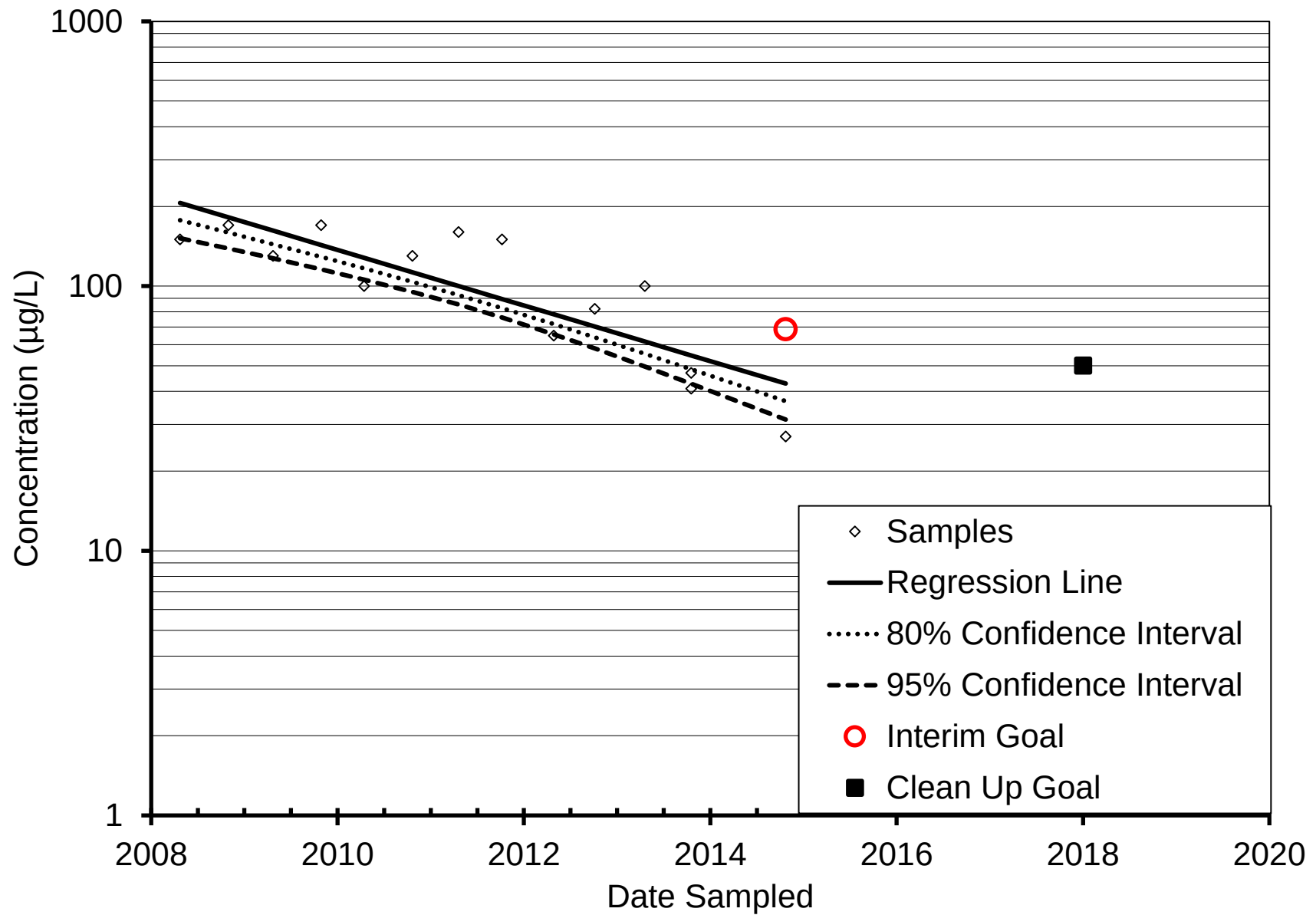
Manganese in MW-101S



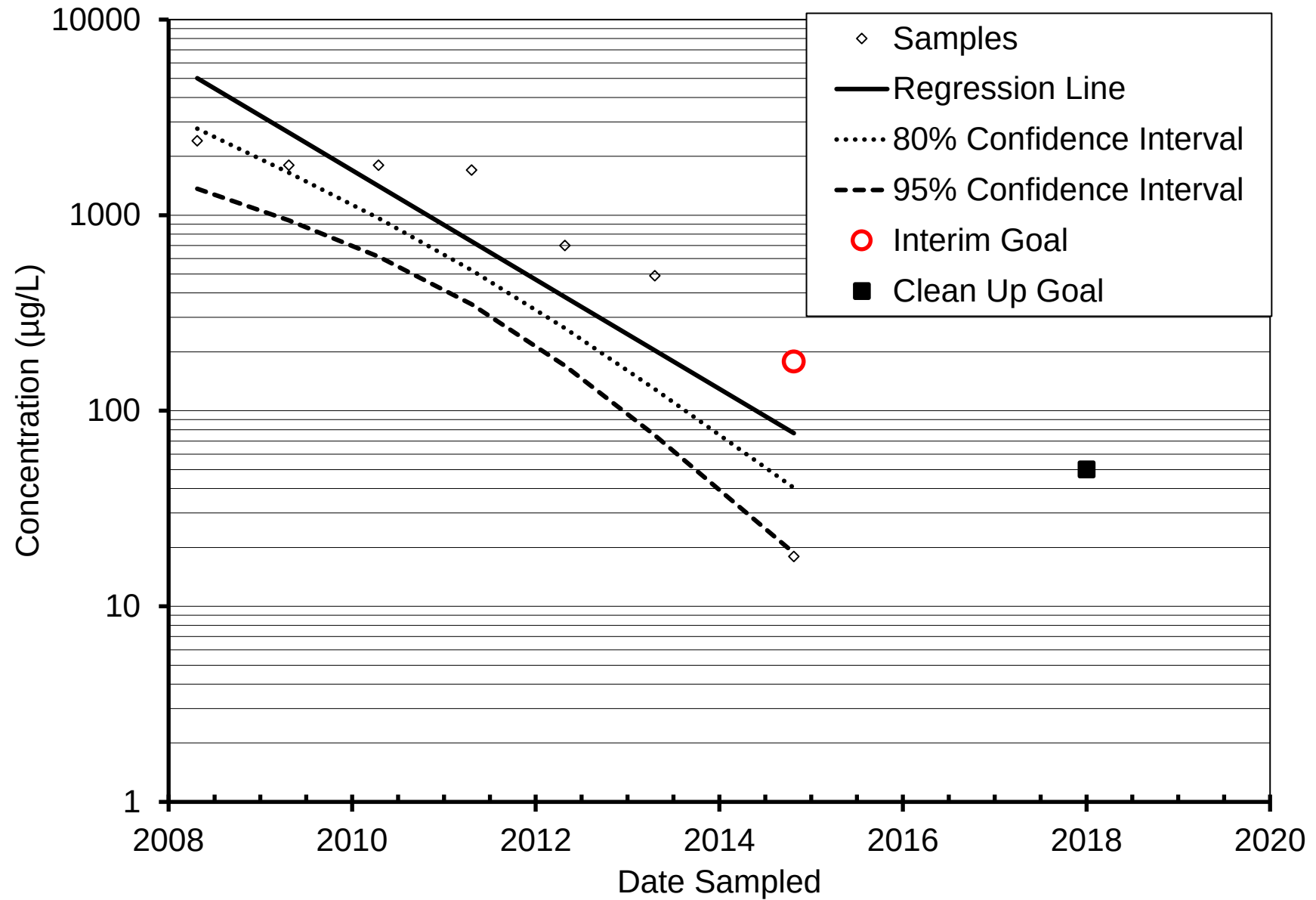
Manganese in MW-103S



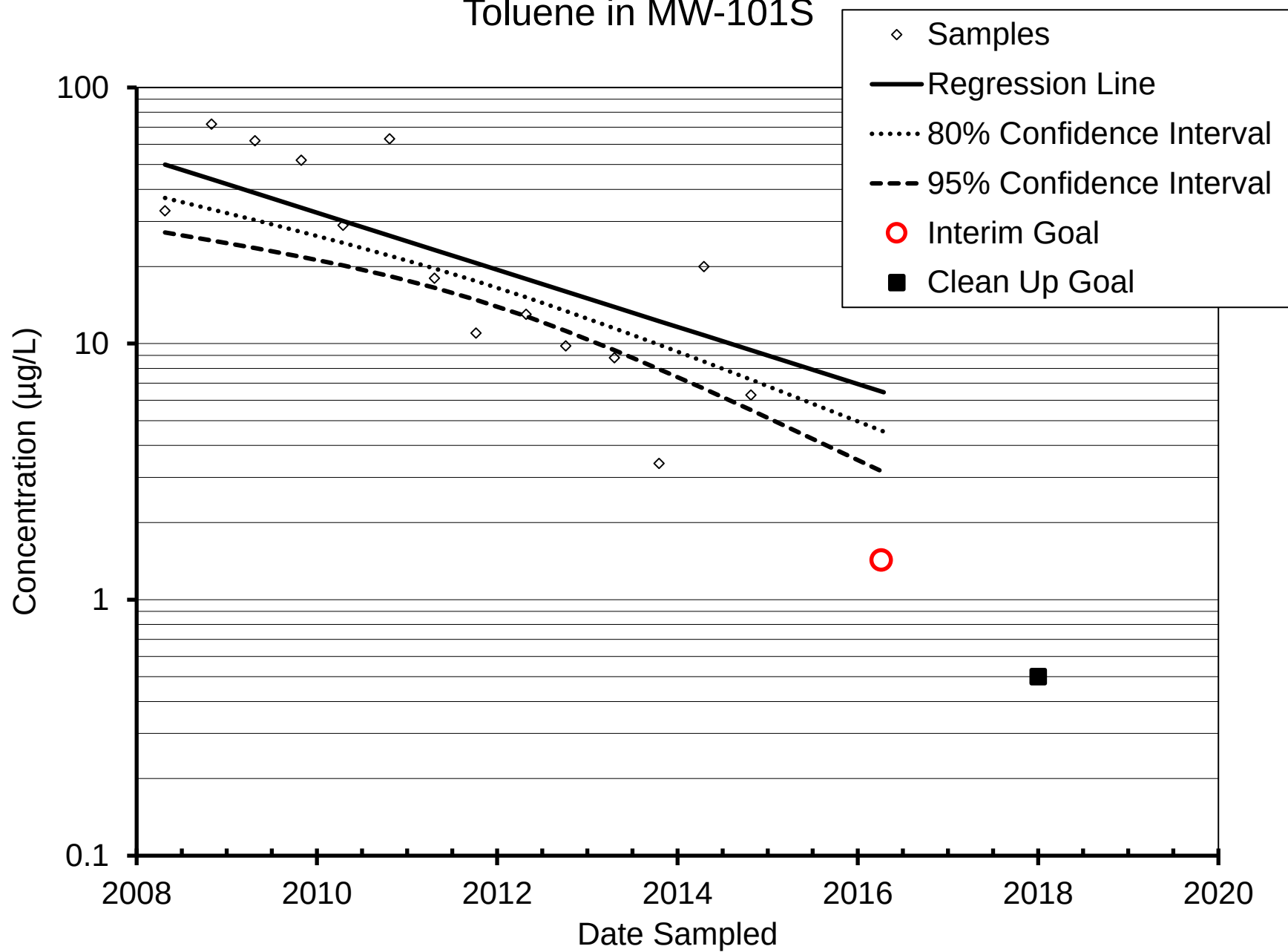
Manganese in MW-106S



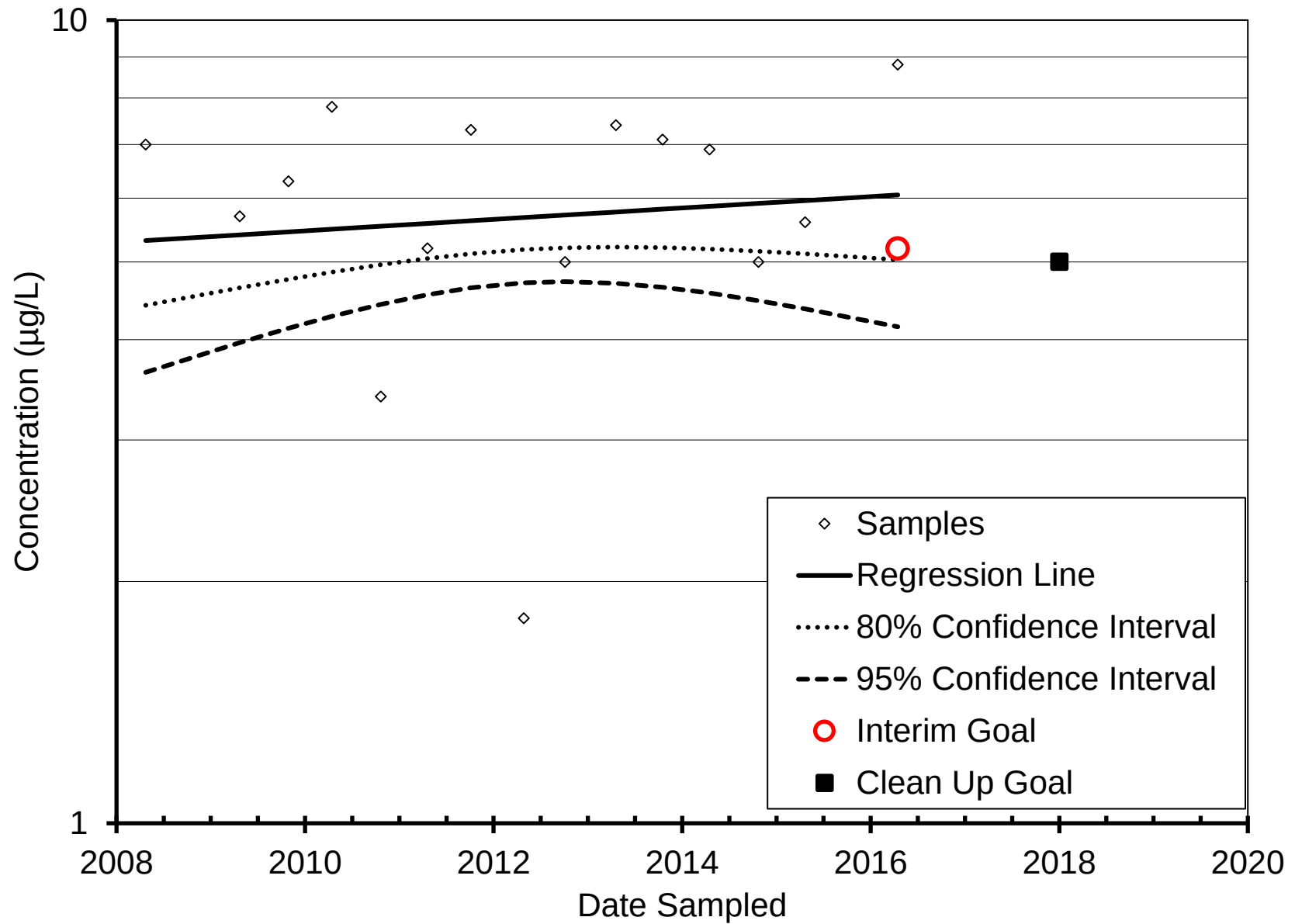
Manganese in MW-120S



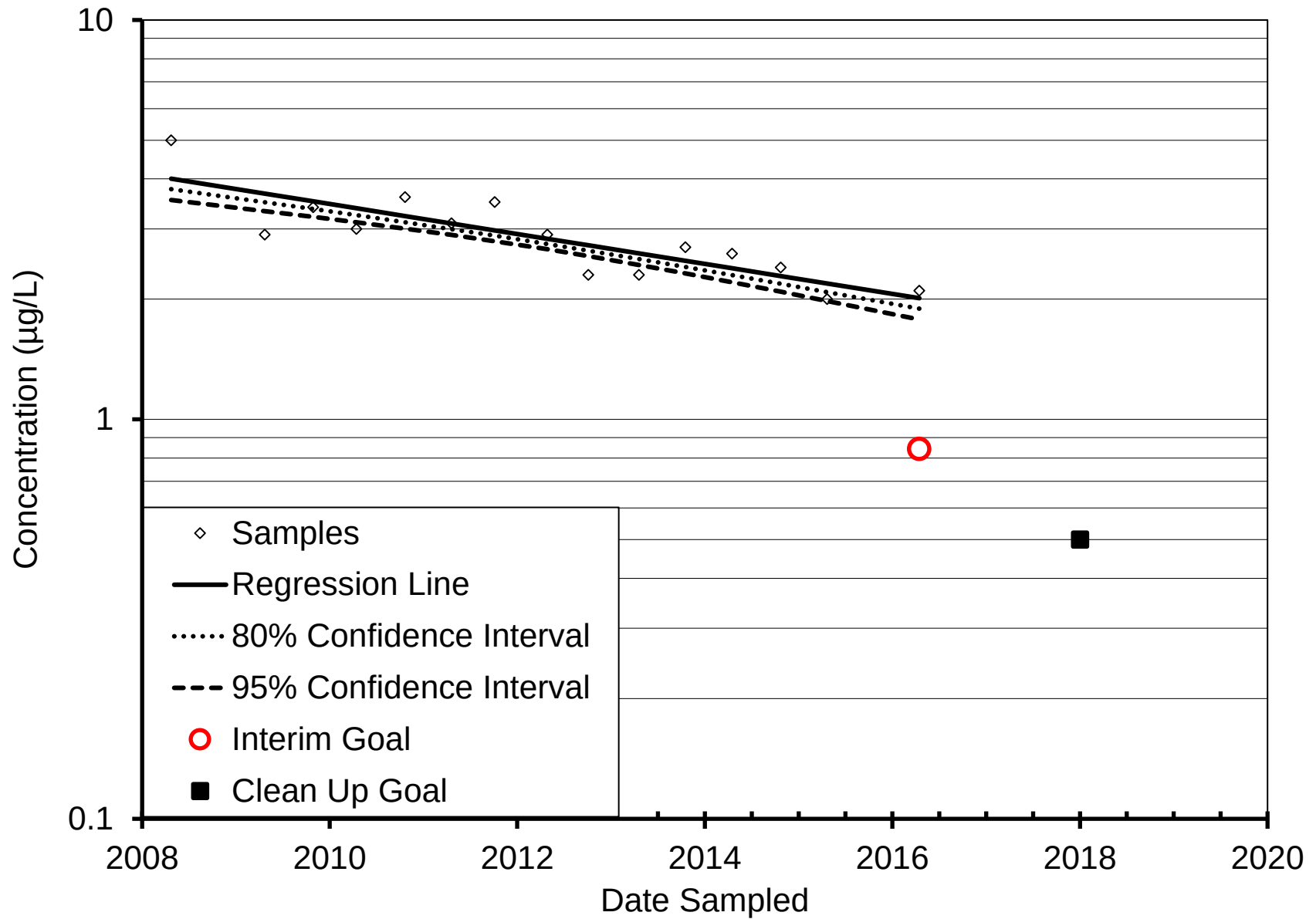
Toluene in MW-101S



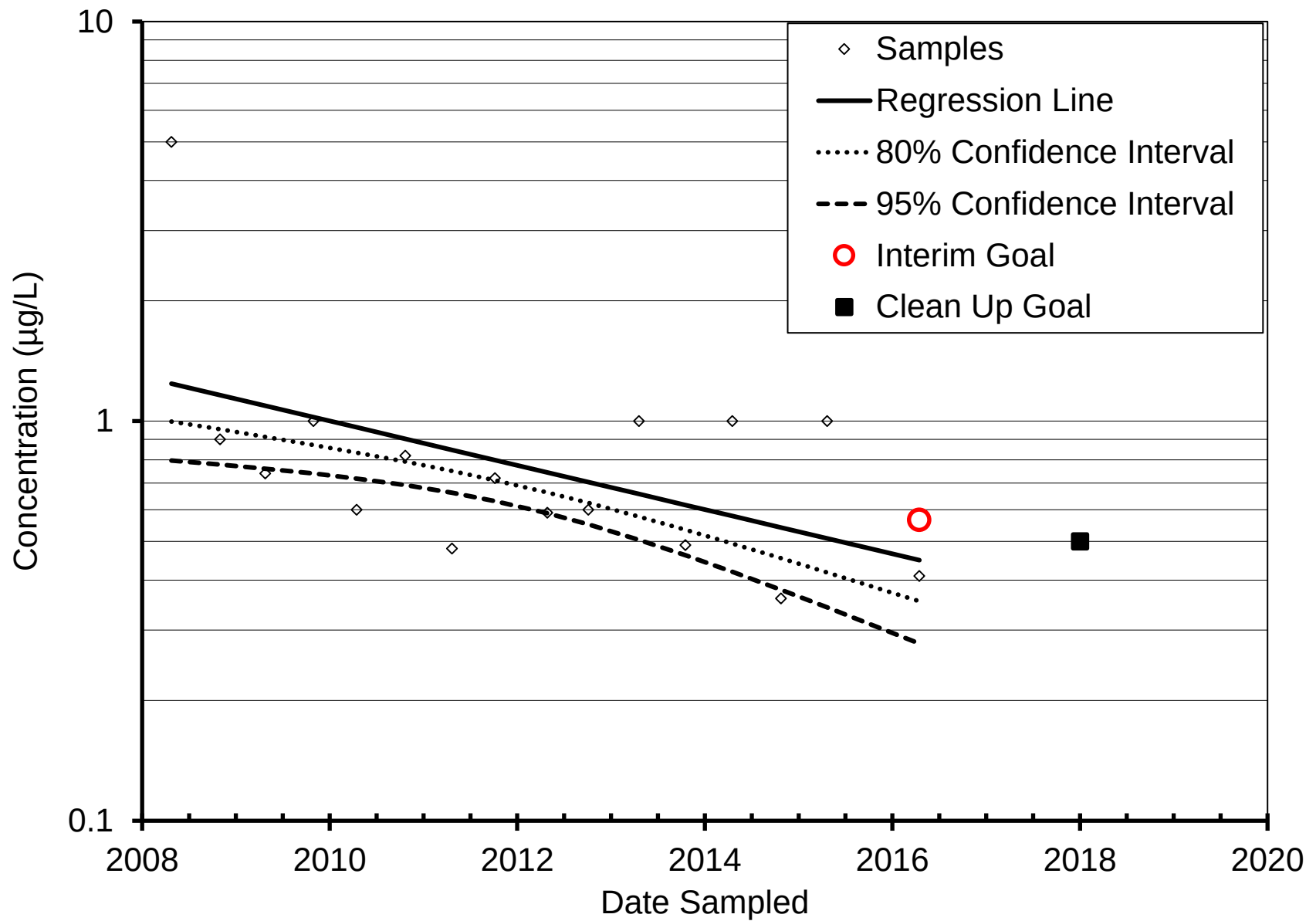
Arsenic in MW-4R



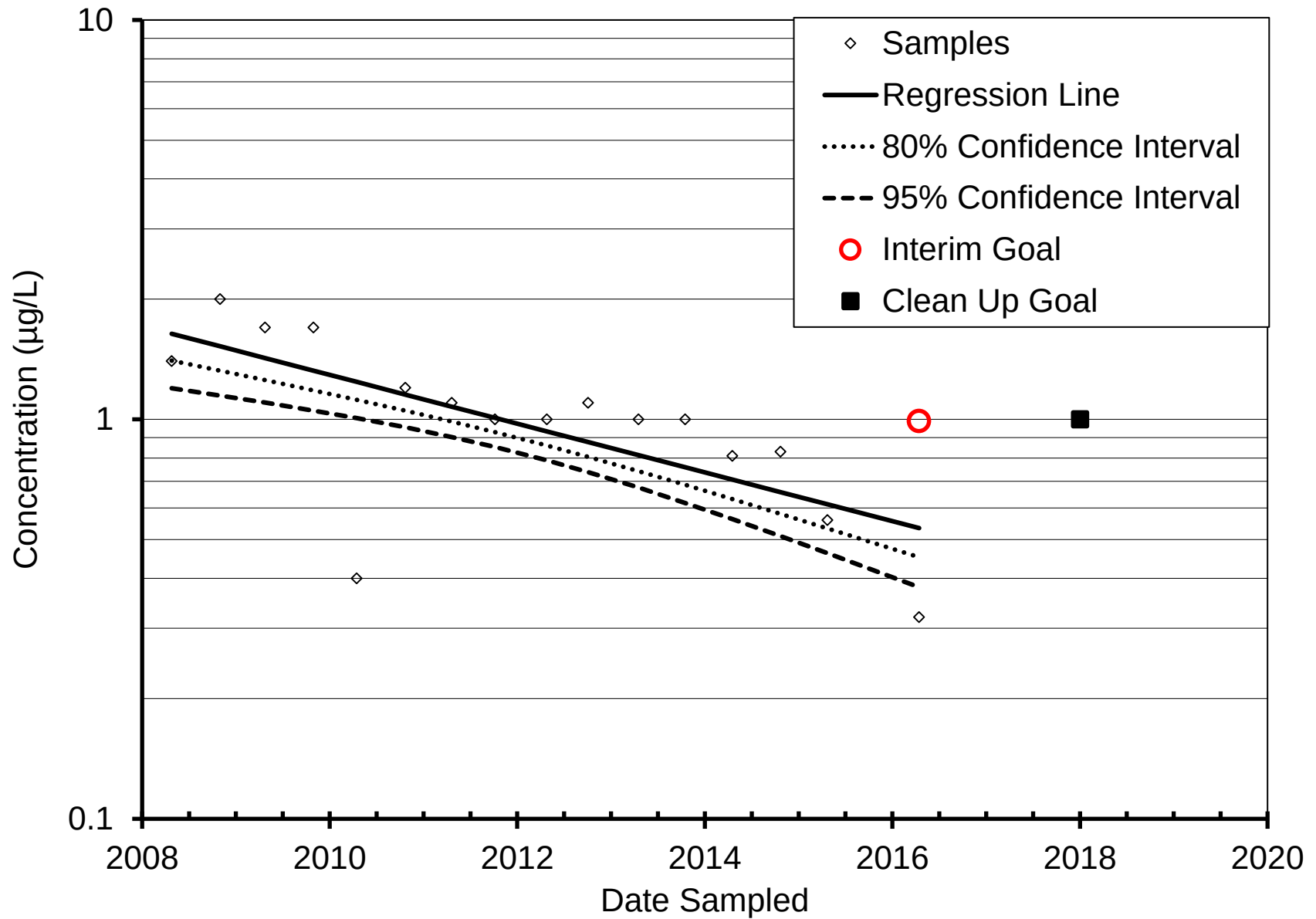
Benzene in MW-4R



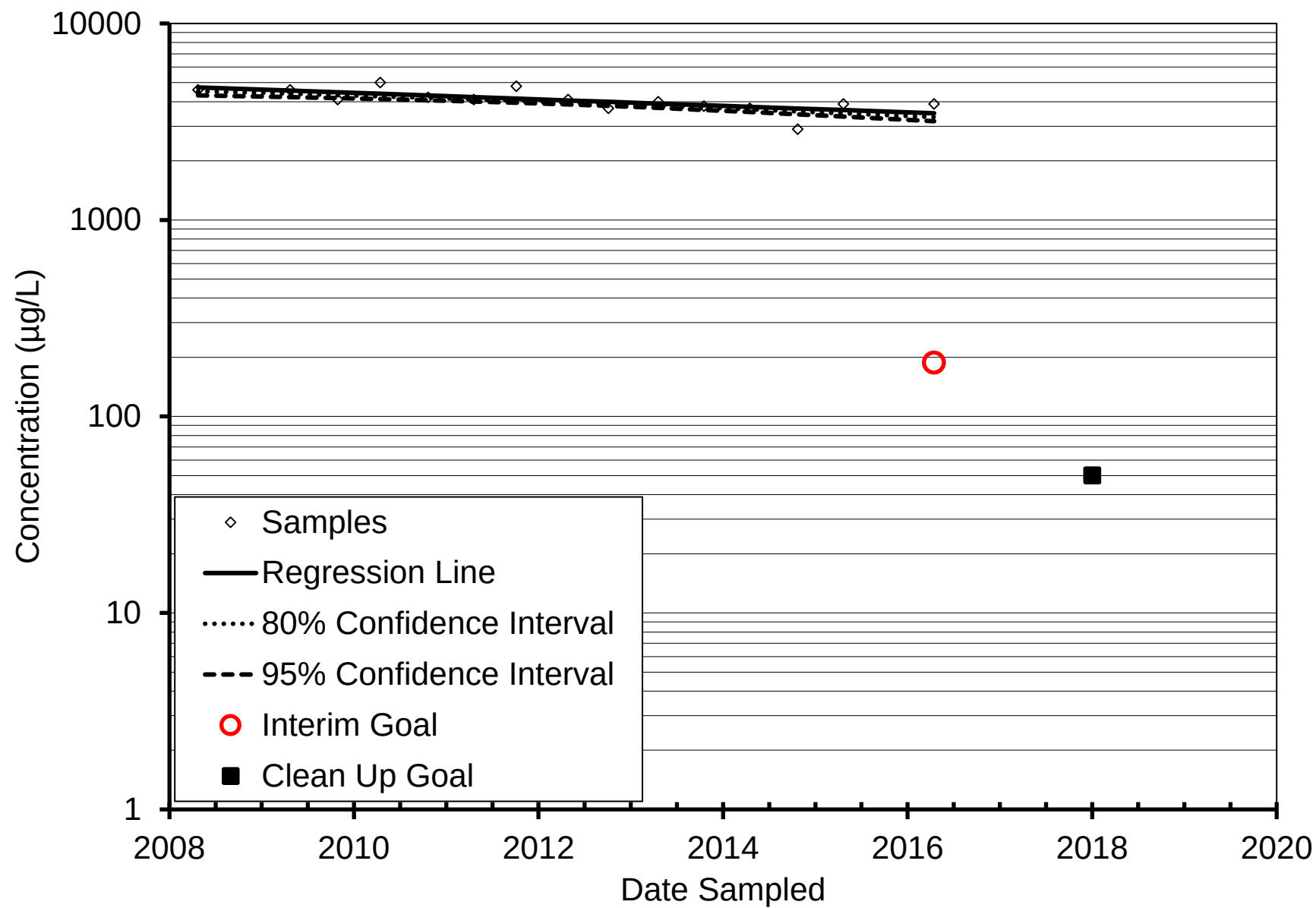
Benzene in MW-5B



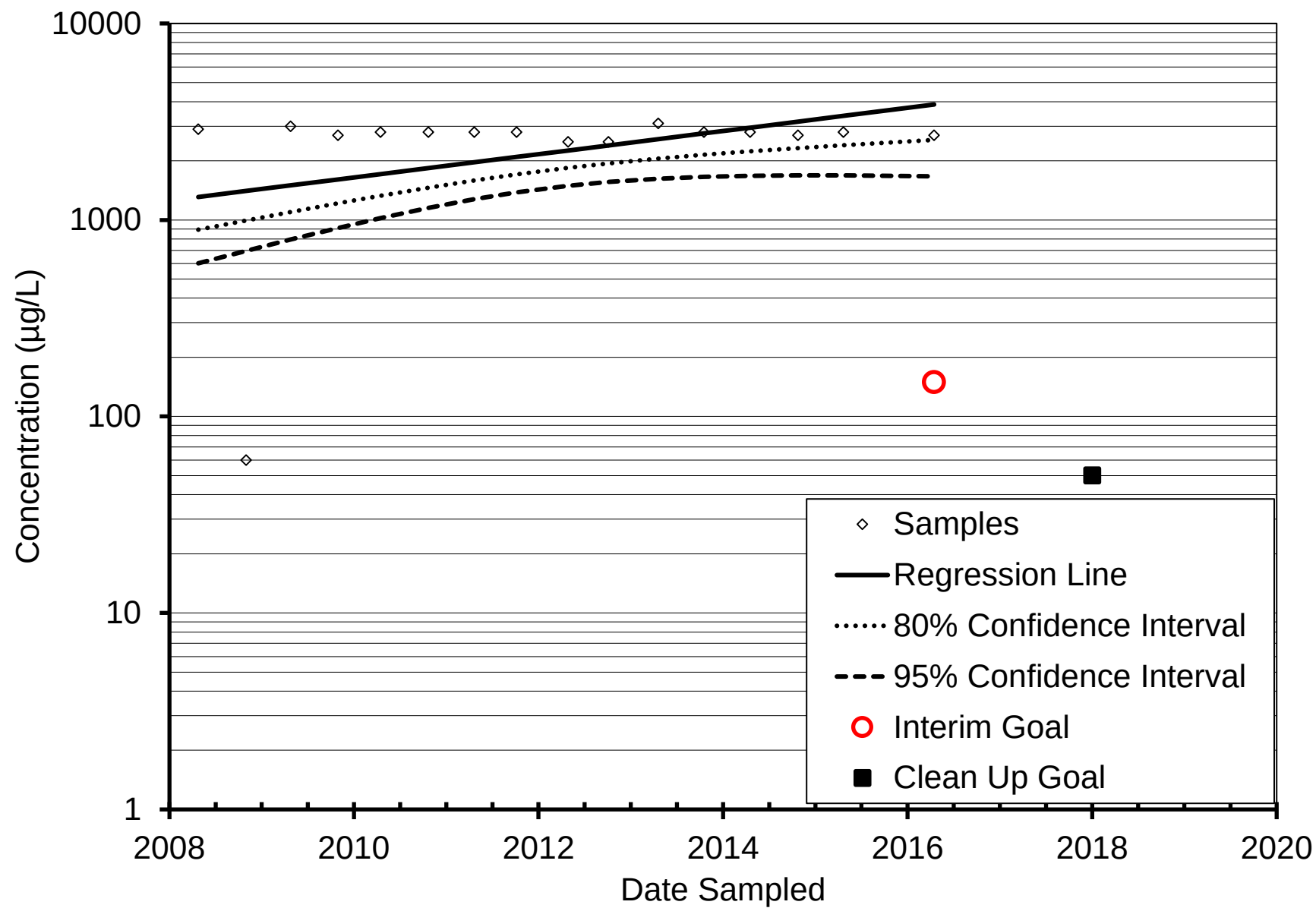
Chloroethane in MW-111I



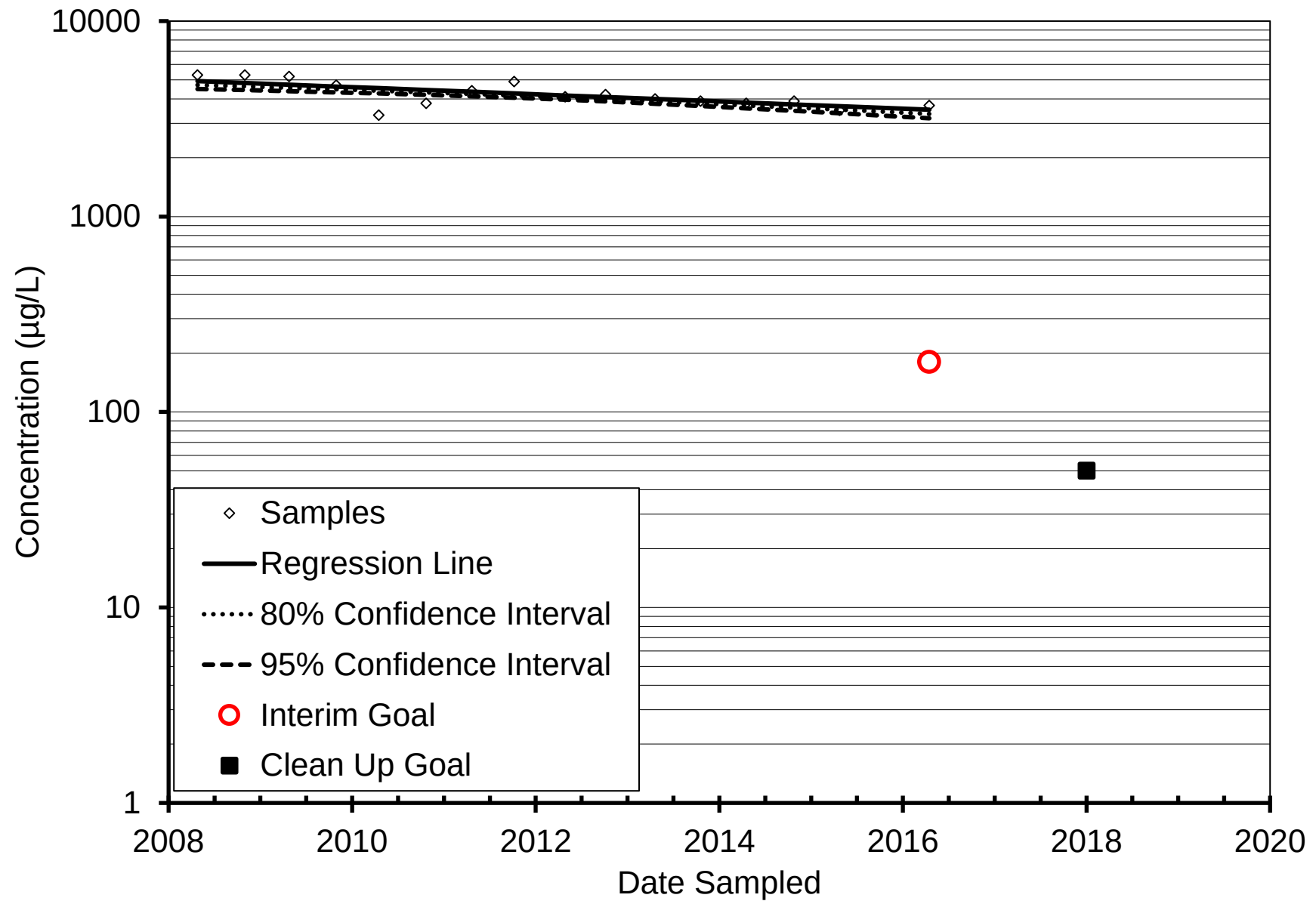
Manganese in MW-4R



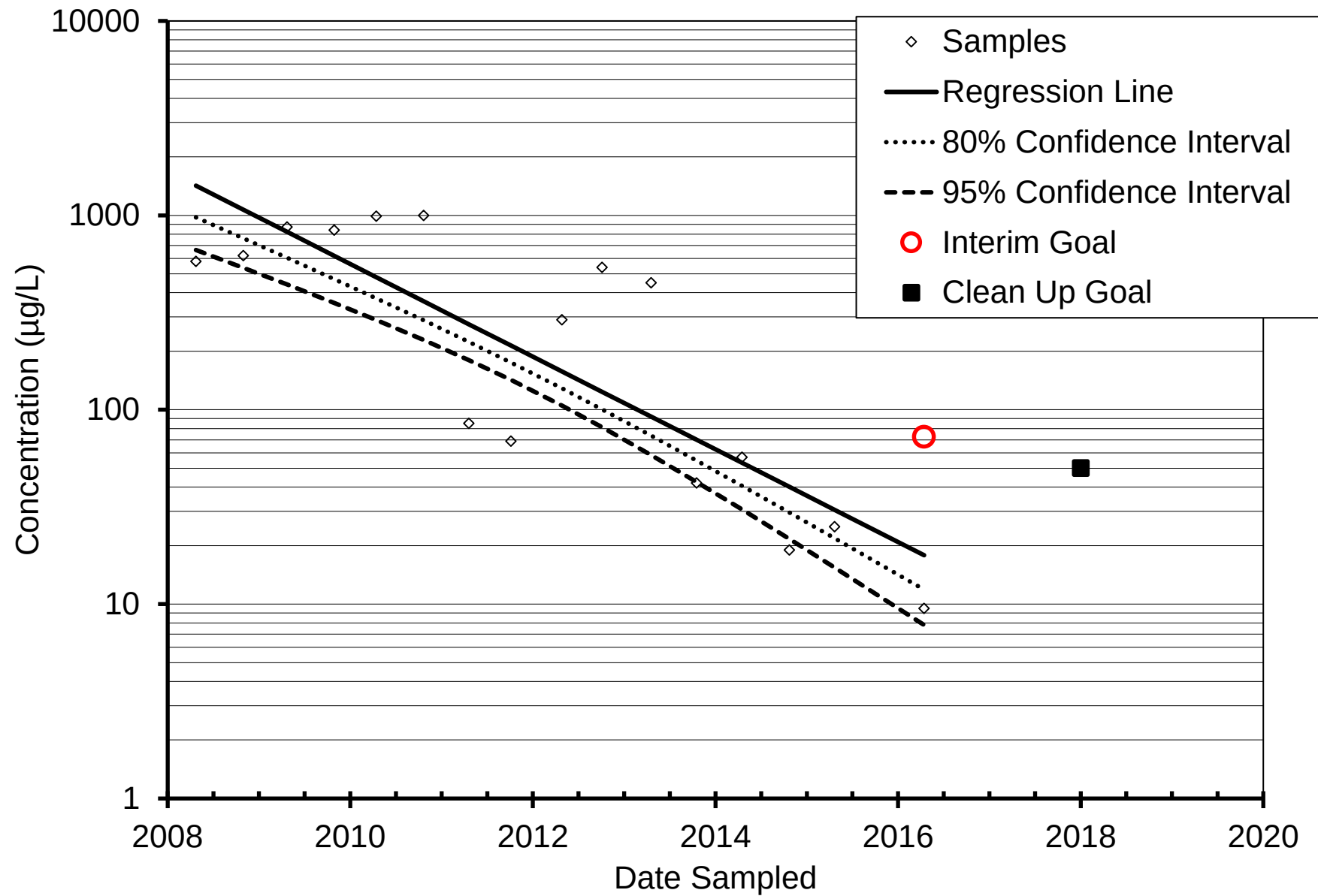
Manganese in MW-5B



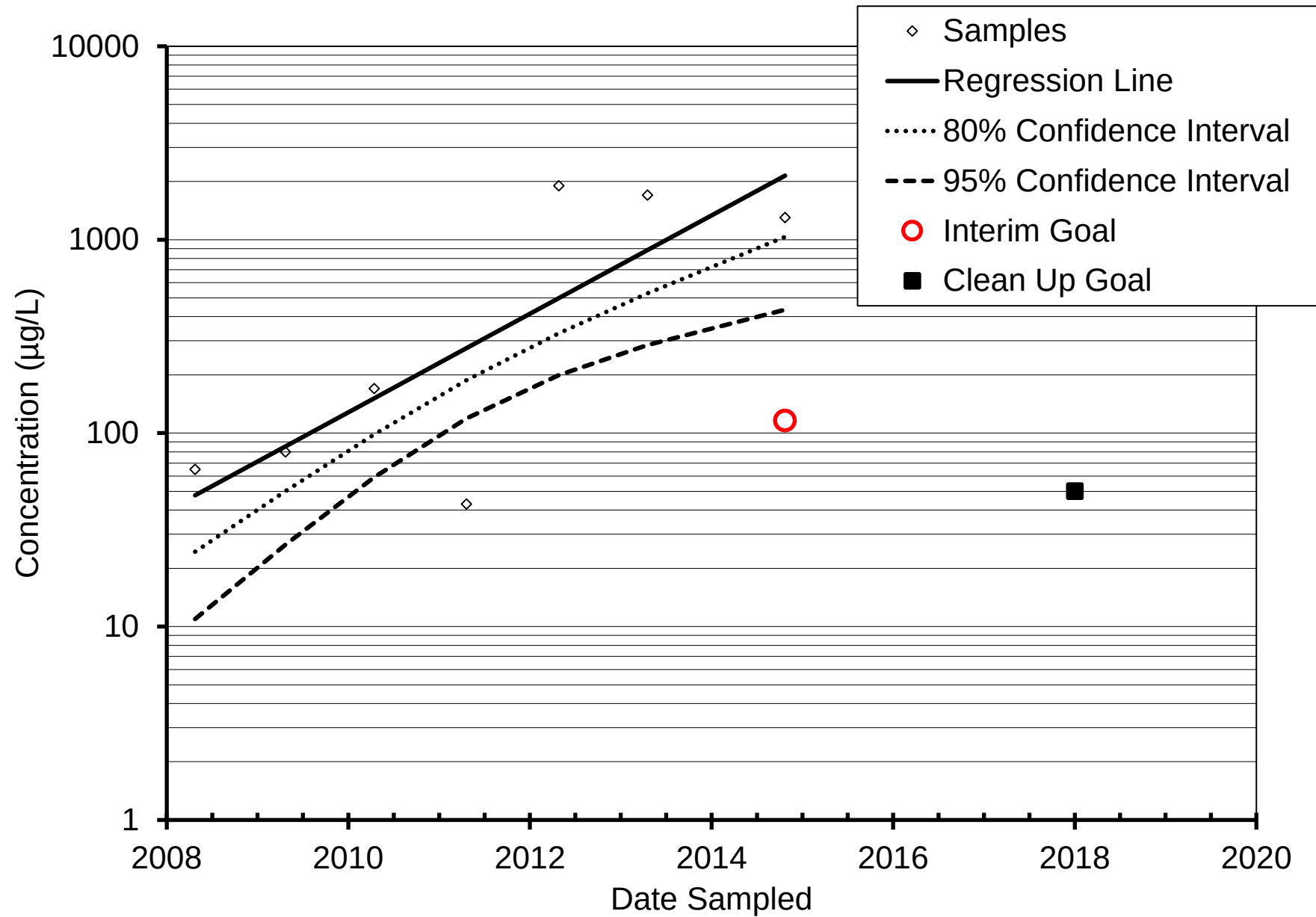
Manganese in MW-101B



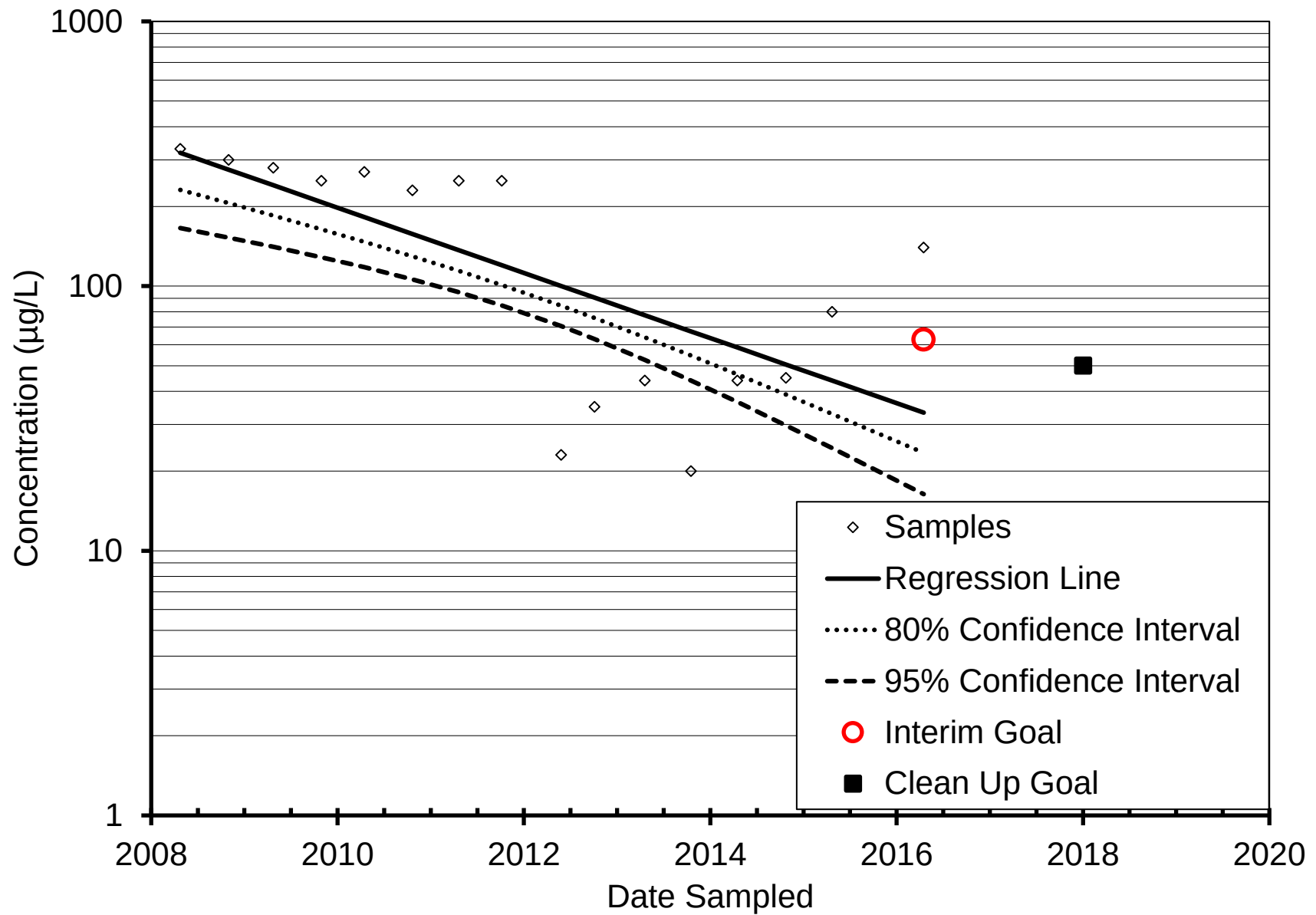
Manganese in MW-102B



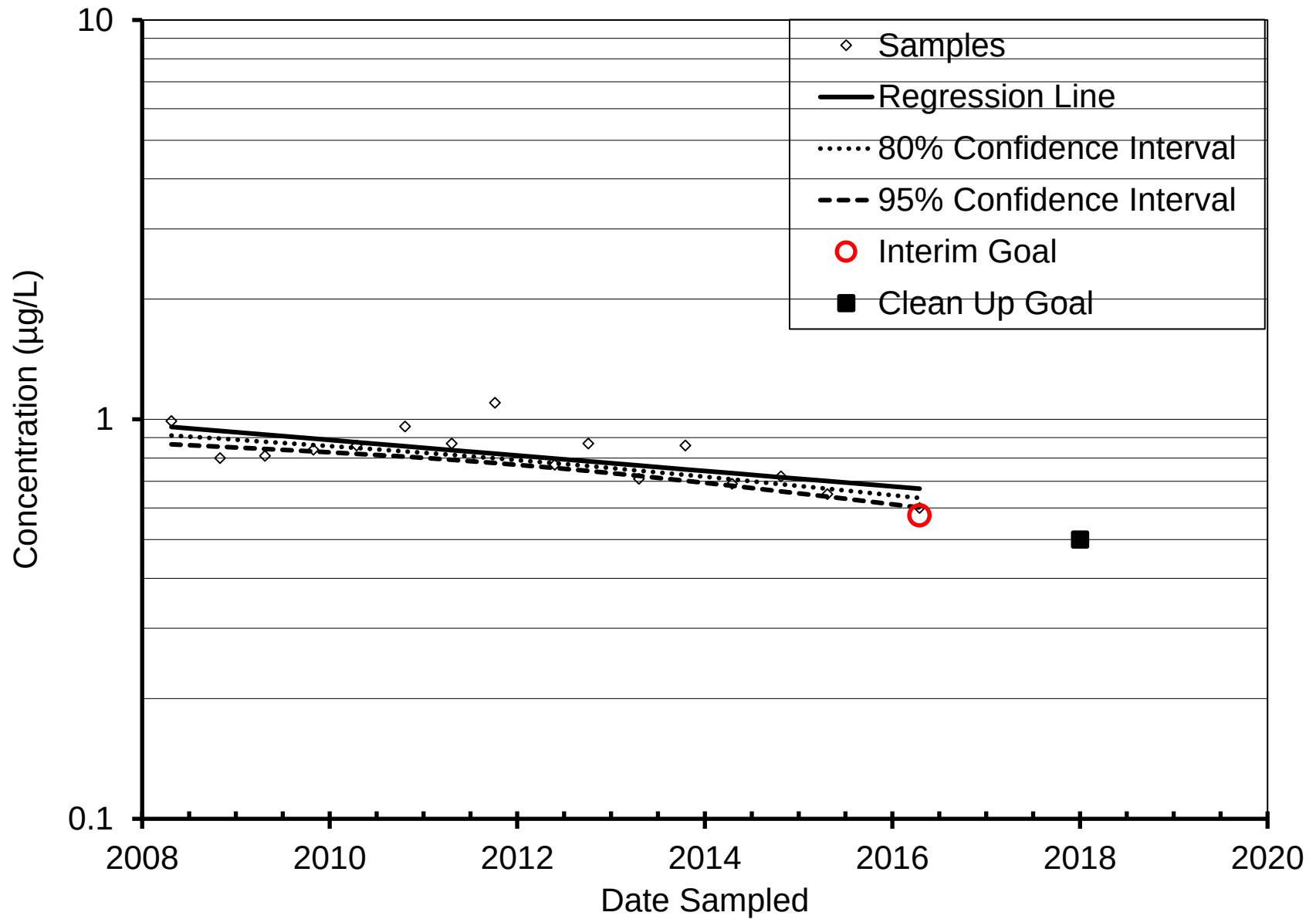
Manganese in MW-103B



Manganese in MW-120B



Trichloroethene in MW-120B



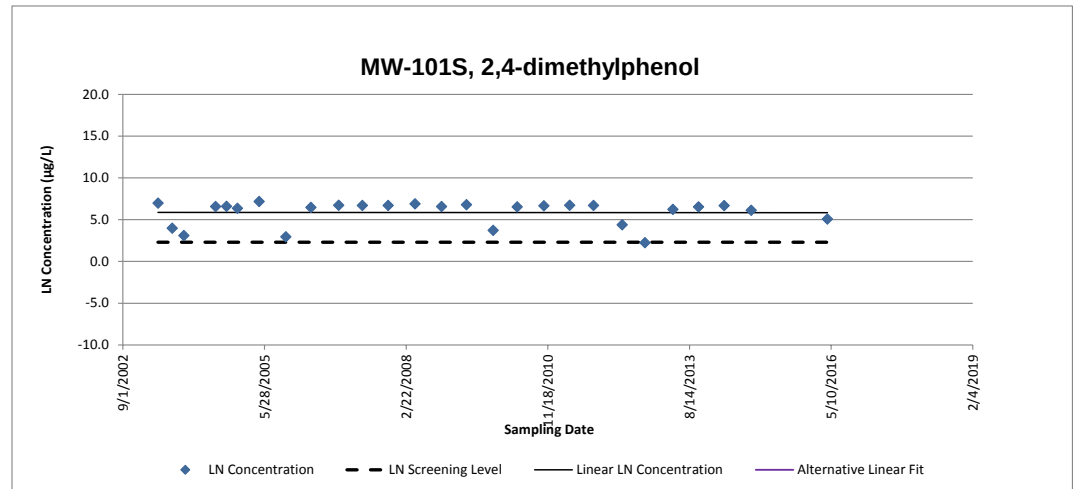
ATTACHMENT B

Linear Regression Analysis Details



Sample Information**Sample Location** MW-101S**Constituent** 2,4-dimethylphenol

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	1070	6.98
8/15/2003	53.8	3.99
11/6/2003	22	3.09
6/17/2004	710	6.57
9/2/2004	730	6.59
11/18/2004	580	6.36
4/20/2005	1300	7.17
10/26/2005	19	2.94
4/20/2006	640	6.46
11/2/2006	830	6.72
4/19/2007	810	6.70
10/18/2007	810	6.70
4/24/2008	1000	6.91
10/29/2008	720	6.58
4/23/2009	890	6.79
10/28/2009	41	3.71
4/15/2010	690	6.54
10/21/2010	790	6.67
4/21/2011	840	6.73
10/6/2011	810	6.70
4/26/2012	80	4.38
10/4/2012	9.5	2.25
4/19/2013	510	6.23
10/17/2013	680	6.52
4/16/2014	800	6.68
10/24/2014	460	6.13
4/14/2016	160	5.08

**Notes:**

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	27
# of nondetects	3
% of data as detects	89

Results

Coefficient of Determination (R^2) =	0.0001	
p-Value =	9.72E-01	
Attenuation Rate in Groundwater (K) =	0.00001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0003	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	10.0
LN Screening Level	2.3026
Intercept	6.148
Slope	0.0000
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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Abbreviations and Notes

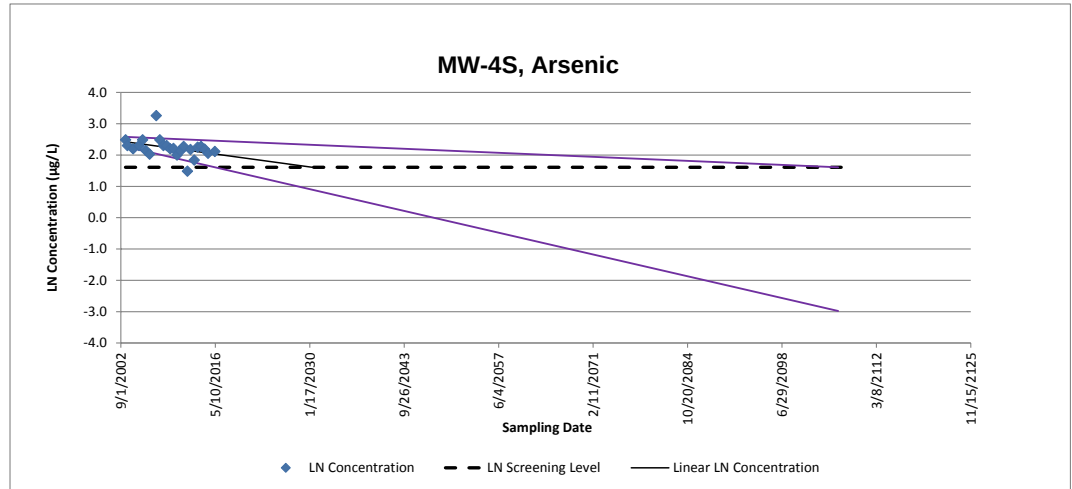
µg/l = micrograms per liter

LN = Natural Logarithm

Sample Information

Sample Location MW-4S
Constituent Arsenic

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/5/2003	12	2.48
8/12/2003	10	2.30
6/15/2004	9	2.20
4/19/2005	10	2.30
10/24/2005	12	2.48
4/18/2006	8.5	2.14
10/31/2006	7.6	2.03
10/16/2007	26	3.26
4/22/2008	12	2.48
10/28/2008	10	2.30
4/21/2009	10	2.30
10/27/2009	9	2.20
4/13/2010	9.1	2.21
10/20/2010	7.4	2.00
4/19/2011	8.4	2.13
10/5/2011	9.7	2.27
4/26/2012	4.4	1.48
10/3/2012	8.8	2.17
4/18/2013	6.3	1.84
10/16/2013	9.5	2.25
4/15/2014	9.7	2.27
10/22/2014	8.9	2.19
4/21/2015	7.8	2.05
4/14/2016	8.3	2.12



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality	
Total # of data points used in regression	24
# of nondetects	0
% of data as detects	100

Results		
Coefficient of Determination (R^2) =	0.1437	
p-Value =	6.78E-02	
Attenuation Rate in Groundwater (K) =	0.0001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0000	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	8.41E+03	days

Date Screening Level Reached (Average Slope & Intercept)	
Screening Level	5.0
LN Screening Level	1.6094
Intercept	2.424
Slope	-0.0001
Average Date to Screening Level	6/1/2030

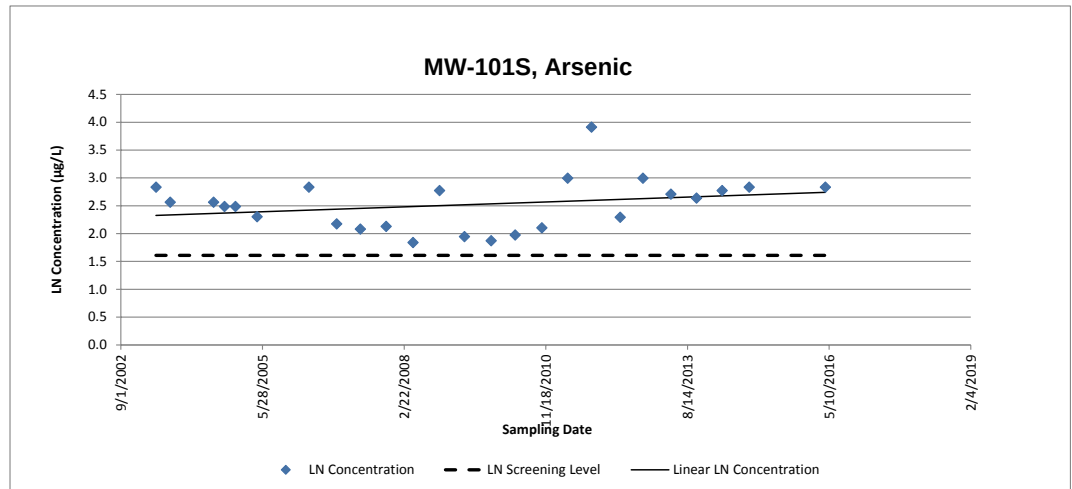
Range of Dates to Reach the Screening Level (90% Confidence Level)		
2016	to	2106

Abbreviations and Notes
 µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-101S
Constituent Arsenic

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	17	2.83
8/15/2003	13	2.56
6/17/2004	13	2.56
9/2/2004	12	2.48
11/18/2004	12	2.48
4/20/2005	10	2.30
4/20/2006	17	2.83
11/2/2006	8.8	2.17
4/19/2007	8	2.08
10/18/2007	8.4	2.13
4/24/2008	6.3	1.84
10/29/2008	16	2.77
4/23/2009	7	1.95
10/28/2009	6.5	1.87
4/15/2010	7.2	1.97
10/21/2010	8.2	2.10
4/21/2011	20	3.00
10/6/2011	50	3.91
4/26/2012	9.9	2.29
10/4/2012	20	3.00
4/19/2013	15	2.71
10/17/2013	14	2.64
4/16/2014	16	2.77
10/24/2014	17	2.83
4/14/2016	17	2.83



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	25
# of nondetects	4
% of data as detects	84

Results

Coefficient of Determination (R^2) =	0.0681	
p-Value =	2.08E-01	
Attenuation Rate in Groundwater (K) =	-0.0001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0002	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	5.0
LN Screening Level	1.6094
Intercept	2.327
Slope	0.0001
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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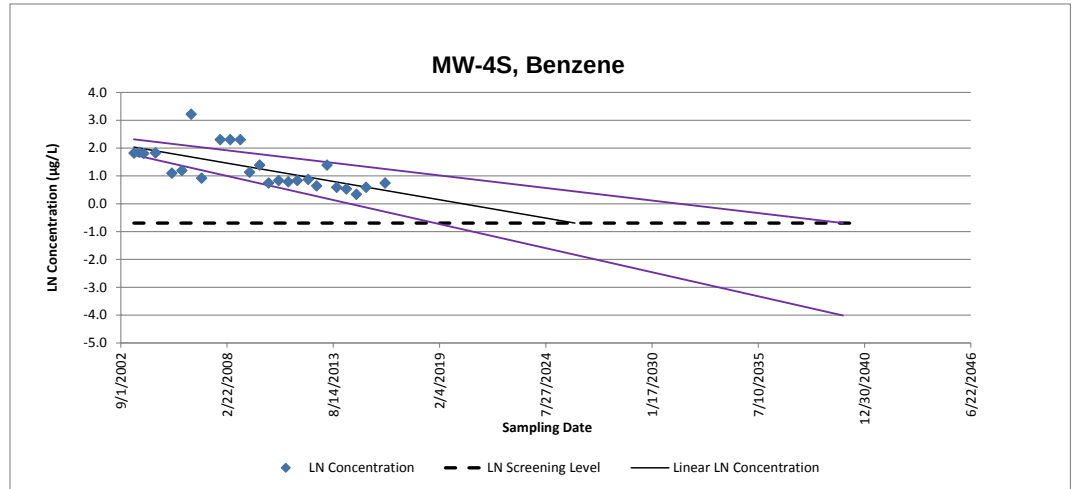
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-4S
Constituent Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/5/2003	6.17	1.82
8/12/2003	6.39	1.85
11/4/2003	6.11	1.81
6/15/2004	6.2	1.82
4/19/2005	3	1.10
10/24/2005	3.3	1.19
4/18/2006	25	3.22
10/31/2006	2.5	0.92
10/16/2007	10	2.30
4/22/2008	10	2.30
10/28/2008	10	2.30
4/21/2009	3.1	1.13
10/27/2009	4	1.39
4/13/2010	2.1	0.74
10/20/2010	2.3	0.83
4/19/2011	2.2	0.79
10/5/2011	2.3	0.83
4/26/2012	2.4	0.88
10/3/2012	1.9	0.64
4/18/2013	4	1.39
10/16/2013	1.8	0.59
4/15/2014	1.7	0.53
10/22/2014	1.4	0.34
4/21/2015	1.8	0.59
4/14/2016	2.1	0.74



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	25
# of nondetects	7
% of data as detects	72

Less than 75% data above reporting limits.

Results

Coefficient of Determination (R^2) =	0.4334	
p-Value =	3.47E-04	
Attenuation Rate in Groundwater (K) =	0.0003	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0002	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	2.11E+03	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	0.5
LN Screening Level	-0.6931
Intercept	2.036
Slope	-0.0003
Average Date to Screening Level	1/24/2026

Range of Dates to Reach the Screening Level (90% Confidence Level)

2018	to	2039
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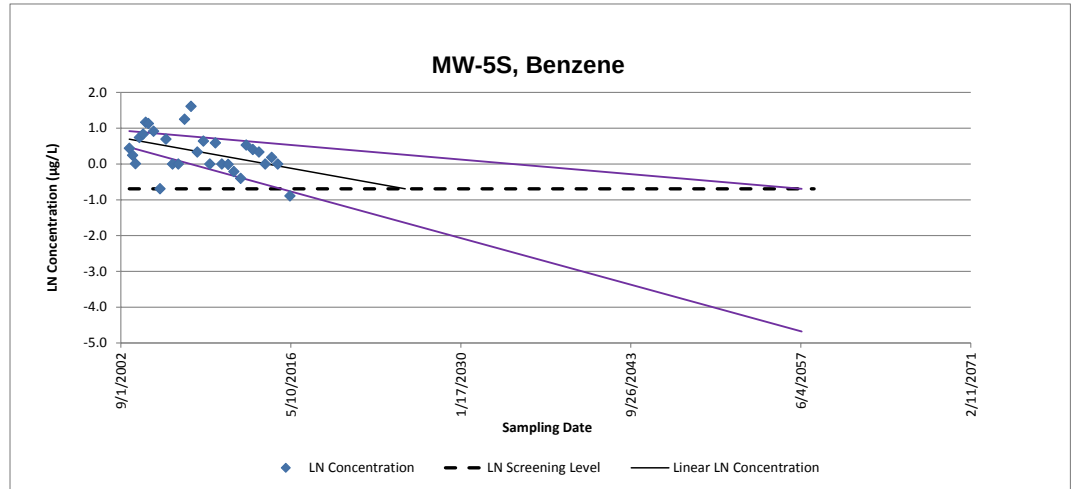
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-5S
Constituent Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	1.55	0.44
8/14/2003	1.28	0.25
11/6/2003	1.01	0.01
2/26/2004	2.1	0.74
6/16/2004	2.3	0.83
9/2/2004	3.2	1.16
11/17/2004	3.1	1.13
4/19/2005	2.5	0.92
10/26/2005	0.5	-0.69
4/19/2006	2	0.69
11/1/2006	1	0.00
4/19/2007	1	0.00
10/17/2007	3.5	1.25
4/23/2008	5	1.61
10/29/2008	1.4	0.34
4/23/2009	1.9	0.64
10/28/2009	1	0.00
4/14/2010	1.8	0.59
10/21/2010	1	0.00
4/21/2011	0.99	-0.01
10/5/2011	0.81	-0.21
4/26/2012	0.67	-0.40
10/3/2012	1.7	0.53
4/18/2013	1.5	0.41
10/16/2013	1.4	0.34
4/16/2014	1	0.00
10/23/2014	1.2	0.18
4/21/2015	1	0.00
4/14/2016	0.41	-0.89



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression 29
 # of nondetects 7
 % of data as detects 76

Results

Coefficient of Determination (R^2) = 0.1894
 p-Value = 1.83E-02
 Attenuation Rate in Groundwater (K) = 0.0002 days⁻¹
 Minimum attenuation Rate in Groundwater at 90% confidence (K) = 0.0001 days⁻¹
 Chemical Half Life in Groundwater ($t_{1/2}$) = 4.06E+03 days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level 0.5
 LN Screening Level -0.6931
 Intercept 0.694
 Slope -0.0002
 Average Date to Screening Level 7/26/2025

Range of Dates to Reach the Screening Level (90% Confidence Level)

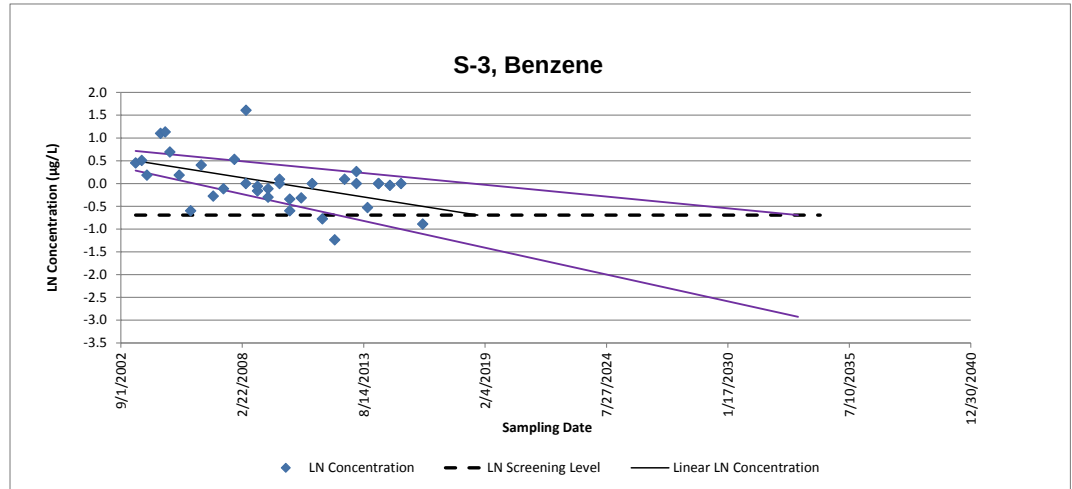
2015 to 2057

Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information**Sample Location** S-3**Constituent** Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/2/2003	1.57	0.45
8/12/2003	1.66	0.51
11/4/2003	1.2	0.18
6/15/2004	3	1.10
8/31/2004	3.1	1.13
11/16/2004	2	0.69
4/18/2005	1.2	0.18
10/24/2005	0.55	-0.60
4/18/2006	1.5	0.41
10/31/2006	0.76	-0.27
4/17/2007	0.89	-0.12
10/16/2007	1.7	0.53
4/22/2008	1	0.00
4/25/2008	5	1.61
10/28/2008	0.85	-0.16
10/30/2008	0.94	-0.06
4/21/2009	0.74	-0.30
4/23/2009	0.89	-0.12
10/27/2009	1.1	0.10
10/28/2009	1	0.00
4/13/2010	0.55	-0.60
4/14/2010	0.71	-0.34
10/20/2010	0.73	-0.31
4/19/2011	1	0.00
10/4/2011	0.46	-0.78
4/24/2012	0.29	-1.24
10/2/2012	1.1	0.10
4/16/2013	1.3	0.26
4/17/2013	1	0.00
10/15/2013	0.59	-0.53
4/15/2014	1	0.00
4/17/2014	1	0.00
10/21/2014	0.96	-0.04
4/21/2015	1	0.00
4/13/2016	0.41	-0.89

**Notes:**

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	35
# of nondetects	10
% of data as detects	71

Less than 75% data above reporting limits.

Results

Coefficient of Determination (R ²) =	0.2540	
p-Value =	2.03E-03	
Attenuation Rate in Groundwater (K) =	0.0002	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0001	days ⁻¹
Chemical Half Life in Groundwater (t _{1/2}) =	3.27E+03	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	0.5
LN Screening Level	-0.6931
Intercept	0.500
Slope	-0.0002
Average Date to Screening Level	10/6/2018

Range of Dates to Reach the Screening Level (90% Confidence Level)

2012	to	2033
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Abbreviations and Notes

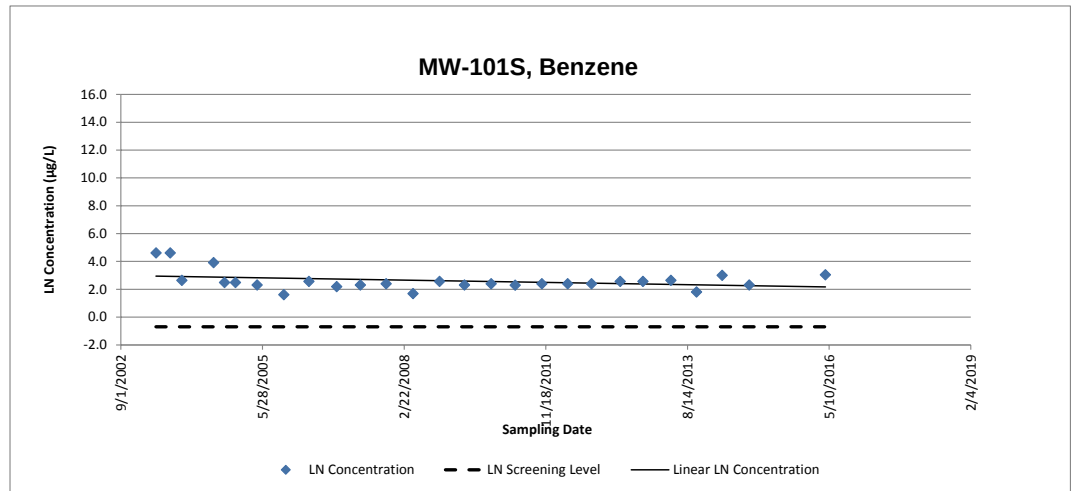
µg/l = micrograms per liter

LN = Natural Logarithm

Sample Information

Sample Location **MW-101S**
Constituent Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	100	4.61
8/15/2003	100	4.61
11/6/2003	14	2.64
6/17/2004	50	3.91
9/2/2004	12	2.48
11/18/2004	12	2.48
4/20/2005	10	2.30
10/26/2005	5	1.61
4/20/2006	13	2.56
11/2/2006	9	2.20
4/19/2007	10	2.30
10/18/2007	11	2.40
4/24/2008	5.4	1.69
10/29/2008	13	2.56
4/23/2009	10	2.30
10/28/2009	11	2.40
4/15/2010	9.9	2.29
10/21/2010	11	2.40
4/21/2011	11	2.40
10/6/2011	11	2.40
4/26/2012	13	2.56
10/4/2012	13	2.56
4/19/2013	14	2.64
10/17/2013	6.1	1.81
4/16/2014	20	3.00
10/24/2014	10	2.30
4/14/2016	21	3.04


Notes:

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	27
# of nondetects	6
% of data as detects	78

Results

Coefficient of Determination (R^2) =	0.1028	
p-Value =	1.03E-01	
Attenuation Rate in Groundwater (K) =	0.0002	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0000	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	0.5
LN Screening Level	-0.6931
Intercept	9.134
Slope	-0.0002
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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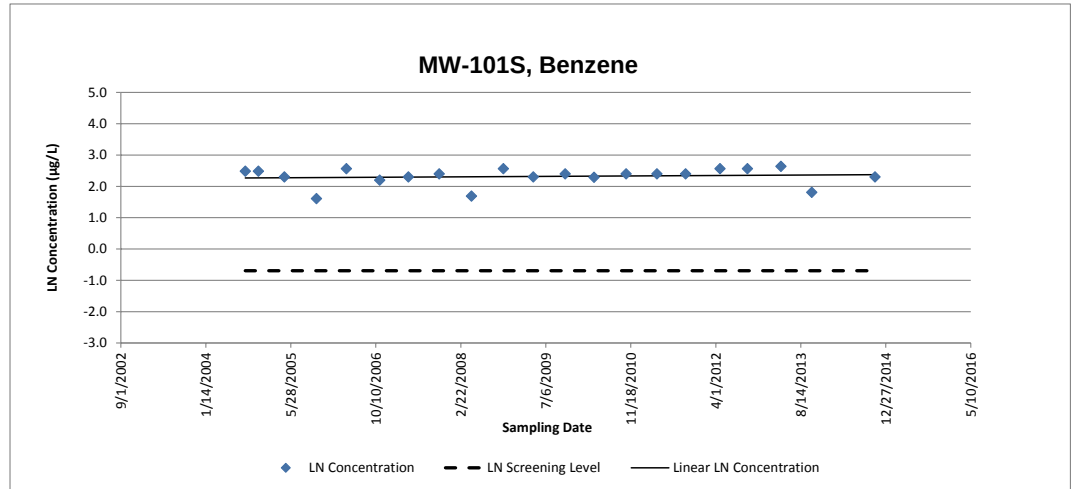
Abbreviations and Notes

µg/l = micrograms per liter
LN = Natural Logarithm

Sample Information

Sample Location MW-101S
Constituent Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
9/2/2004	12	2.48
11/18/2004	12	2.48
4/20/2005	10	2.30
10/26/2005	5	1.61
4/20/2006	13	2.56
11/2/2006	9	2.20
4/19/2007	10	2.30
10/18/2007	11	2.40
4/24/2008	5.4	1.69
10/29/2008	13	2.56
4/23/2009	10	2.30
10/28/2009	11	2.40
4/15/2010	9.9	2.29
10/21/2010	11	2.40
4/21/2011	11	2.40
10/6/2011	11	2.40
4/26/2012	13	2.56
10/4/2012	13	2.56
4/19/2013	14	2.64
10/17/2013	6.1	1.81
10/24/2014	10	2.30



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality	
Total # of data points used in regression	21
# of nondetects	1
% of data as detects	95

Results		
Coefficient of Determination (R^2) =	0.0128	
p-Value =	6.25E-01	
Attenuation Rate in Groundwater (K) =	0.0000	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)	
Screening Level	0.5
LN Screening Level	-0.6931
Intercept	1.186
Slope	0.0000
Average Date to Screening Level	NA

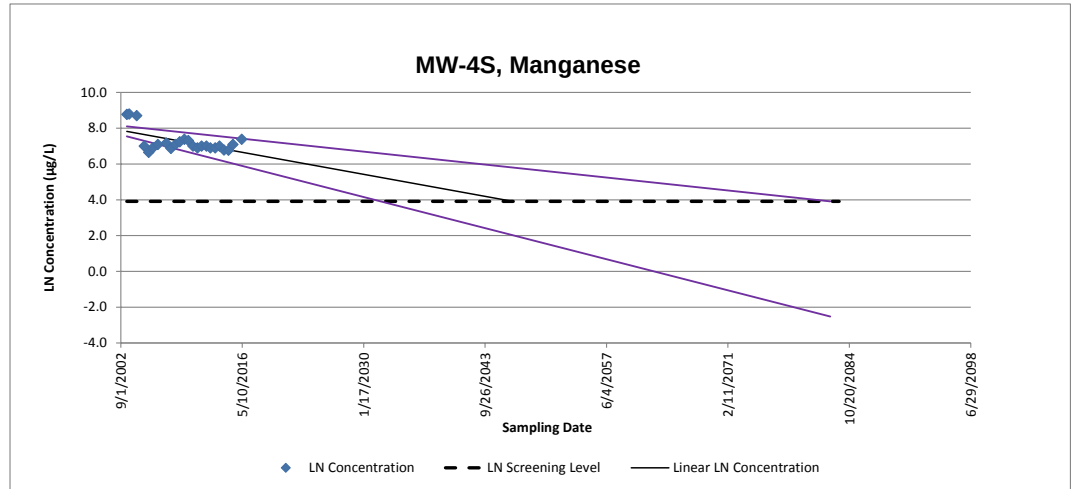
Range of Dates to Reach the Screening Level (90% Confidence Level)		
NA	to	NA

Abbreviations and Notes
 µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-4S
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/5/2003	6460	8.77
8/12/2003	6550	8.79
6/15/2004	6000	8.70
4/19/2005	1100	7.00
10/24/2005	770	6.65
4/18/2006	1000	6.91
10/31/2006	1200	7.09
10/16/2007	1300	7.17
4/22/2008	960	6.87
10/28/2008	1200	7.09
4/21/2009	1400	7.24
10/27/2009	1600	7.38
4/13/2010	1500	7.31
10/20/2010	1100	7.00
4/19/2011	990	6.90
10/5/2011	1100	7.00
4/26/2012	1100	7.00
10/3/2012	990	6.90
4/18/2013	990	6.90
10/16/2013	1100	7.00
4/15/2014	880	6.78
10/22/2014	870	6.77
4/21/2015	1200	7.09
4/14/2016	1600	7.38



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality	
Total # of data points used in regression	24
# of nondetects	0
% of data as detects	100

Results		
Coefficient of Determination (R^2) =	0.3184	
p-Value =	4.08E-03	
Attenuation Rate in Groundwater (K) =	0.0002	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	2.82E+03	days

Date Screening Level Reached (Average Slope & Intercept)	
Screening Level	50
LN Screening Level	3.9120
Intercept	7.823
Slope	-0.0002
Average Date to Screening Level	11/9/2046

Range of Dates to Reach the Screening Level (90% Confidence Level)		
2031	to	2082

Abbreviations and Notes

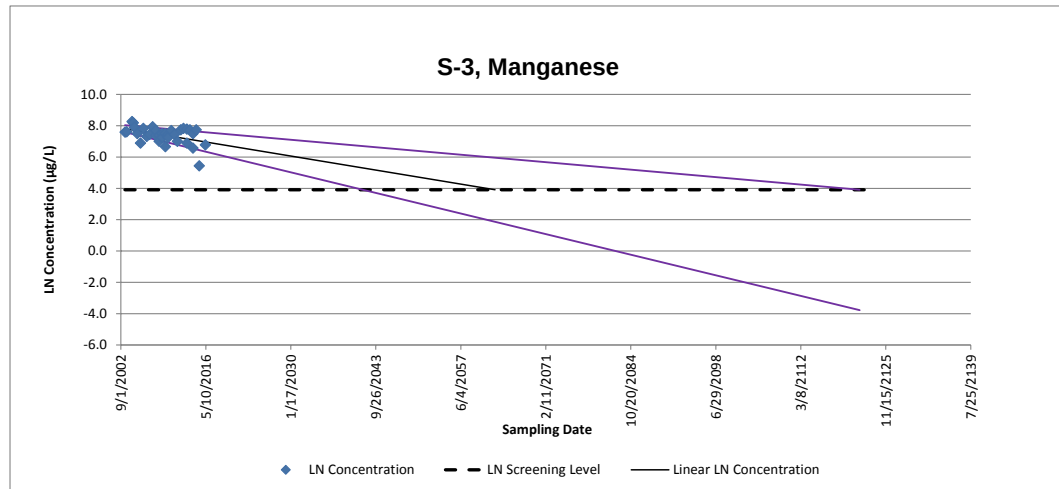
µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location S-3

Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/2/2003	1970	7.59
8/12/2003	2030	7.62
6/15/2004	3900	8.27
8/31/2004	3600	8.19
11/16/2004	2700	7.90
4/18/2005	1800	7.50
10/24/2005	980	6.89
4/18/2006	2500	7.82
10/31/2006	1500	7.31
4/17/2007	1700	7.44
10/16/2007	2800	7.94
4/22/2008	1600	7.38
4/25/2008	2200	7.70
10/28/2008	1600	7.38
10/30/2008	1100	7.00
4/21/2009	1800	7.50
4/23/2009	1400	7.24
10/27/2009	1800	7.50
10/28/2009	780	6.66
4/13/2010	1700	7.44
4/14/2010	1400	7.24
10/20/2010	2200	7.70
4/19/2011	1700	7.44
10/4/2011	1100	7.00
4/24/2012	2300	7.74
10/2/2012	2500	7.82
4/16/2013	2400	7.78
4/17/2013	980	6.89
10/15/2013	2300	7.74
4/15/2014	710	6.57
4/17/2014	1800	7.50
10/21/2014	2300	7.74
4/21/2015	230	5.44
4/13/2016	880	6.78



Notes:

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	34
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.1966	
p-Value =	8.64E-03	
Attenuation Rate in Groundwater (K) =	0.0002	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	3.87E+03	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	7.813
Slope	-0.0002
Average Date to Screening Level	12/7/2062

Range of Dates to Reach the Screening Level (90% Confidence Level)

2041	to	2121
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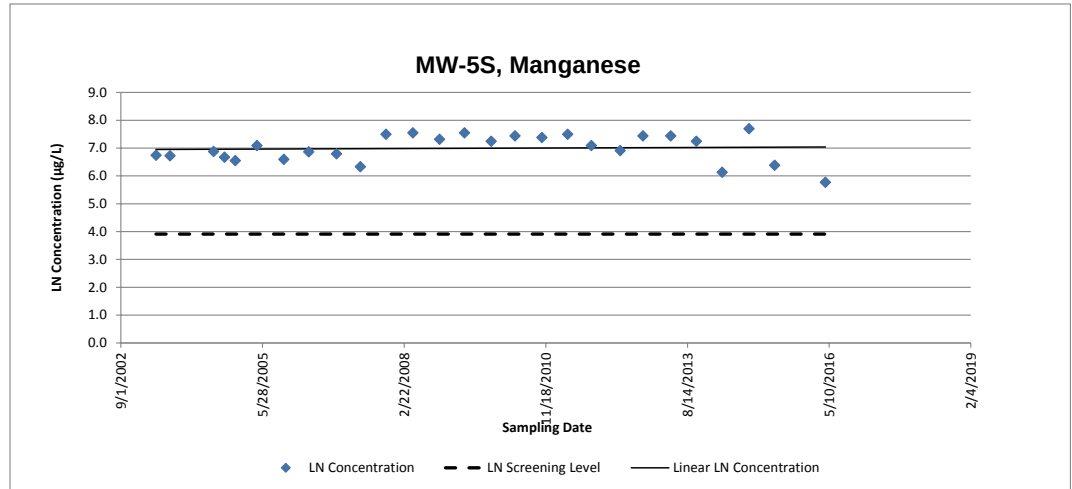
Abbreviations and Notes

µg/l = micrograms per liter
LN = Natural Logarithm

Sample Information

Sample Location MW-5S
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	850	6.75
8/14/2003	830	6.72
6/16/2004	970	6.88
9/2/2004	790	6.67
11/17/2004	700	6.55
4/19/2005	1200	7.09
10/26/2005	730	6.59
4/19/2006	960	6.87
11/1/2006	890	6.79
4/19/2007	560	6.33
10/17/2007	1800	7.50
4/23/2008	1900	7.55
10/29/2008	1500	7.31
4/23/2009	1900	7.55
10/28/2009	1400	7.24
4/14/2010	1700	7.44
10/21/2010	1600	7.38
4/21/2011	1800	7.50
10/5/2011	1200	7.09
4/26/2012	1000	6.91
10/3/2012	1700	7.44
4/18/2013	1700	7.44
10/16/2013	1400	7.24
4/16/2014	460	6.13
10/23/2014	2200	7.70
4/21/2015	590	6.38
4/14/2016	320	5.77

**Notes:**

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	27
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.0029	
p-Value =	7.89E-01	
Attenuation Rate in Groundwater (K) =	0.0000	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	6.951
Slope	0.0000
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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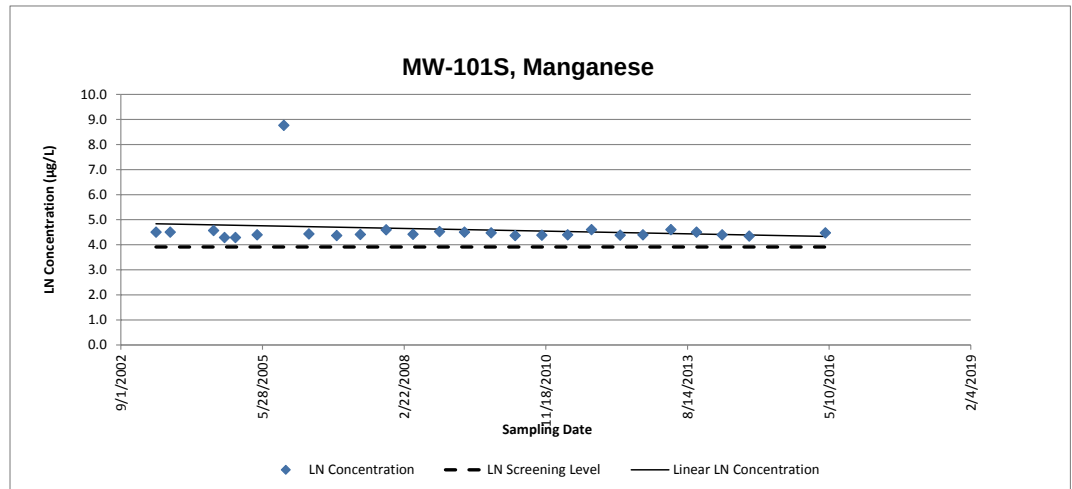
Abbreviations and Notes

µg/l = micrograms per liter
LN = Natural Logarithm

Sample Information

Sample Location MW-101S
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	90	4.50
8/15/2003	90	4.50
6/17/2004	96	4.56
9/2/2004	73	4.29
11/18/2004	73	4.29
4/20/2005	81	4.39
10/26/2005	6400	8.76
4/20/2006	84	4.43
11/2/2006	79	4.37
4/19/2007	82	4.41
10/18/2007	99	4.60
4/24/2008	83	4.42
10/29/2008	92	4.52
4/23/2009	90	4.50
10/28/2009	88	4.48
4/15/2010	79	4.37
10/21/2010	80	4.38
4/21/2011	81	4.39
10/6/2011	100	4.61
4/26/2012	80	4.38
10/4/2012	81	4.39
4/19/2013	100	4.61
10/17/2013	90	4.50
4/16/2014	81	4.39
10/24/2014	77	4.34
4/14/2016	88	4.48



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	26
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.0299	
p-Value =	3.98E-01	
Attenuation Rate in Groundwater (K) =	0.0001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	4.837
Slope	-0.0001
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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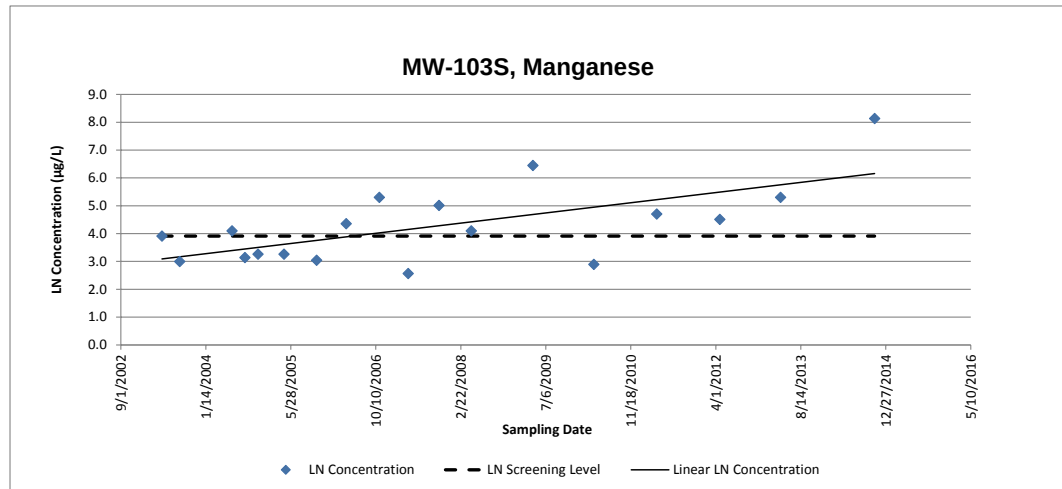
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location **MW-103S**
 Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/1/2003	50	3.91
8/13/2003	20	3.00
6/16/2004	60	4.09
8/31/2004	23	3.14
11/16/2004	26	3.26
4/18/2005	26	3.26
10/27/2005	21	3.04
4/19/2006	78	4.36
10/31/2006	200	5.30
4/18/2007	13	2.56
10/17/2007	150	5.01
4/23/2008	60	4.09
4/21/2009	630	6.45
4/14/2010	18	2.89
4/20/2011	110	4.70
4/25/2012	91	4.51
4/17/2013	200	5.30
10/22/2014	3400	8.13


Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	18
# of nondetects	2
% of data as detects	89

Results

Coefficient of Determination (R^2) =	0.4225	
p-Value =	3.50E-03	
Attenuation Rate in Groundwater (K) =	-0.0007	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0010	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	3.091
Slope	0.0007
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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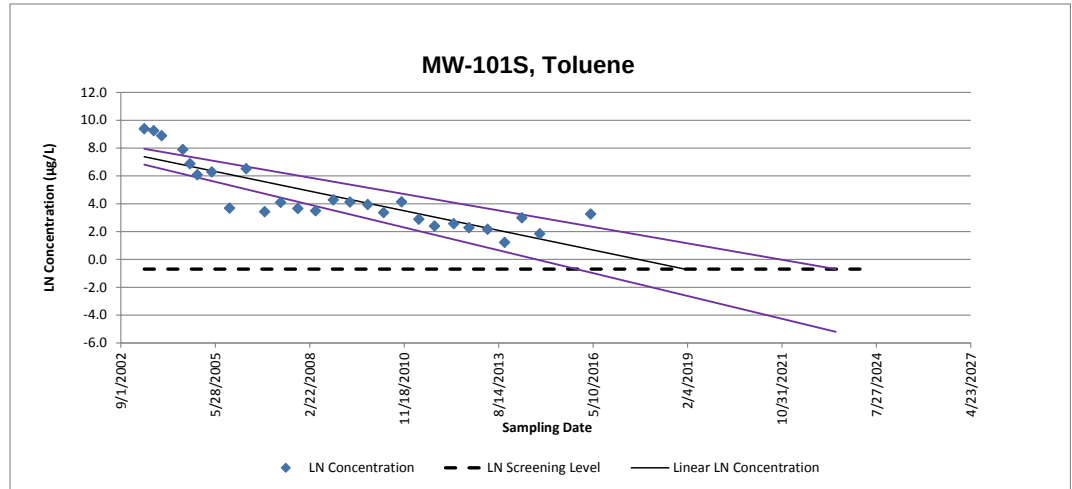
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-101S
Constituent Toluene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	12000	9.39
8/15/2003	10400	9.25
11/6/2003	7260	8.89
6/17/2004	2700	7.90
9/2/2004	970	6.88
11/18/2004	440	6.09
4/20/2005	540	6.29
10/26/2005	40	3.69
4/20/2006	680	6.52
11/2/2006	31	3.43
4/19/2007	60	4.09
10/18/2007	39	3.66
4/24/2008	33	3.50
10/29/2008	72	4.28
4/23/2009	62	4.13
10/28/2009	52	3.95
4/15/2010	29	3.37
10/21/2010	63	4.14
4/21/2011	18	2.89
10/6/2011	11	2.40
4/26/2012	13	2.56
10/4/2012	9.8	2.28
4/19/2013	8.8	2.17
10/17/2013	3.4	1.22
4/16/2014	20	3.00
10/24/2014	6.3	1.84
4/14/2016	26	3.26



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression 27
 # of nondetects 2
 % of data as detects 93

Results

Coefficient of Determination (R^2) = 0.7229
 p-Value = 1.98E-08
 Attenuation Rate in Groundwater (K) = 0.0014 days⁻¹
 Minimum attenuation Rate in Groundwater at 90% confidence (K) = 0.0012 days⁻¹
 Chemical Half Life in Groundwater ($t_{1/2}$) = 4.91E+02 days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level 0.5
 LN Screening Level -0.6931
 Intercept 7.380
 Slope -0.0014
 Average Date to Screening Level 1/8/2019

Range of Dates to Reach the Screening Level (90% Confidence Level)

2015 to 2023

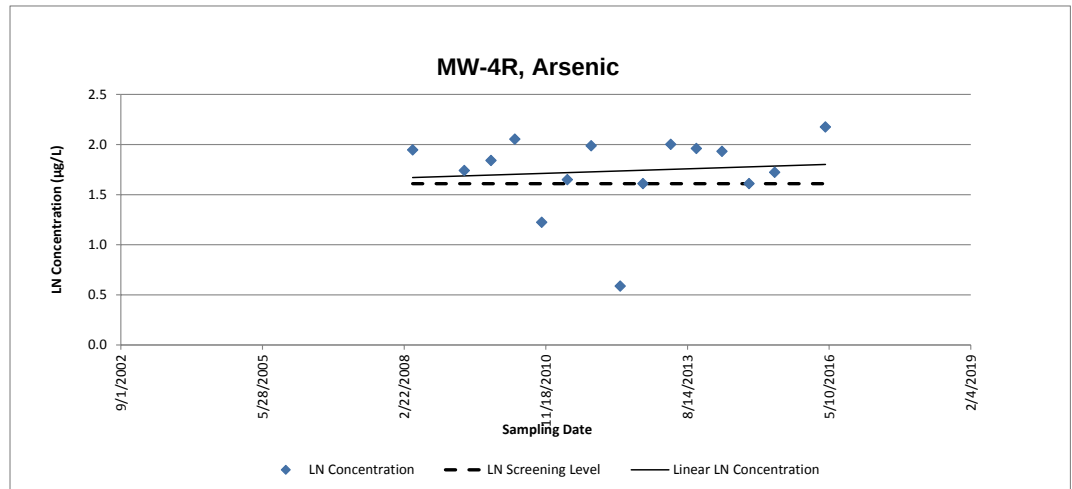
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-4R
Constituent Arsenic

Data		
Sample Date	Concentration (µg/L)	LN Concentration
4/22/2008	7	1.95
4/21/2009	5.7	1.74
10/27/2009	6.3	1.84
4/13/2010	7.8	2.05
10/20/2010	3.4	1.22
4/19/2011	5.2	1.65
10/4/2011	7.3	1.99
4/26/2012	1.8	0.59
10/3/2012	5	1.61
4/18/2013	7.4	2.00
10/16/2013	7.1	1.96
4/15/2014	6.9	1.93
10/22/2014	5	1.61
4/21/2015	5.6	1.72
4/14/2016	8.8	2.17



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	15
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.0095	
p-Value =	7.30E-01	
Attenuation Rate in Groundwater (K) =	0.0000	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0002	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	5.0
LN Screening Level	1.6094
Intercept	1.671
Slope	0.0000
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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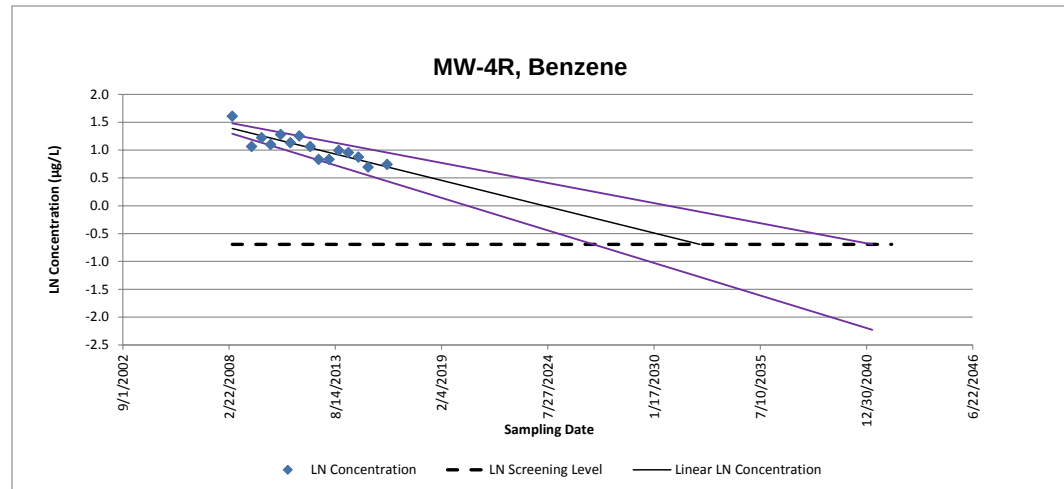
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-4R
Constituent Benzene

Data		
Sample Date	Concentration (µg/L)	LN Concentration
4/22/2008	5	1.61
4/21/2009	2.9	1.06
10/27/2009	3.4	1.22
4/13/2010	3	1.10
10/20/2010	3.6	1.28
4/19/2011	3.1	1.13
10/4/2011	3.5	1.25
4/26/2012	2.9	1.06
10/3/2012	2.3	0.83
4/18/2013	2.3	0.83
10/16/2013	2.7	0.99
4/15/2014	2.6	0.96
10/22/2014	2.4	0.88
4/21/2015	2	0.69
4/14/2016	2.1	0.74



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	15
# of nondetects	2
% of data as detects	87

Results

Coefficient of Determination (R^2) =	0.7149
p-Value =	7.18E-05
Attenuation Rate in Groundwater (K) =	0.0002 days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0002 days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	2.93E+03 days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	0.5
LN Screening Level	-0.6931
Intercept	1.388
Slope	-0.0002
Average Date to Screening Level	5/28/2032

Range of Dates to Reach the Screening Level (90% Confidence Level)

2026	to	2041
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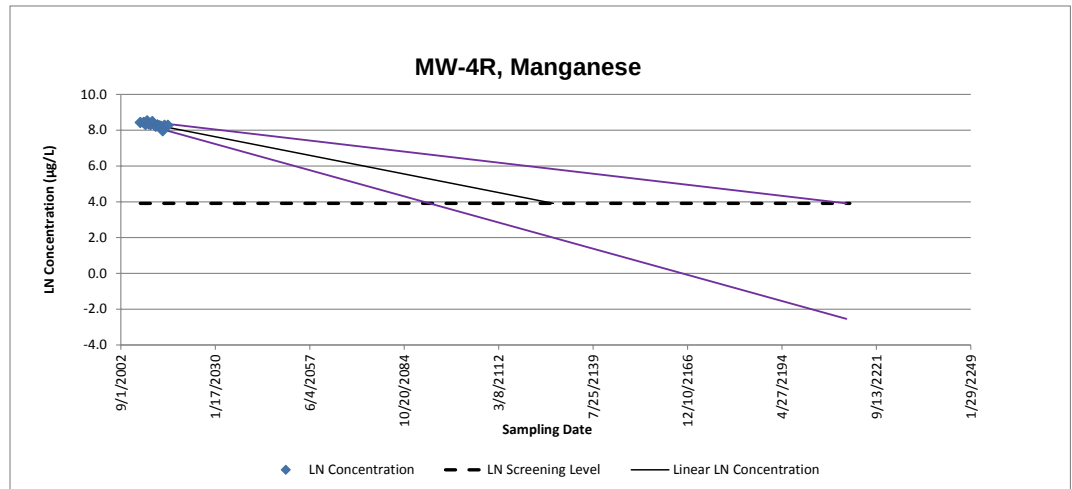
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-4R
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
4/22/2008	4600	8.43
4/21/2009	4600	8.43
10/27/2009	4100	8.32
4/13/2010	5000	8.52
10/20/2010	4200	8.34
4/19/2011	4100	8.32
10/4/2011	4800	8.48
4/26/2012	4100	8.32
10/3/2012	3700	8.22
4/18/2013	4000	8.29
10/16/2013	3800	8.24
4/15/2014	3700	8.22
10/22/2014	2900	7.97
4/21/2015	3900	8.27
4/14/2016	3900	8.27



Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality	
Total # of data points used in regression	15
# of nondetects	0
% of data as detects	100

Results		
Coefficient of Determination (R^2) =	0.4598	
p-Value =	5.46E-03	
Attenuation Rate in Groundwater (K) =	0.0001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	6.66E+03	days

Date Screening Level Reached (Average Slope & Intercept)	
Screening Level	50
LN Screening Level	3.9120
Intercept	8.461
Slope	-0.0001
Average Date to Screening Level	1/26/2128

Range of Dates to Reach the Screening Level (90% Confidence Level)		
2092	to	2213

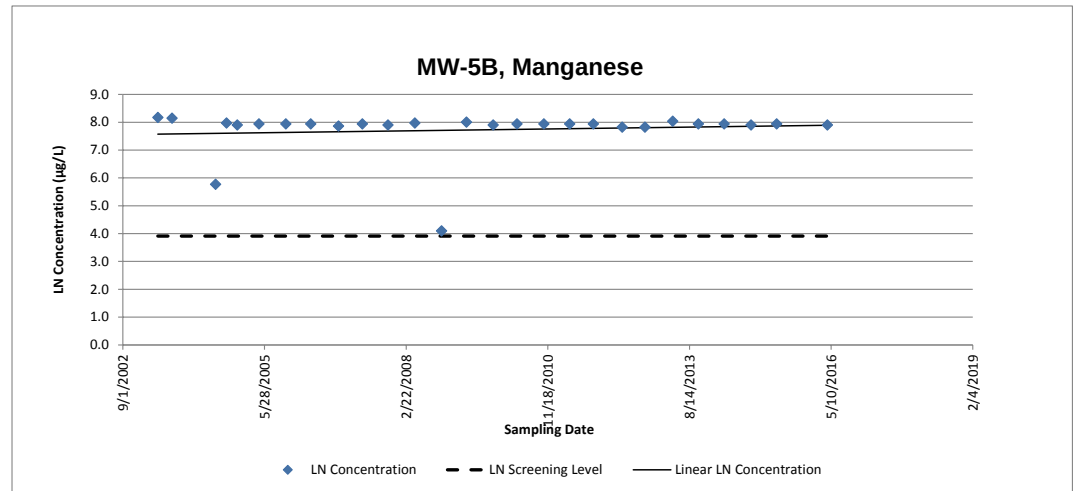
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-5B
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/6/2003	3540	8.17
8/14/2003	3440	8.14
6/17/2004	320	5.77
9/2/2004	2900	7.97
11/17/2004	2700	7.90
4/19/2005	2800	7.94
10/26/2005	2800	7.94
4/19/2006	2800	7.94
11/1/2006	2600	7.86
4/19/2007	2800	7.94
10/17/2007	2700	7.90
4/23/2008	2900	7.97
10/29/2008	60	4.09
4/23/2009	3000	8.01
10/28/2009	2700	7.90
4/14/2010	2800	7.94
10/21/2010	2800	7.94
4/21/2011	2800	7.94
10/5/2011	2800	7.94
4/26/2012	2500	7.82
10/3/2012	2500	7.82
4/18/2013	3100	8.04
10/16/2013	2800	7.94
4/16/2014	2800	7.94
10/23/2014	2700	7.90
4/21/2015	2800	7.94
4/14/2016	2700	7.90


Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	27
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.0130	
p-Value =	5.72E-01	
Attenuation Rate in Groundwater (K) =	-0.0001	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0002	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	7.573
Slope	0.0001
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
----	----	----

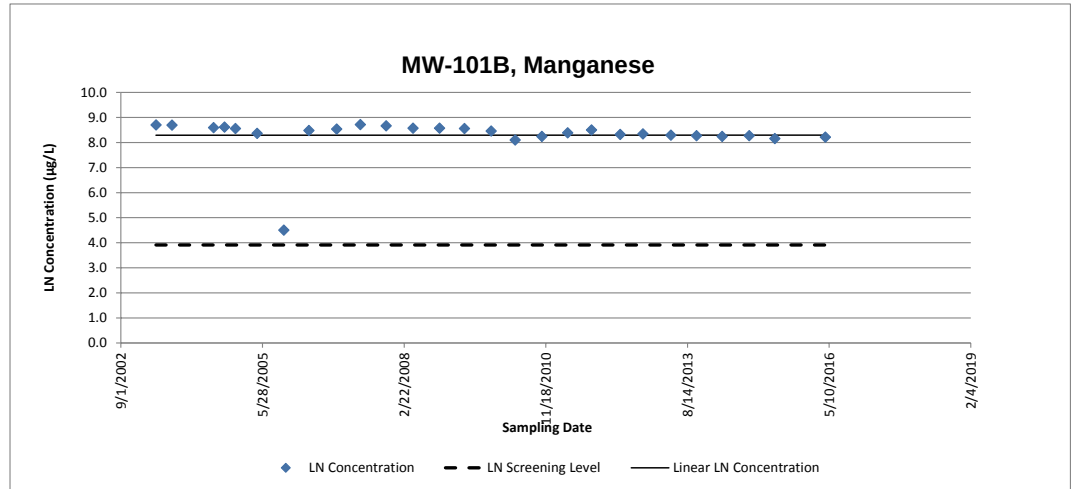
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-101B
Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/7/2003	6000	8.70
8/28/2003	5950	8.69
6/17/2004	5400	8.59
9/2/2004	5500	8.61
11/18/2004	5200	8.56
4/20/2005	4300	8.37
10/26/2005	90	4.50
4/20/2006	4800	8.48
11/2/2006	5100	8.54
4/19/2007	6100	8.72
10/18/2007	5800	8.67
4/24/2008	5300	8.58
10/29/2008	5300	8.58
4/23/2009	5200	8.56
10/28/2009	4700	8.46
4/15/2010	3300	8.10
10/21/2010	3800	8.24
4/21/2011	4400	8.39
10/6/2011	4900	8.50
4/26/2012	4100	8.32
10/4/2012	4200	8.34
4/19/2013	4000	8.29
10/17/2013	3900	8.27
4/16/2014	3800	8.24
10/24/2014	3900	8.27
4/23/2015	3500	8.16
4/14/2016	3700	8.22

**Notes:**

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression	27
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.0000	
p-Value =	9.94E-01	
Attenuation Rate in Groundwater (K) =	0.0000	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0001	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	8.292
Slope	0.0000
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
----	----	----

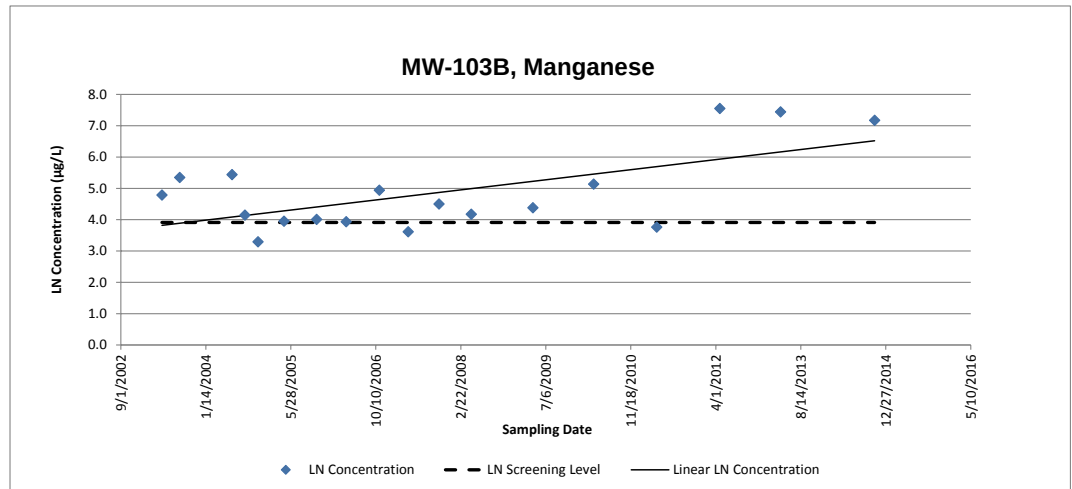
Abbreviations and Notes

µg/l = micrograms per liter
LN = Natural Logarithm

Sample Information

Sample Location **MW-103B**
 Constituent Manganese

Data		
Sample Date	Concentration (µg/L)	LN Concentration
5/1/2003	120	4.79
8/13/2003	210	5.35
6/16/2004	230	5.44
8/31/2004	63	4.14
11/16/2004	27	3.30
4/18/2005	52	3.95
10/27/2005	55	4.01
4/19/2006	51	3.93
10/31/2006	140	4.94
4/18/2007	37	3.61
10/17/2007	90	4.50
4/23/2008	65	4.17
4/21/2009	80	4.38
4/13/2010	170	5.14
4/20/2011	43	3.76
4/25/2012	1900	7.55
4/17/2013	1700	7.44
10/22/2014	1300	7.17


Notes:

ND taken at reporting limit/reported value
 Qualified data converted to reported value

Data quality

Total # of data points used in regression	18
# of nondetects	0
% of data as detects	100

Results

Coefficient of Determination (R^2) =	0.3862	
p-Value =	5.90E-03	
Attenuation Rate in Groundwater (K) =	-0.0006	days ⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) =	-0.0009	days ⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) =	NA	days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level	50
LN Screening Level	3.9120
Intercept	3.820
Slope	0.0006
Average Date to Screening Level	NA

Range of Dates to Reach the Screening Level (90% Confidence Level)

NA	to	NA
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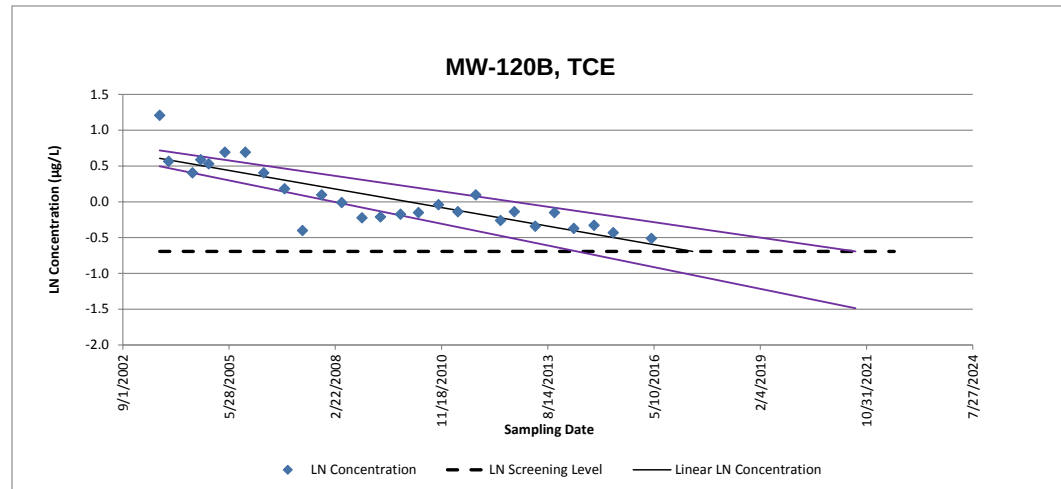
Abbreviations and Notes

µg/l = micrograms per liter
 LN = Natural Logarithm

Sample Information

Sample Location MW-120B
Constituent TCE

Data		
Sample Date	Concentration (µg/L)	LN Concentration
8/14/2003	3.35	1.21
11/5/2003	1.76	0.57
6/17/2004	1.5	0.41
9/2/2004	1.8	0.59
11/17/2004	1.7	0.53
4/19/2005	2	0.69
10/27/2005	2	0.69
4/19/2006	1.5	0.41
11/1/2006	1.2	0.18
4/19/2007	0.67	-0.40
10/17/2007	1.1	0.10
4/23/2008	0.99	-0.01
10/29/2008	0.8	-0.22
4/22/2009	0.81	-0.21
10/28/2009	0.84	-0.17
4/14/2010	0.86	-0.15
10/20/2010	0.96	-0.04
4/20/2011	0.87	-0.14
10/5/2011	1.1	0.10
5/25/2012	0.77	-0.26
10/3/2012	0.87	-0.14
4/18/2013	0.71	-0.34
10/16/2013	0.86	-0.15
4/15/2014	0.69	-0.37
10/23/2014	0.72	-0.33
4/22/2015	0.65	-0.43
4/15/2016	0.6	-0.51



Notes:

ND taken at reporting limit/reported value
Qualified data converted to reported value

Data quality

Total # of data points used in regression 27
of nondetects 0
% of data as detects 100

Results

Coefficient of Determination (R^2) = 0.7089
p-Value = 3.70E-08
Attenuation Rate in Groundwater (K) = 0.0003 days⁻¹
Minimum attenuation Rate in Groundwater at 90% confidence (K) = 0.0002 days⁻¹
Chemical Half Life in Groundwater ($t_{1/2}$) = 2.67E+03 days

Date Screening Level Reached (Average Slope & Intercept)

Screening Level 0.5
LN Screening Level -0.6931
Intercept 0.607
Slope -0.0003
Average Date to Screening Level 5/9/2017

Range of Dates to Reach the Screening Level (90% Confidence Level)

2014 to 2021

Abbreviations and Notes

µg/l = micrograms per liter
LN = Natural Logarithm



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Copies:

From:

Melissa Beauchemin, Risk Assessor
Allen Walker, Project Manager

Date:

September 30, 2014

ARCADIS Project No.:

BN012392.2014

Subject:

Barkhamsted Sediment Data - Ecological Screen

At the request of USEPA Region 1 and as part of the 5-year review process, this memorandum presents the results of the ecological sediment screen in the Unnamed Brook at the Barkhamsted New-Hartford Superfund Site. The screen was conducted on sediment data collected at the Site since 2003 to ensure that the sediment remedial action objectives (RAOs) are being met.

Twenty-seven sediment samples were collected from three locations (SED-3, SED-9, SED-16) from the Unnamed Brook associated with the Site between August 2003 and April 2014. Sediments were analyzed for 23 metals, 28 pesticides/polychlorinated biphenyls (PCBs), 67 semi-volatile organic compounds (SVOCs) and 74 volatile organic compounds (VOCs). Twenty-two metals, seven pesticides, ten SVOCs, and seven VOCs were detected in sediments collected from the Site. Table 1 provides all sediment data collected at the Site since 2003.

Table 2 provides summary statistics of the sediment data including the minimum and maximum detected concentrations, percent detection, arithmetic average, median, geometric mean, location of maximum detected concentrations, and minimum and maximum non-detect concentrations. In addition, sediment screening values from USEPA Region 3 Biological Technical Advisory Group (BTAG) Freshwater Sediment Screening Benchmarks for the protection of benthic organisms (USEPA 2006) are provided for comparison.

The arithmetic average detected results were compared to the sediment screening values to obtain a hazard quotient (HQ). If the HQ is greater than 1, there is the potential for risk from the analyte. The magnitude of the exceedance of the HQs provides insight into the magnitude of potential adverse effects; i.e., the greater the HQ, the more likelihood of adverse effects.

Benchmarks were exceeded for manganese (HQ = 2.2), selenium (HQ = 3.5), and bis(2-Ethylhexyl)phthalate (HQ = 3.0). Although each analyte has HQs greater than 1, the magnitudes of the exceedances are low, with all HQs below 5. Manganese is frequently found at high concentrations even at background levels; it is an essential nutrient for plants and animals and is not bioaccumulative (USEPA 2007). Selenium is an essential element for plant growth (USEPA 2007) and was only detected in 6 of the 18 results (Table 2). Bis(2-Ethylhexyl)phthalate is a common landfill constituent found in many plastics (ATSDR 2002) and was only detected in 2 of 12 results (Table 2). While historical results (i.e., 2003-2012) for manganese, selenium, and bis(2-Ethylhexyl)phthalate exceeded benchmarks, results from the most recently available round of data (i.e., October 2013) were either non-detect or below screening benchmarks. All other analytes were detected in sediments at average concentrations below their respective benchmarks. It is also important to note that many of the highest detected concentrations occurred at sample location SED-3 (Table 2), which is located upstream of the landfill. This indicates that concentrations of many constituents are higher in the background location than at the site-related location.

For analytes not detected in sediment, the minimum detection limits were also compared to screening benchmarks. The minimum detection limits of only 3 of the 146 non-detect analytes (chlordane, toxaphene, and carbon disulfide) exceeded benchmarks. Carbon disulfide was not detected at detection limits above benchmarks in the August 2003 sampling round and was not analyzed for in subsequent sampling rounds. Carbon disulfide is highly mobile and not bioaccumulative (ATSDR 1996) and was therefore likely excluded as a contaminant of concern (COC).

There is some uncertainty with the results for toxaphene and chlordane because analytical instruments cannot detect these compounds in sediments at extremely low levels. Determination of chlordane residues is difficult because of the complex nature of the components and the fact that each component degrades independently (IARC 2001). The analysis and chemical characterization of toxaphene is difficult because of the extreme complexity of the compound. In fact, at low levels, it is difficult to distinguish toxaphene from background noise (Washington Department of Ecology 2012, Gouteux et al. 2002).

Despite the uncertainties identified above, results from 11 years of sediment data indicate that the RAOs for sediment are being met and that there are no potential ecological risks to benthic invertebrates associated with sediment in the Unnamed Brook. Sediment sampling can likely be discontinued because RAOs have been met. Remedial actions have reduced concentrations of sediment COCs to levels below those which may cause adverse effects to benthic organisms.

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**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 8/14/2003	SED-3 8/15/2003	SED-9 8/15/2003	SED-16 6/17/2004	SED-3 6/17/2004	SED-9 6/17/2004	SED-16 4/20/2005
Inorganics									
Aluminum	mg/Kg	7429-90-5	NA	NA	NA	5600 [4000]	30000	4600	5900 [4300]
Antimony	mg/Kg	7440-36-0	NA	NA	NA	<2.6 [<2.7]	<5.6	<6.2	<2.7 [<5.5]
Arsenic	mg/Kg	7440-38-2	NA	NA	NA	<1.3 [<1.3]	4	<3.1	<1.4 [6.1]
Barium	mg/Kg	7440-39-3	NA	NA	NA	53 [37]	160	34	61 [49]
Beryllium	mg/Kg	7440-41-7	NA	NA	NA	<0.26 [<0.27]	1.6	<0.62	<0.18 [<0.37]
Cadmium	mg/Kg	7440-43-9	NA	NA	NA	<0.26 [<0.27]	0.82	<0.62	<0.27 [<0.55]
Calcium	mg/Kg	7440-70-2	NA	NA	NA	1300 [750]	4500	1100	600 [810]
Chromium	mg/Kg	7440-47-3	NA	NA	NA	10 [6.9]	39	25	11 [13]
Cobalt	mg/Kg	7440-48-4	NA	NA	NA	6.5 [5.6]	20	4.2	4.9 [6.5]
Copper	mg/Kg	7440-50-8	NA	NA	NA	7.6 [6.6]	18	17	5.3 [42]
Iron	mg/Kg	7439-89-6	NA	NA	NA	16000 [10000]	33000	19000	12000 [48000]
Lead	mg/Kg	7439-92-1	NA	NA	NA	6.4 [6]	55	22	3.2 [5.5]
Magnesium	mg/Kg	7439-95-4	NA	NA	NA	2100 [1600]	4600	2300	2600 [1900]
Manganese	mg/Kg	7439-96-5	NA	NA	NA	730 [600]	3400	300	500 [630]
Mercury	mg/Kg	7439-97-6	NA	NA	NA	<0.11 [<0.12]	<0.27	<0.094	<0.036 [<0.029]
Nickel	mg/Kg	7440-02-0	NA	NA	NA	7.9 [5.6]	25	9.1	5.6 [16]
Potassium	mg/Kg	7440-09-7	NA	NA	NA	2000 [1400]	1700	1700	2600 [1600]
Selenium	mg/Kg	7782-49-2	NA	NA	NA	<1.3 [<1.3]	<2.8	<3.1	<1.4 [<2.7]
Silver	mg/Kg	7440-22-4	NA	NA	NA	<1.3 [<1.3]	<2.8	<3.1	<1.4 [<2.7]
Sodium	mg/Kg	7440-23-5	NA	NA	NA	<130 [<130]	<280	<250	<270 [<550]
Thallium	mg/Kg	7440-28-0	NA	NA	NA	<1.3 [<1.3]	<2.8	<3.1	<1.4 [<2.7]
Vanadium	mg/Kg	7440-62-2	NA	NA	NA	17 [11]	58	15	18 [13]
Zinc	mg/Kg	7440-66-6	NA	NA	NA	34 [25]	140	31	31 [25]
Pesticides/PCBs									
4,4'-DDT	ug/Kg	50-29-3	<4.44	<12.8	<3.96 [<4.22]	<26 [<24]	<54	<22	<24 [<22]
4,4'-DDD	ug/Kg	72-54-8	<2.96	<8.54	<2.64 [<2.8]	<26 [<24]	<54	<22	<24 [<22]
4,4'-DDE	ug/Kg	72-55-9	<2.22	<6.4	<1.976 [<2.1]	<26 [<24]	<54	<22	<24 [<22]
Aldrin	ug/Kg	309-00-2	<2.6	<7.46	<2.3 [<2.46]	<26 [<24]	<54	<22	<24 [<22]
alpha-BHC	ug/Kg	319-84-6	<2.6	<7.46	<2.3 [<2.46]	<26 [<24]	<54	<22	<24 [<22]
alpha-Chlordane	ug/Kg	5103-71-9	<3.14	<9.06	<2.8 [<2.98]	NA	NA	NA	NA
beta-BHC	ug/Kg	319-85-7	<3.34	<9.6	<2.96 [<3.16]	<26 [<24]	<54	<22	<24 [<22]
Chlordane, total	ug/Kg	57-74-9	<46.2	<133.4	<41.2 [<43.8]	<126 [<120]	<260	<114	<122 [<110]
Dieldrin	ug/Kg	60-57-1	<2.4	<6.94	<2.14 [<2.28]	<26 [<24]	<54	<22	<24 [<22]
Endosulfan I	ug/Kg	959-98-8	<2.4	<6.94	<2.14 [<2.28]	NA	NA	NA	NA
Endosulfan II	ug/Kg	33213-65-9	<2.4	<6.94	<2.14 [<2.28]	NA	NA	NA	NA
Endosulfan Sulfate	ug/Kg	1031-07-8	<2.6	<7.46	<2.3 [<2.46]	<26 [<24]	<54	<22	<24 [<22]
Endrin	ug/Kg	72-20-8	<2.96	<8.54	<2.64 [<2.8]	<26 [<24]	<54	<22	<24 [<22]
Endrin Aldehyde	ug/Kg	7421-93-4	<2.6	<7.46	<2.3 [<2.46]	<26 [<24]	<54	<22	<24 [<22]
Endrin Ketone	ug/Kg	53494-70-5	<2.6	<7.46	<2.3 [<2.46]	NA	NA	NA	NA
gamma-BHC (Lindane)	ug/Kg	58-89-9	<4.26	<12.26	<3.78 [<4.04]	<26 [<24]	<54	<22	<24 [<22]
gamma-Chlordane	ug/Kg	5103-74-2	<2.96	<8.54	<2.64 [<2.8]	NA	NA	NA	NA
Heptachlor	ug/Kg	76-44-8	<3.7	<10.66	<3.3 [<3.5]	<26 [<24]	<54	<22	<24 [<22]
Heptachlor Epoxide	ug/Kg	1024-57-3	<2.6	<7.46	<2.3 [<2.46]	<26 [<24]	<54	<22	<24 [<22]
Methoxychlor	ug/Kg	72-43-5	<4.82	<13.86	<4.28 [<4.56]	<50 [<48]	<106	<46	<48 [<44]
PCB-1260	ug/Kg	11096-82-5	<24	<69.4	<21.4 [<22.2]	<0.52 [<0.5]	<1.12	<0.48	<88 [<78]
PCB-1254	ug/Kg	11097-69-1	<31.4	<90.6	<28 [<29]	<0.76 [<0.72]	<1.6	<0.68	<88 [<78]
PCB-1221	ug/Kg	11104-28-2	<31.4	<90.6	<28 [<29]	<0.76 [<0.72]	<1.6	<0.68	<88 [<78]
PCB-1232	ug/Kg	11141-16-5	<31.4	<90.6	<28 [<29]	<0.76 [<0.72]	<1.6	<0.68	<88 [<78]
PCB-1248	ug/Kg	12672-29-6	<31.4	<90.6	<28 [<29]	<0.76 [<0.72]	<1.6	<0.68	<88 [<78]
PCB-1016	ug/Kg	12674-11-2	<31.4	<90.6	<28 [<29]	<0.6 [<0.58]	<1.28	<0.54	<88 [<78]
PCB-1242	ug/Kg	53469-21-9	<31.4	<90.6	<28 [<29]	NA	NA	NA	NA
Toxaphene	ug/Kg	8001-35-2	<296	<854	<264 [<280]	<1260 [<1200]	<2600	<1140	<1220 [<1100]

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 8/14/2003	SED-3 8/15/2003	SED-9 8/15/2003	SED-16 6/17/2004	SED-3 6/17/2004	SED-9 6/17/2004	SED-16 4/20/2005
Semivolatile Organics									
2,4,5-Trichlorophenol	ug/Kg	95-95-4	<55.6	<159.4	<49.4 [<51.2]	<11 [<10.6]	<24	<20	NA
2,4,6-Trichlorophenol	ug/Kg	88-06-2	<55.6	<159.4	<49.4 [<51.2]	<8.6 [<8.2]	<18.4	<16	NA
2,4-Dichlorophenol	ug/Kg	120-83-2	<55.6	<159.4	<49.4 [<51.2]	<11.4 [<11]	<24	<22	NA
2,4-Dimethylphenol	ug/Kg	105-67-9	<148.2	<426	<131.6 [<136.8]	<10.6 [<10.2]	<22	<20	NA
2,4-Dinitrophenol	ug/Kg	51-28-5	<37	<106.4	<33 [<34.2]	<32 [<30]	<68	<58	NA
2,4-Dinitrotoluene	ug/Kg	121-14-2	<18.52	<53.2	<16.46 [<17.08]	<2.6 [<2.6]	<5.6	<4.8	NA
2,6-Dinitrotoluene	ug/Kg	606-20-2	<55.6	<159.4	<49.4 [<51.2]	<1.92 [<1.86]	<4.2	<3.6	NA
2-Chloronaphthalene	ug/Kg	91-58-7	<37	<106.4	<33 [<34.2]	<1.98 [<1.9]	<4.2	<3.8	NA
2-Chlorophenol	ug/Kg	95-57-8	<37	<106.4	<33 [<34.2]	<26 [<26]	<56	<48	NA
2-Methylnaphthalene	ug/Kg	91-57-6	<37	<106.4	<33 [<34.2]	<11 [<10.6]	<24	<20	NA
2-Methylphenol	ug/Kg	95-48-7	<55.6	<159.4	<49.4 [<51.2]	<11.2 [<10.8]	<24	<20	NA
2-Nitroaniline	ug/Kg	88-74-4	<18.52	<53.2	<16.46 [<17.08]	<7.8 [<7.6]	<16.8	<14.6	NA
2-Nitrophenol	ug/Kg	88-75-5	<37	<106.4	<33 [<34.2]	<11 [<10.6]	<24	<20	NA
3 & 4 Methylphenol	ug/Kg	108-39-4/106-44-5	34.7	<106.4	<33 [<34.2]	<12 [<11.6]	<26	<22	NA
3,3'-Dichlorobenzidine	ug/Kg	91-94-1	<185.2	<532	<164.6 [<170.8]	<4.2 [<4]	<9	<7.8	NA
3-Nitroaniline	ug/Kg	99-09-2	<55.6	<159.4	<49.4 [<51.2]	<10.2 [<9.8]	<22	<19	NA
4,6-Dinitro-2-Methylphenol	ug/Kg	534-52-1	<92.6	<266	<82.4 [<85.4]	NA	NA	NA	NA
4-Bromophenyl-phenylether	ug/Kg	101-55-3	<37	<106.4	<33 [<34.2]	<3.2 [<3]	<6.8	<5.8	NA
4-Chloro-3-Methylphenol	ug/Kg	59-50-7	<37	<106.4	<33 [<34.2]	<14.6 [<14]	<32	<28	NA
4-Chloroaniline	ug/Kg	106-47-8	<166.6	<478	<148.2 [<153.8]	<8.4 [<8]	<17.8	<15.6	NA
4-Chloro-phenyl-phenyl ether	ug/Kg	7005-72-3	<55.6	<159.4	<49.4 [<51.2]	<1.36 [<1.3]	<3	<2.6	NA
4-Nitroaniline	ug/Kg	100-01-6	<37	<106.4	<33 [<34.2]	<30 [<28]	<64	<56	NA
4-Nitrophenol	ug/Kg	100-02-7	<74	<212	<65.8 [<68.4]	<10 [<9.6]	<22	<18.6	NA
Acenaphthene	ug/Kg	83-32-9	<37	<106.4	<33 [<34.2]	<1.72 [<1.66]	<3.6	<3.2	NA
Acenaphthylene	ug/Kg	208-96-8	<37	<106.4	<33 [<34.2]	<1.54 [<1.48]	<3.2	<2.8	NA
Acetophenone	ug/Kg	98-86-2	<18.52	<53.2	<16.46 [<17.08]	NA	NA	NA	NA
Aniline	ug/Kg	62-53-3	<129.6	<372	<115.2 [<119.6]	<46 [<46]	<100	<88	NA
Anthracene	ug/Kg	120-12-7	<37	<106.4	<33 [<34.2]	<1.86 [<1.78]	<4	<3.4	NA
Azobenzene	ug/Kg	103-33-3	<74	<212	<65.8 [<68.4]	NA	NA	NA	NA
Benzo(a)anthracene	ug/Kg	56-55-3	<111.2	<318	50.2 [<102.6]	<1.7 [<1.62]	<3.6	<3.2	<138 [<128]
Benzo(a)pyrene	ug/Kg	50-32-8	<74	<212	<65.8 [<68.4]	<1.4 [<1.36]	<3	<2.6	<164 [<150]
Benzo(b)fluoranthene	ug/Kg	205-99-2	<148.2	<426	<131.6 [<136.8]	<3.4 [<3.2]	<7.2	<6.4	<104 [<94]
Benzo(ghi)perylene	ug/Kg	191-24-2	<556	<1594	<494 [<512]	<2.6 [<2.6]	<5.6	<4.8	NA
Benzo(k)fluoranthene	ug/Kg	207-08-9	<92.6	<266	<82.4 [<85.4]	<4.6 [<4.6]	<10	<8.8	NA
Benzoic Acid	ug/Kg	65-85-0	<1222	<3500	<1086 [<1128]	<8.6 [<8.2]	<18.4	<16	NA
Benzyl Alcohol	ug/Kg	100-51-6	<55.6	<159.4	<49.4 [<51.2]	<9.4 [<9]	<20	<17.6	NA
bis(2-Chloroethoxy)methane	ug/Kg	111-91-1	<55.6	<159.4	<49.4 [<51.2]	<1.86 [<1.78]	<4	<3.4	NA
bis(2-Chloroethyl)ether	ug/Kg	111-44-4	<37	<106.4	<33 [<34.2]	<1.36 [<1.3]	<3	<2.6	NA
bis(2-chloroisopropyl)Ether	ug/Kg	108-60-1	<37	<106.4	<33 [<34.2]	<18 [<17.4]	<38	<34	NA
bis(2-Ethylhexyl)phthalate	ug/Kg	117-81-7	<260	<744	499 [<240]	<12.8 [<12.2]	<28	<24	NA
Butylbenzylphthalate	ug/Kg	85-68-7	<37	<106.4	30.9 [64.1]	<3.4 [<3.2]	<7.2	<6.4	NA
Carbazole	ug/Kg	86-74-8	<37	<106.4	<33 [<34.2]	NA	NA	NA	NA
Chrysene	ug/Kg	218-01-9	<111.2	<318	58.4 [<102.6]	<1.72 [<1.66]	<3.6	<3.2	NA
Dibenzo(a,h)Anthracene	ug/Kg	53-70-3	<92.6	<266	<82.4 [<85.4]	<2.2 [<2.2]	<4.8	<4.2	NA
Dibenzofuran	ug/Kg	132-64-9	<37	<106.4	<33 [<34.2]	<8.6 [<8.2]	<18.4	<16	NA
Diethylphthalate	ug/Kg	84-66-2	<148.2	<426	<131.6 [<136.8]	<2.2 [<2]	<4.6	<4	NA
Dimethylphthalate	ug/Kg	131-11-3	<37	<106.4	<33 [<34.2]	<1.12 [<1.08]	<2.4	<2	NA
Di-n-butylphthalate	ug/Kg	84-74-2	<37	<106.4	<33 [<34.2]	<2.8 [<2.8]	<6.2	<5.4	NA
Di-n-octylphthalate	ug/Kg	117-84-0	<55.6	<159.4	<49.4 [<51.2]	<5 [<4.8]	<10.6	<9.2	NA
Fluoranthene	ug/Kg	206-44-0	<111.2	<318	85.2 [<102.6]	<2.4 [<2.2]	<5	<4.4	NA
Fluorene	ug/Kg	86-73-7	<37	<106.4	<33 [<34.2]	<2.2 [<2.2]	<4.6	<4	NA
Hexachlorobenzene	ug/Kg	118-74-1	<55.6	<159.4	<49.4 [<51.2]	<2.2 [<2.2]	<4.8	<4.2	NA
Hexachlorobutadiene	ug/Kg	87-68-3	<55.6	<159.4	<49.4 [<51.2]	<5.8 [<5.8]	<4.8	<5.2	<1.92 [<3.8]
Hexachlorocyclopentadiene	ug/Kg	77-47-4	<55.6	<159.4	<49.4 [<51.2]	<4.4 [<4.2]	<9.6	<8.2	NA
Hexachloroethane	ug/Kg	67-72-1	<37	<106.4	<33 [<34.2]	<2.2 [<2.2]	<4.8	<4.2	NA
Indeno[1,2,3-cd]pyrene	ug/Kg	193-39-5	<482	<1382	<428 [<444]	<2.4 [<2.4]	<5.4	<4.6	<94 [<86]

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 8/14/2003	SED-3 8/15/2003	SED-9 8/15/2003	SED-16 6/17/2004	SED-3 6/17/2004	SED-9 6/17/2004	SED-16 4/20/2005
Isophorone	ug/Kg	78-59-1	<18.52	<53.2	<16.46 [<17.08]	<1.62 [<1.56]	<3.4	<3	NA
Naphthalene	ug/Kg	91-20-3	<4.4	<17.8	<33 [<34.2]	<3.6 [<3.4]	<3.8	<3.4	<1.22 [<2.4]
Nitrobenzene	ug/Kg	98-95-3	<37	<106.4	<33 [<34.2]	<1.72 [<1.66]	<3.6	<3.2	NA
N-Nitrosodimethylamine	ug/Kg	62-75-9	<18.52	<53.2	<16.46 [<17.08]	NA	NA	NA	NA
N-Nitroso-Di-n-Propylamine	ug/Kg	621-64-7	<148.2	<426	<131.6 [<136.8]	<1.28 [<1.22]	<2.8	<2.4	NA
N-nitrosodiphenylamine	ug/Kg	86-30-6	<37	<106.4	<33 [<34.2]	<2.8 [<2.8]	<6.2	<5.4	NA
Pentachlorophenol	ug/Kg	87-86-5	<260	<744	<230 [<240]	<14.8 [<14.2]	<32	<28	NA
Phenanthrene	ug/Kg	85-01-8	<37	<106.4	54.3 [<34.2]	<1.62 [<1.56]	<3.4	<3	<220 [<194]
Phenol	ug/Kg	108-95-2	<37	<106.4	<33 [<34.2]	<5.8 [<5.6]	<12.4	<10.8	NA
Pyrene	ug/Kg	129-00-0	<74	<212	144 [<40.2]	<1.56 [<1.5]	<3.4	<3	<140 [<130]
Pyridine	ug/Kg	110-86-1	<111.2	<318	<98.8 [<102.6]	NA	NA	NA	NA
Volatile Organics									
1,1,1,2-Tetrachloroethane	ug/Kg	630-20-6	<3.6	<14.2	<2.6 [<3]	<4.6 [<4.6]	<16.8	<4	<3.2 [<6.2]
1,1,1-Trichloroethane	ug/Kg	71-55-6	<4.4	<17.8	<3.2 [<3.8]	<5.8 [<5.8]	<20	<5.2	<0.188 [<0.38]
1,1,2,2-Tetrachloroethane	ug/Kg	79-34-5	<5.2	<21.4	<3.8 [<4.6]	<3.6 [<3.4]	<12.6	<3	<0.34 [<0.68]
1,1,2-Trichloroethane	ug/Kg	79-00-5	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.34 [<0.68]
1,1-Biphenyl	ug/Kg	92-52-4	<37	<106.4	<33 [<34.2]	NA	NA	NA	NA
1,1-Dichloroethane	ug/Kg	75-34-3	<4.4	<17.8	<3.2 [<3.8]	<3.6 [<3.4]	<12.6	<3	<1.04 [<2]
1,1-Dichloroethene	ug/Kg	75-35-4	<4.4	<17.8	<3.2 [<3.8]	<3.6 [<3.4]	<12.6	<3	<0.54 [<1.06]
1,1-Dichloropropene	ug/Kg	563-58-6	<5.2	<21.4	<3.8 [<4.6]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
1,2,3-Trichlorobenzene	ug/Kg	87-61-6	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<1.76 [<3.4]
1,2,3-Trichloropropane	ug/Kg	96-18-4	<7	<28.4	<5 [<6.2]	<5.8 [<5.8]	<20	<5.2	<0.34 [<0.68]
1,2,4-Trichlorobenzene	ug/Kg	120-82-1	<37	<14.2	<33 [<34.2]	<2.4 [<2.4]	<8.4	<3.8	<1.22 [<2.4]
1,2,4-Trimethylbenzene	ug/Kg	95-63-6	2.5	<14.2	<2.6 [<4.3]	<3.8 [<3.8]	<13.4	<3.2	<1.04 [<2]
1,2-Dibromo-3-Chloropropane	ug/Kg	96-12-8	<4.4	<17.8	<3.2 [<3.8]	<4.6 [<4.6]	<16.8	<4	<2.2 [<4.2]
1,2-Dibromoethane	ug/Kg	106-93-4	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<1.56 [<3]
1,2-Dichlorobenzene	ug/Kg	95-50-1	<55.6	<159.4	<49.4 [<51.2]	<2.4 [<2.4]	<8.4	<2.6	<1.04 [<2]
1,2-Dichloroethane	ug/Kg	107-06-2	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<1.38 [<2.8]
1,2-Dichloropropane	ug/Kg	78-87-5	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<0.34 [<0.68]
1,3,5-Trimethylbenzene	ug/Kg	108-67-8	<4.4	<17.8	<3.2 [<3.8]	<3.6 [<3.4]	<12.6	<3	<0.34 [<0.68]
1,3-Dichlorobenzene	ug/Kg	541-73-1	<37	<106.4	<33 [<34.2]	<3.6 [<3.4]	<3.6	<3.2	<1.22 [<2.4]
1,3-Dichloropropane	ug/Kg	142-28-9	NA	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
1,4-Dichlorobenzene	ug/Kg	106-46-7	<55.6	<17.8	<49.4 [<51.2]	<3.6 [<3.4]	<3.4	<3	<1.38 [<2.8]
1,4-Dioxane	ug/Kg	123-91-1	<97.8	<394	<70.2 [<84.6]	NA	NA	NA	NA
1-Chlorohexane	ug/Kg	544-10-5	<2.6	<10.6	<1.8 [<2.2]	NA	NA	NA	NA
2,2-Dichloropropane	ug/Kg	594-20-7	<3.6	<14.2	<2.6 [<3]	<4.6 [<4.6]	<16.8	<4	<0.188 [<0.38]
2-Butanone	ug/Kg	78-93-3	<30.8	<124.4	<22.2 [<26.6]	<38 [<38]	<138	<34	<26 [<52]
2-Chlorotoluene	ug/Kg	95-49-8	<0.8	<3.6	<0.6 [<0.8]	<3.6 [<3.4]	<12.6	<3	<0.68 [<1.36]
2-Hexanone	ug/Kg	591-78-6	<38	<152.8	<27.2 [<32.8]	<22 [<20]	<76	<18.4	<19.4 [<38]
4-Chlorotoluene	ug/Kg	106-43-4	<2.6	<10.6	<1.8 [<2.2]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
4-Methyl-2-pentanone	ug/Kg	108-10-1	<26.4	<106.6	<19 [<22.8]	<24 [<24]	<88	<22	<20 [<40]
Acetone	ug/Kg	67-64-1	108	<248	<44.4 [<106]	66 [<62]	640	60	160 [<17.2]
Benzene	ug/Kg	71-43-2	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<0.188 [<0.38]
Bromobenzene	ug/Kg	108-86-1	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<0.34 [<0.68]
Bromochloromethane	ug/Kg	74-97-5	<5.2	<21.4	<3.8 [<4.6]	<3.6 [<3.4]	<12.6	<3	<1.56 [<3]
Bromodichloromethane	ug/Kg	75-27-4	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<1.56 [<3]
Bromoform	ug/Kg	75-25-2	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
Bromomethane	ug/Kg	74-83-9	<7	<28.4	<5 [<6.2]	<4.6 [<4.6]	<16.8	<4	<0.188 [<0.38]
Carbon Disulfide	ug/Kg	75-15-0	<5.2	<21.4	<3.8 [<4.6]	NA	NA	NA	NA
Carbon Tetrachloride	ug/Kg	56-23-5	<4.4	<17.8	<3.2 [<3.8]	<4.6 [<4.6]	<16.8	<4	<0.54 [<1.06]
Chlorobenzene	ug/Kg	108-90-7	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<0.68 [<1.36]
Chlorobromomethane	ug/Kg	74-97-5	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ug/Kg	75-00-3	<7	<28.4	<5 [<6.2]	<4.6 [<4.6]	<16.8	<4	<0.34 [<0.68]
Chloroform	ug/Kg	67-66-3	<4.4	<17.8	<3.2 [<3.8]	<3.6 [<3.4]	<12.6	<3	<0.68 [<1.36]
Chloromethane	ug/Kg	74-87-3	<5.2	<21.4	<3.8 [<4.6]	<4.6 [<4.6]	<16.8	<4	<0.54 [<1.06]
cis-1,2-Dichloroethene	ug/Kg	156-59-2	<5.2	<21.4	<3.8 [<4.6]	<4.6 [<4.6]	<16.8	<4	<0.54 [<1.06]
cis-1,3-Dichloropropene	ug/Kg	10061-01-5	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<0.34 [<0.68]

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 8/14/2003	SED-3 8/15/2003	SED-9 8/15/2003	SED-16 6/17/2004	SED-3 6/17/2004	SED-9 6/17/2004	SED-16 4/20/2005
Dibromochloromethane	ug/Kg	124-48-1	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<0.34 [<0.68]
Dibromomethane	ug/Kg	74-95-3	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.54 [<1.06]
Dichlorobromomethane	ug/Kg	75-27-4	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane	ug/Kg	75-71-8	<5.2	<21.4	<3.8 [<4.6]	NA	NA	NA	NA
Diethyl Ether	ug/Kg	60-29-7	<3.6	<14.2	<2.6 [<3]	NA	NA	NA	NA
Di-isopropyl ether	ug/Kg	108-20-3	<2.6	<10.6	<1.8 [<2.2]	NA	NA	NA	NA
Ethyl tertiary-butyl ether	ug/Kg	637-92-3	<2.6	<10.6	<1.8 [<2.2]	NA	NA	NA	NA
Ethylbenzene	ug/Kg	100-41-4	<3.6	<14.2	<2.6 [2.4]	<2.4 [<2.4]	<8.4	<2	<0.68 [<1.36]
Ethylene Dibromide	ug/Kg	106-93-4	NA	NA	NA	NA	NA	NA	NA
Isopropylbenzene	ug/Kg	98-82-8	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.54 [<1.06]
m&p-Xylenes	ug/Kg	108-38-3/106-42-3	<2.6	<10.6	<1.8 [12.4]	<5.8 [<5.8]	<20	<5.2	<1.04 [<2]
Methylene Chloride	ug/Kg	75-09-2	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<0.34 [<0.68]
Methyl-tert-butyl-ether	ug/Kg	1634-04-4	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<0.88 [<1.74]
n-Butylbenzene	ug/Kg	104-51-8	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<1.38 [<2.8]
n-Propylbenzene	ug/Kg	103-65-1	<4.4	<17.8	<3.2 [<3.8]	<3.6 [<3.4]	<12.6	<3	<1.04 [<2]
o-Xylene	ug/Kg	95-47-6	NA	NA	NA	<2.4 [<2.4]	<8.4	<2	<0.68 [<1.36]
p-Isopropyltoluene	ug/Kg	99-87-6	19.2	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.88 [<1.74]
sec-Butylbenzene	ug/Kg	135-98-8	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.88 [<1.74]
Styrene	ug/Kg	100-42-5	<2.6	<10.6	<1.8 [<2.2]	<2.4 [<2.4]	<8.4	<2	<0.54 [<1.06]
tert-Butylbenzene	ug/Kg	98-06-6	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<1.04 [<2]
Tertiary-amyl methyl ether	ug/Kg	994-05-8	<2.6	<10.6	<1.8 [<2.2]	NA	NA	NA	NA
Tetrachloroethene	ug/Kg	127-18-4	<3.6	<14.2	<2.6 [<3]	<3.6 [<3.4]	<12.6	<3	<0.54 [<1.06]
Tetrahydrofuran	ug/Kg	109-99-9	<7	<28.4	<5 [<6.2]	NA	NA	NA	NA
Toluene	ug/Kg	108-88-3	9	<14.2	<2.6 [2]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
trans-1,2-Dichloroethene	ug/Kg	156-60-5	<4.4	<17.8	<3.2 [<3.8]	<2.4 [<2.4]	<8.4	<2	<0.188 [<0.38]
trans-1,3-Dichloropropene	ug/Kg	10061-02-6	<3.6	<14.2	<2.6 [<3]	<2.4 [<2.4]	<8.4	<2	<0.54 [<1.06]
Trichloroethene	ug/Kg	79-01-6	<4.4	<17.8	<3.2 [<3.8]	<4.6 [<4.6]	<16.8	<4	<0.188 [<0.38]
Trichlorofluoromethane	ug/Kg	75-69-4	<5.2	<21.4	<3.8 [<4.6]	<3.6 [<3.4]	<12.6	<3	<0.188 [<0.38]
Vinyl Chloride	ug/Kg	75-01-4	<5.2	<21.4	<3.8 [<4.6]	<3.6 [<3.4]	<12.6	<3	<0.54 [<1.06]

Notes:

NA = Not analyzed.

< = Not detected. The associated value is the detection limit.

[] = Duplicate result.

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-3 4/20/2005	SED-9 4/20/2005	SED-16 4/18/2006	SED-3 4/18/2006	SED-9 4/18/2006	SED-16 4/20/2007	SED-3 4/20/2007
Inorganics									
Aluminum	mg/Kg	7429-90-5	26000	5100	5600	23000 [26000]	3300	4500 [6300]	31000
Antimony	mg/Kg	7440-36-0	<14	<2.7	<3.2	<9.5 [<9.5]	<3.7	0.55 [1.3]	1.6
Arsenic	mg/Kg	7440-38-2	<6.9	<1.3	4.3	23 [6.5]	12	0.48 [1.5]	2.6
Barium	mg/Kg	7440-39-3	130	37	43	150 [180]	28	32 [48]	130
Beryllium	mg/Kg	7440-41-7	1	<0.18	<1.3	1.4 [1.5]	<1.5	<0.25 [<0.28]	<0.52
Cadmium	mg/Kg	7440-43-9	<1.4	<0.27	0.19	1.1 [1.2]	<1.5	0.14 [0.41]	0.58
Calcium	mg/Kg	7440-70-2	3200	1100	960	4600 [4200]	640	710 [1500]	3300
Chromium	mg/Kg	7440-47-3	33	10	340	39 [57]	11	10 [15]	35
Cobalt	mg/Kg	7440-48-4	23	4.2	5.5	19 [27]	2.8	3.9 [5.7]	10
Copper	mg/Kg	7440-50-8	<14	12	51	15 [17]	5.1	5.9 [9.4]	17
Iron	mg/Kg	7439-89-6	32000	14000	11000	36000 [37000]	10000	9300 [15000]	27000
Lead	mg/Kg	7439-92-1	62	4.4	9	54 [56]	4.8	1.9 [11]	31
Magnesium	mg/Kg	7439-95-4	3900	2100	2000	3900 [4100]	1400	1900 [1800]	4100
Manganese	mg/Kg	7439-96-5	4000	400	200	3600 [5300]	360	190 [690]	410
Mercury	mg/Kg	7439-97-6	0.19	<0.027	<0.053	0.3 [0.3]	<0.060	<0.063 [<0.082]	0.21
Nickel	mg/Kg	7440-02-0	22	6.7	85	25 [31]	5.5	5.5 [7.2]	23
Potassium	mg/Kg	7440-09-7	1900	1500	1300	1000 [1100]	760	1700 [1500]	1800
Selenium	mg/Kg	7782-49-2	<6.9	<1.3	4.4	17 [7.2]	22	<0.61 [<0.70]	<1.3
Silver	mg/Kg	7440-22-4	<6.9	<1.3	<3.2	<9.5 [<9.5]	<3.7	<0.61 [<0.70]	<1.3
Sodium	mg/Kg	7440-23-5	<560	<270	400	1500 [840]	600	40 [33]	66
Thallium	mg/Kg	7440-28-0	<6.9	<1.3	<6.5	<19 [<19]	<7.5	<1.2 [0.45]	<2.6
Vanadium	mg/Kg	7440-62-2	57	15	18	53 [55]	9.5	12 [15]	42
Zinc	mg/Kg	7440-66-6	130	29	33	140 [150]	26	19 [35]	88
Pesticides/PCBs									
4,4'-DDT	ug/Kg	50-29-3	<50	<24	<12.2	<32 [<34]	<12.6	<22 [<24]	<48
4,4'-DDD	ug/Kg	72-54-8	<50	<24	<9.4	<24 [<26]	NA	<22 [<24]	<48
4,4'-DDE	ug/Kg	72-55-9	<50	<24	<6.8	<18.2 [<19.4]	<7.2	<22 [<24]	<48
Aldrin	ug/Kg	309-00-2	<50	<24	<6.6	<17.6 [<19]	<7	<22 [<24]	<48
alpha-BHC	ug/Kg	319-84-6	<50	<24	<6.6	<17.6 [<18.8]	<7	<22 [<24]	<48
alpha-Chlordane	ug/Kg	5103-71-9	NA	NA	NA	NA	NA	NA	NA
beta-BHC	ug/Kg	319-85-7	<50	<24	<7.2	<18.8 [<20]	<7.4	<22 [<24]	<48
Chlordane, total	ug/Kg	57-74-9	<240	<122	<1180	<3200 [<3400]	<1240	<28 [<30]	<56
Dieldrin	ug/Kg	60-57-1	<50	<24	<7	<18.4 [<19.8]	<7.2	<22 [<24]	<48
Endosulfan I	ug/Kg	959-98-8	NA	NA	<6	<15.6 [<16.8]	<6.2	<22 [<24]	<48
Endosulfan II	ug/Kg	33213-65-9	NA	NA	<6.4	<16.6 [<17.8]	<6.6	<22 [<24]	<48
Endosulfan Sulfate	ug/Kg	1031-07-8	<50	<24	<6.8	<17.8 [<19.2]	<7	<22 [<24]	<48
Endrin	ug/Kg	72-20-8	<50	<24	<11.2	<30 [<32]	<11.8	<22 [<24]	<48
Endrin Aldehyde	ug/Kg	7421-93-4	<50	<24	<9.2	<24 [<26]	<9.6	<22 [<24]	<48
Endrin Ketone	ug/Kg	53494-70-5	NA	NA	<18.4	<48 [<52]	<19.2	<22 [<24]	<48
gamma-BHC (Lindane)	ug/Kg	58-89-9	<50	<24	<6.6	<17.2 [<18.4]	<6.8	<22 [<24]	<48
gamma-Chlordane	ug/Kg	5103-74-2	NA	NA	NA	NA	NA	NA	NA
Heptachlor	ug/Kg	76-44-8	<50	<24	<7	<18.6 [<19.8]	<7.4	<22 [<24]	<48
Heptachlor Epoxide	ug/Kg	1024-57-3	<50	<24	<6.6	<17.4 [<18.6]	<6.8	<22 [<24]	<48
Methoxychlor	ug/Kg	72-43-5	<100	<48	<10.2	<28 [<28]	<10.6	<22 [<24]	<48
PCB-1260	ug/Kg	11096-82-5	<164	<76	<30	<80 [<86]	<32	<28 [<30]	<60
PCB-1254	ug/Kg	11097-69-1	<164	<76	<240	<620 [<680]	<240	<220 [<240]	<480
PCB-1221	ug/Kg	11104-28-2	<164	<76	<240	<620 [<680]	<240	<220 [<240]	<480
PCB-1232	ug/Kg	11141-16-5	<164	<76	<240	<620 [<680]	<240	<220 [<240]	<480
PCB-1248	ug/Kg	12672-29-6	<164	<76	<240	<620 [<680]	<240	<220 [<240]	<480
PCB-1016	ug/Kg	12674-11-2	<164	<76	<42	<110 [<118]	<44	<62 [<66]	<128
PCB-1242	ug/Kg	53469-21-9	NA	NA	NA	NA	NA	NA	NA
Toxaphene	ug/Kg	8001-35-2	<2400	<1220	<1180	<3200 [<3400]	<1240	<1140 [<1220]	<2400

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Parameter	Units	CAS	SED-3 4/20/2005	SED-9 4/20/2005	SED-16 4/18/2006	SED-3 4/18/2006	SED-9 4/18/2006	SED-16 4/20/2007	SED-3 4/20/2007
Semivolatile Organics									
2,4,5-Trichlorophenol	ug/Kg	95-95-4	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	ug/Kg	88-06-2	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	ug/Kg	120-83-2	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	ug/Kg	105-67-9	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol	ug/Kg	51-28-5	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	ug/Kg	121-14-2	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	ug/Kg	606-20-2	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	ug/Kg	91-58-7	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	ug/Kg	95-57-8	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	ug/Kg	91-57-6	NA	NA	NA	NA	NA	NA	NA
2-Methylphenol	ug/Kg	95-48-7	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline	ug/Kg	88-74-4	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	ug/Kg	88-75-5	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	ug/Kg	108-39-4/106-44-5	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine	ug/Kg	91-94-1	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	ug/Kg	99-09-2	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-Methylphenol	ug/Kg	534-52-1	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	ug/Kg	101-55-3	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol	ug/Kg	59-50-7	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	ug/Kg	106-47-8	NA	NA	NA	NA	NA	NA	NA
4-Chloro-phenyl-phenyl ether	ug/Kg	7005-72-3	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	ug/Kg	100-01-6	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	ug/Kg	100-02-7	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	ug/Kg	83-32-9	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	ug/Kg	208-96-8	NA	NA	NA	NA	NA	NA	NA
Acetophenone	ug/Kg	98-86-2	NA	NA	NA	NA	NA	NA	NA
Aniline	ug/Kg	62-53-3	NA	NA	NA	NA	NA	NA	NA
Anthracene	ug/Kg	120-12-7	NA	NA	NA	NA	NA	NA	NA
Azobenzene	ug/Kg	103-33-3	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/Kg	56-55-3	<280	<132	<164	<440 [<480]	<180	<198 [<220]	<420
Benzo(a)pyrene	ug/Kg	50-32-8	<320	<156	<170	<460 [<500]	<186	<128 [<136]	<260
Benzo(b)fluoranthene	ug/Kg	205-99-2	<200	<98	<240	<620 [<680]	<260	<192 [<200]	<400
Benzo(ghi)perylene	ug/Kg	191-24-2	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ug/Kg	207-08-9	NA	NA	NA	NA	NA	NA	NA
Benzoic Acid	ug/Kg	65-85-0	NA	NA	NA	NA	NA	NA	NA
Benzyl Alcohol	ug/Kg	100-51-6	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	ug/Kg	111-91-1	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	ug/Kg	111-44-4	NA	NA	NA	NA	NA	NA	NA
bis(2-chloroisopropyl)Ether	ug/Kg	108-60-1	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	ug/Kg	117-81-7	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	ug/Kg	85-68-7	NA	NA	NA	NA	NA	NA	NA
Carbazole	ug/Kg	86-74-8	NA	NA	NA	NA	NA	NA	NA
Chrysene	ug/Kg	218-01-9	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)Anthracene	ug/Kg	53-70-3	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	ug/Kg	132-64-9	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	ug/Kg	84-66-2	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	ug/Kg	131-11-3	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	ug/Kg	84-74-2	NA	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	ug/Kg	117-84-0	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	ug/Kg	206-44-0	NA	NA	NA	NA	NA	NA	NA
Fluorene	ug/Kg	86-73-7	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	ug/Kg	118-74-1	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	ug/Kg	87-68-3	<10.2	<3.6	<2.6	<7 [<7.6]	<2.8	<2.4 [<2.2]	<5.8
Hexachlorocyclopentadiene	ug/Kg	77-47-4	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	ug/Kg	67-72-1	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	ug/Kg	193-39-5	<184	<88	<280	<720 [<800]	<300	<240 [<260]	<520

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Parameter	Units	CAS	SED-3 4/20/2005	SED-9 4/20/2005	SED-16 4/18/2006	SED-3 4/18/2006	SED-9 4/18/2006	SED-16 4/20/2007	SED-3 4/20/2007
Isophorone	ug/Kg	78-59-1	NA	NA	NA	NA	NA	NA	NA
Naphthalene	ug/Kg	91-20-3	<6.6	<2.4	<2.4	<6.4 [<6.8]	<2.6	<5.6 [<5.4]	<14
Nitrobenzene	ug/Kg	98-95-3	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	ug/Kg	62-75-9	NA	NA	NA	NA	NA	NA	NA
N-Nitroso-Di-n-Propylamine	ug/Kg	621-64-7	NA	NA	NA	NA	NA	NA	NA
N-nitrosodiphenylamine	ug/Kg	86-30-6	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/Kg	87-86-5	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	ug/Kg	85-01-8	<420	<200	<174	<460 [<500]	<190	<240 [<260]	<500
Phenol	ug/Kg	108-95-2	NA	NA	NA	NA	NA	NA	NA
Pyrene	ug/Kg	129-00-0	<280	<134	<220	<580 [<640]	<240	<220 [<240]	<480
Pyridine	ug/Kg	110-86-1	NA	NA	NA	NA	NA	NA	NA
Volatile Organics									
1,1,1,2-Tetrachloroethane	ug/Kg	630-20-6	<16.8	<6	<1.82	<4.8 [<5.2]	<1.98	<2.4 [<2.2]	<5.8
1,1,1-Trichloroethane	ug/Kg	71-55-6	<1	<0.36	<2.4	<6.6 [<7.2]	<2.6	<2.4 [<2.2]	<5.8
1,1,2,2-Tetrachloroethane	ug/Kg	79-34-5	<1.84	<0.66	<2.2	<5.6 [<6.2]	<2.2	<2.4 [<2.2]	<5.8
1,1,2-Trichloroethane	ug/Kg	79-00-5	<1.84	<0.66	<0.74	<1.96 [<2.2]	<0.8	<2.4 [<2.2]	<5.8
1,1-Biphenyl	ug/Kg	92-52-4	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	ug/Kg	75-34-3	<5.6	<1.96	<2.2	<6 [<6.6]	<2.4	<3.6 [<3.4]	<8.8
1,1-Dichloroethene	ug/Kg	75-35-4	<2.8	<1.02	<2.4	<6.2 [<6.6]	<2.6	<2.4 [<2.2]	<5.8
1,1-Dichloropropene	ug/Kg	563-58-6	<1	<0.36	<2.6	<6.6 [<7.2]	<2.8	<2.4 [<2.2]	<5.8
1,2,3-Trichlorobenzene	ug/Kg	87-61-6	<9.4	<3.4	<2.2	<6 [<6.6]	<2.4	<4 [<3.8]	<10
1,2,3-Trichloropropane	ug/Kg	96-18-4	<1.84	<0.66	<3.4	<9 [<9.6]	<3.6	<3.4 [<3.2]	<8.4
1,2,4-Trichlorobenzene	ug/Kg	120-82-1	<6.6	<2.4	<1.78	<4.8 [<5.2]	<1.92	<3.8 [<3.4]	<9.2
1,2,4-Trimethylbenzene	ug/Kg	95-63-6	<5.6	<1.96	<1.04	<2.8 [<3]	<1.12	<2.4 [<2.2]	<5.8
1,2-Dibromo-3-Chloropropane	ug/Kg	96-12-8	<11.2	<4	<2.6	<7 [<7.6]	<2.8	<4.2 [<4]	<10.4
1,2-Dibromoethane	ug/Kg	106-93-4	<8.4	<3	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	ug/Kg	95-50-1	<5.6	<1.96	<1.08	<2.8 [<3.2]	<1.18	<2.4 [<2.2]	<5.8
1,2-Dichloroethane	ug/Kg	107-06-2	<7.4	<2.6	<0.98	<2.6 [<2.8]	<1.06	<2.4 [<2.2]	<5.8
1,2-Dichloropropane	ug/Kg	78-87-5	<1.84	<0.66	<1.18	<3.2 [<3.4]	<1.28	<2.4 [<2.2]	<5.8
1,3,5-Trimethylbenzene	ug/Kg	108-67-8	<1.84	<0.66	<1.62	<4.4 [<4.6]	<1.76	<2.4 [<2.2]	<5.8
1,3-Dichlorobenzene	ug/Kg	541-73-1	<6.6	<2.4	<0.64	<1.7 [<1.84]	<0.7	<2.4 [<2.2]	<5.8
1,3-Dichloropropane	ug/Kg	142-28-9	<1	<0.36	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	ug/Kg	106-46-7	<7.4	<2.6	<1.14	<3 [<3.2]	<1.22	<2.4 [<2.2]	<5.8
1,4-Dioxane	ug/Kg	123-91-1	NA	NA	NA	NA	NA	NA	NA
1-Chlorohexane	ug/Kg	544-10-5	NA	NA	NA	NA	NA	NA	NA
2,2-Dichloropropane	ug/Kg	594-20-7	<1	<0.36	<3.2	<8.4 [<9.2]	<3.4	<2.6 [<2.4]	<6.2
2-Butanone	ug/Kg	78-93-3	97	<50	<19.4	<52 [<56]	<20	<17.2 [16]	<42
2-Chlorotoluene	ug/Kg	95-49-8	<3.6	<1.32	<1.78	<4.8 [<5.2]	<1.92	<2.4 [<2.2]	<5.8
2-Hexanone	ug/Kg	591-78-6	<104	<38	<12.2	<32 [<36]	<13.2	<8.2 [<7.6]	<20
4-Chlorotoluene	ug/Kg	106-43-4	<1	<0.36	<1.34	<3.6 [<3.8]	<1.44	<2.4 [<2.2]	<5.8
4-Methyl-2-pentanone	ug/Kg	108-10-1	<110	<40	<11.8	<32 [<34]	<12.8	<46 [<44]	<116
Acetone	ug/Kg	67-64-1	1100	<16.6	<116	<300 [<340]	<124	<22 [410]	<52
Benzene	ug/Kg	71-43-2	<1	<0.36	<1.62	<4.4 [<4.6]	<1.76	<2.4 [<2.2]	<5.8
Bromobenzene	ug/Kg	108-86-1	<1.84	<0.66	<1.24	<3.2 [<3.6]	<1.34	<2.4 [<2.2]	<5.8
Bromochloromethane	ug/Kg	74-97-5	<8.4	<3	NA	NA	NA	NA	NA
Bromodichloromethane	ug/Kg	75-27-4	<8.4	<3	NA	NA	NA	NA	NA
Bromoform	ug/Kg	75-25-2	<1	<0.36	<1.52	<4 [<4.4]	<1.66	<2.4 [<2.2]	<5.8
Bromomethane	ug/Kg	74-83-9	<1	<0.36	<1.58	<4.2 [<4.6]	<1.7	<3.8 [<3.6]	<9.4
Carbon Disulfide	ug/Kg	75-15-0	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	ug/Kg	56-23-5	<2.8	<1.02	<2.4	<6.4 [<6.8]	<2.6	<2.6 [<2.6]	<6.6
Chlorobenzene	ug/Kg	108-90-7	<3.6	<1.32	<1.52	<4 [<4.4]	<1.66	<2.4 [<2.2]	<5.8
Chlorobromomethane	ug/Kg	74-97-5	NA	NA	<1.08	<2.8 [<3.2]	<1.18	<2.4 [<2.2]	<5.8
Chloroethane	ug/Kg	75-00-3	<1.84	<0.66	<3	<8 [<8.6]	<3.2	<2.4 [<2.2]	<6
Chloroform	ug/Kg	67-66-3	<3.6	<1.32	<1.08	<2.8 [<3.2]	<1.18	<2.4 [<2.2]	<5.8
Chloromethane	ug/Kg	74-87-3	<2.8	<1.02	<2	<5.6 [<6]	<2.2	<2.4 [<2.2]	<5.8
cis-1,2-Dichloroethene	ug/Kg	156-59-2	<2.8	<1.02	<3	<7.8 [<8.6]	<3.2	<2.4 [<2.2]	<5.8
cis-1,3-Dichloropropene	ug/Kg	10061-01-5	<1.84	<0.66	<1.58	<4.2 [<4.6]	<1.7	<2.4 [<2.2]	<5.8

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Parameter	Units	CAS	SED-3 4/20/2005	SED-9 4/20/2005	SED-16 4/18/2006	SED-3 4/18/2006	SED-9 4/18/2006	SED-16 4/20/2007	SED-3 4/20/2007
Dibromochloromethane	ug/Kg	124-48-1	<1.84	<0.66	<1.34	<3.6 [<3.8]	<1.44	<2.4 [<2.2]	<5.8
Dibromomethane	ug/Kg	74-95-3	<2.8	<1.02	<1.14	<3 [<3.2]	<1.22	<2.4 [<2.2]	<5.8
Dichlorobromomethane	ug/Kg	75-27-4	NA	NA	<0.84	<2.2 [<2.4]	<0.9	<2.6 [<2.4]	<6.4
Dichlorodifluoromethane	ug/Kg	75-71-8	NA	NA	NA	NA	NA	NA	NA
Diethyl Ether	ug/Kg	60-29-7	NA	NA	NA	NA	NA	NA	NA
Di-isopropyl ether	ug/Kg	108-20-3	NA	NA	NA	NA	NA	NA	NA
Ethyl tertiary-butyl ether	ug/Kg	637-92-3	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	ug/Kg	100-41-4	<3.6	<1.32	<2.2	<5.8 [<6.2]	<2.4	<2.4 [<2.2]	<5.8
Ethylene Dibromide	ug/Kg	106-93-4	NA	NA	<0.98	<2.6 [<2.8]	<1.06	<2.4 [<2.2]	<5.8
Isopropylbenzene	ug/Kg	98-82-8	<2.8	<1.02	<2.4	<6.2 [<6.6]	<2.6	<2.4 [<2.2]	<5.8
m&p-Xylenes	ug/Kg	108-38-3/106-42-3	<5.6	<1.96	<3.4	<9.2 [<10]	<3.8	<2.4 [<2.2]	<5.8
Methylene Chloride	ug/Kg	75-09-2	<1.84	<0.66	<3.6	<9.8 [<10.6]	<4	<2.4 [<2.2]	<5.8
Methyl-tert-butyl-ether	ug/Kg	1634-04-4	<4.6	<1.66	<1.78	<4.8 [<5.2]	<1.92	<2.4 [<2.2]	<5.8
n-Butylbenzene	ug/Kg	104-51-8	<7.4	<2.6	<2.4	<6.6 [<7.2]	<2.6	<2.4 [<2.2]	<5.8
n-Propylbenzene	ug/Kg	103-65-1	<5.6	<1.96	<2.2	<5.6 [<6.2]	<2.2	<2.4 [<2.2]	<5.8
o-Xylene	ug/Kg	95-47-6	<3.6	<1.32	<1.72	<4.6 [<5]	<1.86	<2.4 [<2.2]	<5.8
p-Isopropyltoluene	ug/Kg	99-87-6	<4.6	<1.66	<1.92	<5.2 [<5.6]	<2	<2.4 [<2.2]	<5.8
sec-Butylbenzene	ug/Kg	135-98-8	<4.6	<1.66	<2	<5.4 [<5.8]	<2.2	<2.4 [<2.2]	<5.8
Styrene	ug/Kg	100-42-5	<2.8	<1.02	<1.14	<3 [<3.2]	<1.22	<2.4 [<2.2]	<5.8
tert-Butylbenzene	ug/Kg	98-06-6	<5.6	<1.96	<1.82	<4.8 [<5.2]	<1.98	<2.4 [<2.2]	<5.8
Tertiary-amyl methyl ether	ug/Kg	994-05-8	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	ug/Kg	127-18-4	<2.8	<1.02	<3.2	<8.6 [<9.4]	<3.6	<2.4 [<2.2]	<5.8
Tetrahydrofuran	ug/Kg	109-99-9	NA	NA	NA	NA	NA	NA	NA
Toluene	ug/Kg	108-88-3	<1	<0.36	<1.24	<3.2 [<3.6]	<1.34	<2.4 [<2.2]	<5.8
trans-1,2-Dichloroethene	ug/Kg	156-60-5	<1	<0.36	<2.2	<5.6 [<6.2]	<2.2	<2.4 [<2.2]	<5.8
trans-1,3-Dichloropropene	ug/Kg	10061-02-6	<2.8	<1.02	<1.72	<4.6 [<5]	<1.86	<2.4 [<2.2]	<5.8
Trichloroethene	ug/Kg	79-01-6	<1	<0.36	<2.6	<7 [<7.6]	<2.8	<2.4 [<2.2]	<5.8
Trichlorofluoromethane	ug/Kg	75-69-4	<1	<0.36	<2.4	<6.6 [<7.2]	<2.6	<4.6 [<4.4]	<11.4
Vinyl Chloride	ug/Kg	75-01-4	<2.8	<1.02	<3.2	<8.4 [<9.2]	<3.4	<2.4 [<2.2]	<5.8

Notes:

NA = Not analyzed.

< = Not detected. The associated value is the detection limit.

[] = Duplicate result.

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-9 4/20/2007	SED-16 4/25/2008	SED-3 4/25/2008	SED-9 4/25/2008	SED-16 4/26/2012	SED-3 4/26/2012	SED-9 4/26/2012
Inorganics									
Aluminum	mg/Kg	7429-90-5	5600	5100 [4600]	26000	4100	NA	NA	NA
Antimony	mg/Kg	7440-36-0	3.1	0.48 [0.58]	1.7	1.4	NA	NA	NA
Arsenic	mg/Kg	7440-38-2	0.94	0.65 [0.62]	3.6	0.73	NA	NA	NA
Barium	mg/Kg	7440-39-3	42	38 [41]	120	28	NA	NA	NA
Beryllium	mg/Kg	7440-41-7	<0.26	<0.34 [<0.24]	<0.63	<0.23	NA	NA	NA
Cadmium	mg/Kg	7440-43-9	0.3	0.18 [0.21]	1.1	0.18	NA	NA	NA
Calcium	mg/Kg	7440-70-2	1400	640 [1000]	4400	860	NA	NA	NA
Chromium	mg/Kg	7440-47-3	18	8.4 [8.4]	31	8.1	NA	NA	NA
Cobalt	mg/Kg	7440-48-4	4.5	4.1 [3.5]	19	3.1	NA	NA	NA
Copper	mg/Kg	7440-50-8	7.7	14 [6.2]	17	4.3	NA	NA	NA
Iron	mg/Kg	7439-89-6	13000	10000 [12000]	32000	10000	NA	NA	NA
Lead	mg/Kg	7439-92-1	6.1	NA	NA	NA	NA	NA	NA
Magnesium	mg/Kg	7439-95-4	2100	2100 [1800]	3400	1500	NA	NA	NA
Manganese	mg/Kg	7439-96-5	400	320 [390]	1400	260	NA	NA	NA
Mercury	mg/Kg	7439-97-6	0.072	<0.13 [<0.098]	0.19	<0.091	NA	NA	NA
Nickel	mg/Kg	7440-02-0	6.9	6.5 [4.9]	22	4.5	NA	NA	NA
Potassium	mg/Kg	7440-09-7	1500	2200 [1700]	1600	1200	NA	NA	NA
Selenium	mg/Kg	7782-49-2	<0.65	<0.86 [<0.61]	2.3	<0.59	NA	NA	NA
Silver	mg/Kg	7440-22-4	<0.65	<0.86 [<0.61]	<1.6	<0.59	NA	NA	NA
Sodium	mg/Kg	7440-23-5	35	<170 [17]	48	12	NA	NA	NA
Thallium	mg/Kg	7440-28-0	0.23	<1.7 [0.25]	1	0.11	NA	NA	NA
Vanadium	mg/Kg	7440-62-2	13	15 [12]	50	9.8	NA	NA	NA
Zinc	mg/Kg	7440-66-6	31	24 [28]	110	23	NA	NA	NA
Pesticides/PCBs									
4,4'-DDT	ug/Kg	50-29-3	<22	<4.2 [<3.2]	<7	<3.2	<5.4	<3.4	<3.6 [<3.6]
4,4'-DDD	ug/Kg	72-54-8	NA	<3.2 [<2.4]	NA	<2.4	<5.4	<3.4	<3.6 [<3.6]
4,4'-DDE	ug/Kg	72-55-9	<22	<3.6 [<2.6]	<5.8	<2.6	<5.4	<3.4	<3.6 [<3.6]
Aldrin	ug/Kg	309-00-2	<22	<3.6 [<2.6]	<6	<2.6	<5.4	<3.4	<3.6 [<3.6]
alpha-BHC	ug/Kg	319-84-6	<22	<2.8 [<2]	<4.6	<2	<5.4	<3.4	<3.6 [<3.6]
alpha-Chlordane	ug/Kg	5103-71-9	NA	NA	NA	NA	NA	NA	NA
beta-BHC	ug/Kg	319-85-7	<22	<8.4 [<6.2]	<14	<6.2	<8	<5	<5.2 [<5.2]
Chlordane, total	ug/Kg	57-74-9	<28	<88 [<64]	<146	<66	<182	<116	<118 [<120]
Dieldrin	ug/Kg	60-57-1	<22	<3.4 [<2.6]	<5.8	<2.6	<5.4	<3.4	<3.6 [<3.6]
Endosulfan I	ug/Kg	959-98-8	<22	<3.4 [<2.6]	<5.8	<2.6	<5.4	<3.4	<3.6 [<3.6]
Endosulfan II	ug/Kg	33213-65-9	<22	<3.2 [<2.4]	<5.2	<2.4	<5.4	<3.4	<3.6 [<3.6]
Endosulfan Sulfate	ug/Kg	1031-07-8	<22	<3.2 [<2.4]	<5.2	<2.4	<5.4	<3.4	<3.6 [<3.6]
Endrin	ug/Kg	72-20-8	<22	<3.6 [<2.6]	<6	<2.8	<5.4	<3.4	<3.6 [<3.6]
Endrin Aldehyde	ug/Kg	7421-93-4	<22	<5.2 [<3.8]	<8.6	<3.8	<5.4	<3.4	<3.6 [<3.6]
Endrin Ketone	ug/Kg	53494-70-5	<22	<3.4 [<2.6]	<5.8	<2.6	<7	<4.4	<4.4 [<4.6]
gamma-BHC (Lindane)	ug/Kg	58-89-9	<22	<3.8 [<2.8]	<6.4	<2.8	<5.4	<3.4	<3.6 [<3.6]
gamma-Chlordane	ug/Kg	5103-74-2	NA	NA	NA	NA	NA	NA	NA
Heptachlor	ug/Kg	76-44-8	<22	<3.8 [<2.8]	<6.2	<2.8	<5.4	<3.4	<3.6 [<3.6]
Heptachlor Epoxide	ug/Kg	1024-57-3	<22	<2.8 [<2]	<4.6	<2	<5.4	<3.4	<3.6 [<3.6]
Methoxychlor	ug/Kg	72-43-5	<22	<6.2 [<4.6]	<10.2	<4.6	<10.6	<6.6	<6.8 [<7]
PCB-1260	ug/Kg	11096-82-5	<28	<40 [<30]	<66	<30	<154	<98	<100 [<102]
PCB-1254	ug/Kg	11097-69-1	<220	<34 [<24]	<56	<24	<220	<134	<138 [<140]
PCB-1221	ug/Kg	11104-28-2	<220	<80 [<60]	<134	<60	<220	<134	<136 [<140]
PCB-1232	ug/Kg	11141-16-5	<220	<66 [<48]	<110	<48	<320	<200	<200 [<200]
PCB-1248	ug/Kg	12672-29-6	<220	<40 [<30]	<66	<30	<340	<220	<220 [<220]
PCB-1016	ug/Kg	12674-11-2	<62	<24 [<17.8]	<40	<17.8	<108	<68	<70 [<72]
PCB-1242	ug/Kg	53469-21-9	NA	NA	NA	NA	NA	NA	NA
Toxaphene	ug/Kg	8001-35-2	<1140	<340 [<240]	<560	<240	<182	<116	<118 [<120]

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-9 4/20/2007	SED-16 4/25/2008	SED-3 4/25/2008	SED-9 4/25/2008	SED-16 4/26/2012	SED-3 4/26/2012	SED-9 4/26/2012
Semivolatile Organics									
2,4,5-Trichlorophenol	ug/Kg	95-95-4	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	ug/Kg	88-06-2	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	ug/Kg	120-83-2	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	ug/Kg	105-67-9	NA	NA	NA	NA	<190	<118	<124 [<122]
2,4-Dinitrophenol	ug/Kg	51-28-5	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	ug/Kg	121-14-2	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	ug/Kg	606-20-2	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	ug/Kg	91-58-7	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol	ug/Kg	95-57-8	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	ug/Kg	91-57-6	NA	NA	NA	NA	<190	<118	<124 [<122]
2-Methylphenol	ug/Kg	95-48-7	NA	NA	NA	NA	<190	<118	<124 [<122]
2-Nitroaniline	ug/Kg	88-74-4	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol	ug/Kg	88-75-5	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	ug/Kg	108-39-4/106-44-5	NA	NA	NA	NA	130	<118	<124 [<122]
3,3'-Dichlorobenzidine	ug/Kg	91-94-1	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline	ug/Kg	99-09-2	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-Methylphenol	ug/Kg	534-52-1	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	ug/Kg	101-55-3	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol	ug/Kg	59-50-7	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline	ug/Kg	106-47-8	NA	NA	NA	NA	NA	NA	NA
4-Chloro-phenyl-phenyl ether	ug/Kg	7005-72-3	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline	ug/Kg	100-01-6	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol	ug/Kg	100-02-7	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	ug/Kg	83-32-9	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	ug/Kg	208-96-8	NA	NA	NA	NA	NA	NA	NA
Acetophenone	ug/Kg	98-86-2	NA	NA	NA	NA	NA	NA	NA
Aniline	ug/Kg	62-53-3	NA	NA	NA	NA	NA	NA	NA
Anthracene	ug/Kg	120-12-7	NA	NA	NA	NA	NA	NA	NA
Azobenzene	ug/Kg	103-33-3	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/Kg	56-55-3	<194	<180 [<138]	<300	<136	NA	NA	NA
Benzo(a)pyrene	ug/Kg	50-32-8	<124	<120 [<92]	<200	<90	NA	NA	NA
Benzo(b)fluoranthene	ug/Kg	205-99-2	<188	<142 [<108]	<240	<106	NA	NA	NA
Benzo(ghi)perylene	ug/Kg	191-24-2	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ug/Kg	207-08-9	NA	NA	NA	NA	NA	NA	NA
Benzoic Acid	ug/Kg	65-85-0	NA	NA	NA	NA	310	<260	<280 [<260]
Benzyl Alcohol	ug/Kg	100-51-6	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	ug/Kg	111-91-1	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	ug/Kg	111-44-4	NA	NA	NA	NA	NA	NA	NA
bis(2-chloroisopropyl)Ether	ug/Kg	108-60-1	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	ug/Kg	117-81-7	NA	NA	NA	NA	<190	590	<124 [<122]
Butylbenzylphthalate	ug/Kg	85-68-7	NA	NA	NA	NA	NA	NA	NA
Carbazole	ug/Kg	86-74-8	NA	NA	NA	NA	NA	NA	NA
Chrysene	ug/Kg	218-01-9	NA	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)Anthracene	ug/Kg	53-70-3	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	ug/Kg	132-64-9	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	ug/Kg	84-66-2	NA	NA	NA	NA	<190	<118	<124 [<122]
Dimethylphthalate	ug/Kg	131-11-3	NA	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	ug/Kg	84-74-2	NA	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	ug/Kg	117-84-0	NA	NA	NA	NA	<190	<118	<124 [<122]
Fluoranthene	ug/Kg	206-44-0	NA	NA	NA	NA	NA	NA	NA
Fluorene	ug/Kg	86-73-7	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	ug/Kg	118-74-1	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	ug/Kg	87-68-3	<2	<3.8 [<4.2]	<19	<3.4	<5.4	<3.4	<3.6 [<3.4]
Hexachlorocyclopentadiene	ug/Kg	77-47-4	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	ug/Kg	67-72-1	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	ug/Kg	193-39-5	<240	<166 [<126]	<280	<124	NA	NA	NA

**Table 1. Sediment Analytical Results
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Parameter	Units	CAS	SED-9 4/20/2007	SED-16 4/25/2008	SED-3 4/25/2008	SED-9 4/25/2008	SED-16 4/26/2012	SED-3 4/26/2012	SED-9 4/26/2012
Isophorone	ug/Kg	78-59-1	NA	NA	NA	NA	NA	NA	NA
Naphthalene	ug/Kg	91-20-3	<5	<4.2 [<4.6]	<22	<3.6	<9	<5.6	<5.8 [<5.8]
Nitrobenzene	ug/Kg	98-95-3	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	ug/Kg	62-75-9	NA	NA	NA	NA	NA	NA	NA
N-Nitroso-Di-n-Propylamine	ug/Kg	621-64-7	NA	NA	NA	NA	NA	NA	NA
N-nitrosodiphenylamine	ug/Kg	86-30-6	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/Kg	87-86-5	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	ug/Kg	85-01-8	<240	<196 [<150]	<320	<148	NA	NA	NA
Phenol	ug/Kg	108-95-2	NA	NA	NA	NA	<190	<118	<124 [<122]
Pyrene	ug/Kg	129-00-0	<220	<188 [<144]	<320	<142	NA	NA	NA
Pyridine	ug/Kg	110-86-1	NA	NA	NA	NA	NA	NA	NA
Volatile Organics									
1,1,1,2-Tetrachloroethane	ug/Kg	630-20-6	<2	<2.2 [<2.4]	<10.6	<1.86	<4.6	<3	<3 [<3]
1,1,1-Trichloroethane	ug/Kg	71-55-6	<2	<2.2 [<2.4]	<10.6	<1.86	<7	<4.4	<4.6 [<4.4]
1,1,2,2-Tetrachloroethane	ug/Kg	79-34-5	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]
1,1,2-Trichloroethane	ug/Kg	79-00-5	<2	<2.2 [<2.4]	<11	<1.92	<4	<2.4	<2.6 [<2.4]
1,1-Biphenyl	ug/Kg	92-52-4	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	ug/Kg	75-34-3	<3.2	<2.2 [<2.4]	<10.6	<1.86	<7	<4.4	<4.6 [<4.4]
1,1-Dichloroethene	ug/Kg	75-35-4	<2	<2.8 [<3]	<14.2	<2.4	<6.2	<4	<4 [<4]
1,1-Dichloropropene	ug/Kg	563-58-6	<2	<2.8 [<3]	<13.4	<2.4	<5.4	<3.4	<3.6 [<3.4]
1,2,3-Trichlorobenzene	ug/Kg	87-61-6	<3.6	<3.2 [<3.4]	<16	<2.8	<4.2	<2.6	<2.8 [<2.8]
1,2,3-Trichloropropane	ug/Kg	96-18-4	<3	<2.2 [<2.4]	<10.6	<1.86	<4.2	<2.6	<2.8 [<2.8]
1,2,4-Trichlorobenzene	ug/Kg	120-82-1	<3.2	<2.2 [<2.4]	<11.2	<1.96	<4	<2.4	<2.6 [<2.4]
1,2,4-Trimethylbenzene	ug/Kg	95-63-6	<2	<2.2 [<2.4]	<10.6	<1.86	<4.6	<3	<3 [<3]
1,2-Dibromo-3-Chloropropane	ug/Kg	96-12-8	<3.6	<5.4 [<5.8]	<26	<4.6	<5.4	<3.4	<3.6 [<3.4]
1,2-Dibromoethane	ug/Kg	106-93-4	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	ug/Kg	95-50-1	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]
1,2-Dichloroethane	ug/Kg	107-06-2	<2	<2.2 [<2.4]	<11	<1.92	<8.2	<5.2	<5.2 [<5.2]
1,2-Dichloropropane	ug/Kg	78-87-5	<2	<2.2 [<2.4]	<10.6	<1.86	<5.8	<3.6	<3.8 [<3.8]
1,3,5-Trimethylbenzene	ug/Kg	108-67-8	<2	<2.4 [<2.6]	<11.6	<2	<5	<3.2	<3.2 [<3.2]
1,3-Dichlorobenzene	ug/Kg	541-73-1	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]
1,3-Dichloropropane	ug/Kg	142-28-9	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	ug/Kg	106-46-7	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]
1,4-Dioxane	ug/Kg	123-91-1	NA	NA	NA	NA	NA	NA	NA
1-Chlorohexane	ug/Kg	544-10-5	NA	NA	NA	NA	NA	NA	NA
2,2-Dichloropropane	ug/Kg	594-20-7	<2.2	<3.6 [<3.8]	<17.8	<3	<7.8	<5	<5 [<5]
2-Butanone	ug/Kg	78-93-3	<15	<42 [<46]	<220	<38	<42	<26	<28 [<28]
2-Chlorotoluene	ug/Kg	95-49-8	<2	<2.4 [<2.6]	<12.2	<2.2	<4.6	<3	<3 [<3]
2-Hexanone	ug/Kg	591-78-6	<7	<42 [<46]	<220	<38	<54	<34	<36 [<34]
4-Chlorotoluene	ug/Kg	106-43-4	<2	<2.2 [<2.4]	<10.6	<1.86	<4.2	<2.6	<2.8 [<2.8]
4-Methyl-2-pentanone	ug/Kg	108-10-1	<42	<38 [<40]	<186	<32	<38	<24	<24 [<24]
Acetone	ug/Kg	67-64-1	<18.8	<32 [<34]	<156	<28	<400	<240	<260 [<240]
Benzene	ug/Kg	71-43-2	<2	<2.2 [<2.4]	<10.6	<1.86	<6.6	<4.2	<4.2 [<4.2]
Bromobenzene	ug/Kg	108-86-1	<2	<2.2 [<2.4]	<10.6	<1.86	<5.8	<3.6	<3.8 [<3.8]
Bromochloromethane	ug/Kg	74-97-5	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	ug/Kg	75-27-4	NA	NA	NA	NA	NA	NA	NA
Bromoform	ug/Kg	75-25-2	<2	<2.2 [<2.4]	<10.6	<1.86	<6.2	<4	<4 [<4]
Bromomethane	ug/Kg	74-83-9	<3.4	<4.2 [<4.6]	<22	<3.6	<9	<5.6	<5.8 [<5.8]
Carbon Disulfide	ug/Kg	75-15-0	NA	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	ug/Kg	56-23-5	<2.4	<3.6 [<4]	<18.2	<3.2	<6.6	<4.2	<4.2 [<4.2]
Chlorobenzene	ug/Kg	108-90-7	<2	<2.2 [<2.4]	<10.6	<1.86	<4.2	<2.6	<2.8 [<2.8]
Chlorobromomethane	ug/Kg	74-97-5	<2	<2.2 [<2.4]	<10.6	<1.86	<5.4	<3.4	<3.6 [<3.4]
Chloroethane	ug/Kg	75-00-3	<2.2	<3.4 [<3.8]	<17.2	<3	<6.2	<4	<4 [<4]
Chloroform	ug/Kg	67-66-3	<2	<2.2 [<2.4]	<10.6	<1.86	<5.8	<3.6	<3.8 [<3.8]
Chloromethane	ug/Kg	74-87-3	<2	<2.6 [<2.8]	<13	<2.2	<5.4	<3.4	<3.6 [<3.4]
cis-1,2-Dichloroethene	ug/Kg	156-59-2	<2	<2.2 [<2.4]	<10.6	<1.86	<4.6	<3	<3 [<3]
cis-1,3-Dichloropropene	ug/Kg	10061-01-5	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-9 4/20/2007	SED-16 4/25/2008	SED-3 4/25/2008	SED-9 4/25/2008	SED-16 4/26/2012	SED-3 4/26/2012	SED-9 4/26/2012
Dibromochloromethane	ug/Kg	124-48-1	<2	<2.2 [<2.4]	<10.6	<1.86	<4.6	<3	<3 [<3]
Dibromomethane	ug/Kg	74-95-3	<2	<3.2 [<3.4]	<15.6	<2.8	<4.6	<3	<3 [<3]
Dichlorobromomethane	ug/Kg	75-27-4	<2.2	<2.2 [<2.4]	<10.6	<1.86	<5	<3.2	<3.2 [<3.2]
Dichlorodifluoromethane	ug/Kg	75-71-8	NA	NA	NA	NA	NA	NA	NA
Diethyl Ether	ug/Kg	60-29-7	NA	NA	NA	NA	NA	NA	NA
Di-isopropyl ether	ug/Kg	108-20-3	NA	NA	NA	NA	NA	NA	NA
Ethyl tertiary-butyl ether	ug/Kg	637-92-3	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	ug/Kg	100-41-4	<2	<2.6 [<2.8]	<13	<2.2	<6.2	<4	<4 [<4]
Ethylene Dibromide	ug/Kg	106-93-4	<2	<2.4 [<2.6]	<12.2	<2.2	<4.2	<2.6	<2.8 [<2.8]
Isopropylbenzene	ug/Kg	98-82-8	<2	<3 [<3.2]	<14.6	<2.6	<6.2	<4	<4 [<4]
m&p-Xylenes	ug/Kg	108-38-3/106-42-3	<2	<5.2 [<5.6]	<26	<4.4	<11.8	<7.4	<7.6 [<7.4]
Methylene Chloride	ug/Kg	75-09-2	<2	<2.2 [<2.4]	<10.6	<1.86	<7.8	<5	<5 [<5]
Methyl-tert-butyl-ether	ug/Kg	1634-04-4	<2	<2.8 [<3]	<13.6	<2.4	<5.8	<3.6	<3.8 [<3.8]
n-Butylbenzene	ug/Kg	104-51-8	<2	<3.2 [<3.4]	<15.8	<2.8	<4	<2.4	<2.6 [<2.4]
n-Propylbenzene	ug/Kg	103-65-1	<2	<2.8 [<3]	<13.4	<2.4	<4	<2.4	<2.6 [<2.4]
o-Xylene	ug/Kg	95-47-6	<2	<2.2 [<2.4]	<10.6	<1.86	<5	<3.2	<3.2 [<3.2]
p-Isopropyltoluene	ug/Kg	99-87-6	<2	<3.2 [<3.4]	<15.6	<2.8	<5.8	<3.6	<3.8 [<3.8]
sec-Butylbenzene	ug/Kg	135-98-8	<2	<3 [<3.2]	<15	<2.6	<5.4	<3.4	<3.6 [<3.4]
Styrene	ug/Kg	100-42-5	<2	<2.2 [<2.4]	<10.6	<1.86	<4	<2.4	<2.6 [<2.4]
tert-Butylbenzene	ug/Kg	98-06-6	<2	<3.2 [<3.4]	<15.6	<2.8	<5	<3.2	<3.2 [<3.2]
Tertiary-amyl methyl ether	ug/Kg	994-05-8	NA	NA	NA	NA	NA	NA	NA
Tetrachloroethene	ug/Kg	127-18-4	<2	<3 [<3.2]	<15	<2.6	<6.2	<4	<4 [<4]
Tetrahydrofuran	ug/Kg	109-99-9	NA	NA	NA	NA	NA	NA	NA
Toluene	ug/Kg	108-88-3	<2	<2.2 [<2.4]	<10.6	<1.86	<6.6	<4.2	<4.2 [<4.2]
trans-1,2-Dichloroethene	ug/Kg	156-60-5	<2	<2.2 [<2.4]	<11.2	<1.96	<5.4	<3.4	<3.6 [<3.4]
trans-1,3-Dichloropropene	ug/Kg	10061-02-6	<2	<2.4 [<2.6]	<12	<2	<7.8	<5	<5 [<5]
Trichloroethene	ug/Kg	79-01-6	<2	<3.2 [<3.4]	<16	<2.8	<7.8	<5	<5 [<5]
Trichlorofluoromethane	ug/Kg	75-69-4	<4	<3.6 [<3.8]	<17.8	<3.2	<5.8	<3.6	<3.8 [<3.8]
Vinyl Chloride	ug/Kg	75-01-4	<2	<3.4 [<3.6]	<16.8	<3	<6.2	<4	<4 [<4]

Notes:

NA = Not analyzed.

< = Not detected. The associated value is the detection limit.

[] = Duplicate result.

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 10/15/2013	SED-3 10/15/2013	SED-9 10/15/2013	SED-16 4/17/2014	SED-3 4/17/2014	SED-9 4/17/2014
Inorganics								
Aluminum	mg/Kg	7429-90-5	5800	11000	4100 [3100]	NA	NA	NA
Antimony	mg/Kg	7440-36-0	<20	<33	<16 [<19]	NA	NA	NA
Arsenic	mg/Kg	7440-38-2	<2.7	1.1	<2.2 [<2.5]	NA	NA	NA
Barium	mg/Kg	7440-39-3	45	60	39 [25]	NA	NA	NA
Beryllium	mg/Kg	7440-41-7	0.17	0.6	0.082 [0.12]	NA	NA	NA
Cadmium	mg/Kg	7440-43-9	<0.27	0.37	<0.22 [<0.25]	NA	NA	NA
Calcium	mg/Kg	7440-70-2	610	1100	370 [670]	NA	NA	NA
Chromium	mg/Kg	7440-47-3	11	13	6.2 [5.5]	NA	NA	NA
Cobalt	mg/Kg	7440-48-4	3.7	3.5	2.5 [2.7]	NA	NA	NA
Copper	mg/Kg	7440-50-8	5.4	6.5	6.3 [9.6]	NA	NA	NA
Iron	mg/Kg	7439-89-6	9800	7200	8400 [9600]	NA	NA	NA
Lead	mg/Kg	7439-92-1	3	17	3.7 [3]	NA	NA	NA
Magnesium	mg/Kg	7439-95-4	2700	1400	1800 [1800]	NA	NA	NA
Manganese	mg/Kg	7439-96-5	230	300	150 [360]	NA	NA	NA
Mercury	mg/Kg	7439-97-6	0.35	0.092	<0.024 [<0.022]	NA	NA	NA
Nickel	mg/Kg	7440-02-0	6.1	8.8	5.7 [5.7]	NA	NA	NA
Potassium	mg/Kg	7440-09-7	2200	470	2000 [750]	NA	NA	NA
Selenium	mg/Kg	7782-49-2	0.66	1	<4.4 [<5]	NA	NA	NA
Silver	mg/Kg	7440-22-4	<0.68	<1.1	<0.55 [<0.63]	NA	NA	NA
Sodium	mg/Kg	7440-23-5	55	34	49 [47]	NA	NA	NA
Thallium	mg/Kg	7440-28-0	<8.1	<13	<6.6 [<7.5]	NA	NA	NA
Vanadium	mg/Kg	7440-62-2	18	17	11 [12]	NA	NA	NA
Zinc	mg/Kg	7440-66-6	30	46	36 [35]	NA	NA	NA
Pesticides/PCBs								
4,4'-DDT	ug/Kg	50-29-3	2.6	0.57	<8 [<7.8]	<4.4	<4.8	<48
4,4'-DDD	ug/Kg	72-54-8	<4	<1.34	<15.2 [<15]	<3.6	2.2	<40
4,4'-DDE	ug/Kg	72-55-9	<3	1.2	<11.8 [<11.6]	2.4	<4.4	<42
Aldrin	ug/Kg	309-00-2	<5	<1.68	<19.4 [<19]	<4.6	<5	<50
alpha-BHC	ug/Kg	319-84-6	<3.6	<1.24	<14.2 [<13.8]	<3.4	2.3	<36
alpha-Chlordane	ug/Kg	5103-71-9	NA	NA	NA	NA	NA	NA
beta-BHC	ug/Kg	319-85-7	<2.2	<0.74	<8.4 [<8.4]	<3.4	<3.8	<36
Chlordane, total	ug/Kg	57-74-9	<46	<15.2	<174 [<172]	<42	<46	<440
Dieldrin	ug/Kg	60-57-1	<4.8	0.87	<18.8 [<18.6]	<4.4	<5	<48
Endosulfan I	ug/Kg	959-98-8	<2.6	<0.86	<10 [<9.8]	<3.6	<4	<38
Endosulfan II	ug/Kg	33213-65-9	<3.6	<1.24	<14.2 [<13.8]	<3.4	<3.8	<36
Endosulfan Sulfate	ug/Kg	1031-07-8	<3.8	<1.28	<14.6 [<14.4]	<3.4	<3.8	<38
Endrin	ug/Kg	72-20-8	<2.8	<0.94	<10.8 [<10.6]	<3.6	<4	<40
Endrin Aldehyde	ug/Kg	7421-93-4	<5.2	<1.76	<20 [<19.8]	<4.8	<5.2	<52
Endrin Ketone	ug/Kg	53494-70-5	<5	<1.68	<19.4 [<19]	<4.6	<5	<50
gamma-BHC (Lindane)	ug/Kg	58-89-9	<2.6	0.97	<9.8 [<9.6]	<3.4	2.1	<38
gamma-Chlordane	ug/Kg	5103-74-2	NA	NA	NA	NA	NA	NA
Heptachlor	ug/Kg	76-44-8	<3.2	<1.08	<12.4 [<12]	<4	<4.4	<44
Heptachlor Epoxide	ug/Kg	1024-57-3	<5.2	<1.76	<20 [<20]	<4.8	<5.4	<52
Methoxychlor	ug/Kg	72-43-5	<2.8	1.6	<10.8 [<10.6]	<3.8	<4.2	<42
PCB-1260	ug/Kg	11096-82-5	<240	<460	<240 [<260]	NA	NA	NA
PCB-1254	ug/Kg	11097-69-1	<240	<460	<240 [<260]	NA	NA	NA
PCB-1221	ug/Kg	11104-28-2	<104	<194	<104 [<110]	NA	NA	NA
PCB-1232	ug/Kg	11141-16-5	<104	<194	<104 [<110]	NA	NA	NA
PCB-1248	ug/Kg	12672-29-6	<104	<194	<104 [<110]	NA	NA	NA
PCB-1016	ug/Kg	12674-11-2	<104	<194	<104 [<110]	NA	NA	NA
PCB-1242	ug/Kg	53469-21-9	NA	NA	NA	NA	NA	NA
Toxaphene	ug/Kg	8001-35-2	<118	<40	<460 [<440]	<108	<120	<1180

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 10/15/2013	SED-3 10/15/2013	SED-9 10/15/2013	SED-16 4/17/2014	SED-3 4/17/2014	SED-9 4/17/2014
Semivolatile Organics								
2,4,5-Trichlorophenol	ug/Kg	95-95-4	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	ug/Kg	88-06-2	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	ug/Kg	120-83-2	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol	ug/Kg	105-67-9	<110	<188	<540 [<106]	NA	NA	NA
2,4-Dinitrophenol	ug/Kg	51-28-5	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	ug/Kg	121-14-2	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	ug/Kg	606-20-2	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene	ug/Kg	91-58-7	NA	NA	NA	NA	NA	NA
2-Chlorophenol	ug/Kg	95-57-8	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	ug/Kg	91-57-6	<5	<8.4	<24 [<4.8]	NA	NA	NA
2-Methylphenol	ug/Kg	95-48-7	<12.4	<22	<62 [<12.2]	NA	NA	NA
2-Nitroaniline	ug/Kg	88-74-4	NA	NA	NA	NA	NA	NA
2-Nitrophenol	ug/Kg	88-75-5	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol	ug/Kg	108-39-4/106-44-5	<22	<38	<110 [<22]	NA	NA	NA
3,3'-Dichlorobenzidine	ug/Kg	91-94-1	NA	NA	NA	NA	NA	NA
3-Nitroaniline	ug/Kg	99-09-2	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-Methylphenol	ug/Kg	534-52-1	NA	NA	NA	NA	NA	NA
4-Bromophenyl-phenylether	ug/Kg	101-55-3	NA	NA	NA	NA	NA	NA
4-Chloro-3-Methylphenol	ug/Kg	59-50-7	NA	NA	NA	NA	NA	NA
4-Chloroaniline	ug/Kg	106-47-8	NA	NA	NA	NA	NA	NA
4-Chloro-phenyl-phenyl ether	ug/Kg	7005-72-3	NA	NA	NA	NA	NA	NA
4-Nitroaniline	ug/Kg	100-01-6	NA	NA	NA	NA	NA	NA
4-Nitrophenol	ug/Kg	100-02-7	NA	NA	NA	NA	NA	NA
Acenaphthene	ug/Kg	83-32-9	NA	NA	NA	NA	NA	NA
Acenaphthylene	ug/Kg	208-96-8	NA	NA	NA	NA	NA	NA
Acetophenone	ug/Kg	98-86-2	NA	NA	NA	NA	NA	NA
Aniline	ug/Kg	62-53-3	NA	NA	NA	NA	NA	NA
Anthracene	ug/Kg	120-12-7	NA	NA	NA	NA	NA	NA
Azobenzene	ug/Kg	103-33-3	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	ug/Kg	56-55-3	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	ug/Kg	50-32-8	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	ug/Kg	205-99-2	NA	NA	NA	NA	NA	NA
Benzo(ghi)perylene	ug/Kg	191-24-2	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	ug/Kg	207-08-9	NA	NA	NA	NA	NA	NA
Benzoic Acid	ug/Kg	65-85-0	<580	<1000	<2800 [<560]	NA	NA	NA
Benzyl Alcohol	ug/Kg	100-51-6	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	ug/Kg	111-91-1	NA	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	ug/Kg	111-44-4	NA	NA	NA	NA	NA	NA
bis(2-chloroisopropyl)Ether	ug/Kg	108-60-1	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	ug/Kg	117-81-7	<130	<220	<640 [<128]	NA	NA	NA
Butylbenzylphthalate	ug/Kg	85-68-7	NA	NA	NA	NA	NA	NA
Carbazole	ug/Kg	86-74-8	NA	NA	NA	NA	NA	NA
Chrysene	ug/Kg	218-01-9	NA	NA	NA	NA	NA	NA
Dibenzo(a,h)Anthracene	ug/Kg	53-70-3	NA	NA	NA	NA	NA	NA
Dibenzofuran	ug/Kg	132-64-9	NA	NA	NA	NA	NA	NA
Diethylphthalate	ug/Kg	84-66-2	<12.2	<20	<60 [<12]	NA	NA	NA
Dimethylphthalate	ug/Kg	131-11-3	NA	NA	NA	NA	NA	NA
Di-n-butylphthalate	ug/Kg	84-74-2	NA	NA	NA	NA	NA	NA
Di-n-octylphthalate	ug/Kg	117-84-0	<9.4	<16.2	<46 [60]	NA	NA	NA
Fluoranthene	ug/Kg	206-44-0	NA	NA	NA	NA	NA	NA
Fluorene	ug/Kg	86-73-7	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	ug/Kg	118-74-1	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	ug/Kg	87-68-3	<0.48	<0.94	<0.74 [<0.48]	NA	NA	NA
Hexachlorocyclopentadiene	ug/Kg	77-47-4	NA	NA	NA	NA	NA	NA
Hexachloroethane	ug/Kg	67-72-1	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	ug/Kg	193-39-5	NA	NA	NA	NA	NA	NA

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 10/15/2013	SED-3 10/15/2013	SED-9 10/15/2013	SED-16 4/17/2014	SED-3 4/17/2014	SED-9 4/17/2014
Isophorone	ug/Kg	78-59-1	NA	NA	NA	NA	NA	NA
Naphthalene	ug/Kg	91-20-3	<6.8	<11.6	<34 [<6.6]	NA	NA	NA
Nitrobenzene	ug/Kg	98-95-3	NA	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	ug/Kg	62-75-9	NA	NA	NA	NA	NA	NA
N-Nitroso-Di-n-Propylamine	ug/Kg	621-64-7	NA	NA	NA	NA	NA	NA
N-nitrosodiphenylamine	ug/Kg	86-30-6	NA	NA	NA	NA	NA	NA
Pentachlorophenol	ug/Kg	87-86-5	NA	NA	NA	NA	NA	NA
Phenanthrene	ug/Kg	85-01-8	NA	NA	NA	NA	NA	NA
Phenol	ug/Kg	108-95-2	<42	<74	<200 [<42]	NA	NA	NA
Pyrene	ug/Kg	129-00-0	NA	NA	NA	NA	NA	NA
Pyridine	ug/Kg	110-86-1	NA	NA	NA	NA	NA	NA
Volatile Organics								
1,1,1,2-Tetrachloroethane	ug/Kg	630-20-6	<0.42	<0.8	<0.62 [<0.42]	NA	NA	NA
1,1,1-Trichloroethane	ug/Kg	71-55-6	<0.3	<0.58	<0.46 [<0.3]	NA	NA	NA
1,1,2,2-Tetrachloroethane	ug/Kg	79-34-5	<0.66	<1.3	<1.02 [<0.68]	NA	NA	NA
1,1,2-Trichloroethane	ug/Kg	79-00-5	<0.54	<1.04	<0.82 [<0.54]	NA	NA	NA
1,1-Biphenyl	ug/Kg	92-52-4	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	ug/Kg	75-34-3	<0.5	<0.98	<0.76 [<0.5]	NA	NA	NA
1,1-Dichloroethene	ug/Kg	75-35-4	<0.5	<0.98	<0.78 [<0.52]	NA	NA	NA
1,1-Dichloropropene	ug/Kg	563-58-6	<0.58	<1.14	<0.9 [<0.6]	NA	NA	NA
1,2,3-Trichlorobenzene	ug/Kg	87-61-6	<0.44	<0.84	<0.66 [<0.44]	NA	NA	NA
1,2,3-Trichloropropane	ug/Kg	96-18-4	<0.42	<0.82	<0.64 [<0.42]	NA	NA	NA
1,2,4-Trichlorobenzene	ug/Kg	120-82-1	<0.24	<0.48	<0.38 [<0.26]	NA	NA	NA
1,2,4-Trimethylbenzene	ug/Kg	95-63-6	<0.78	<1.54	<1.2 [<0.8]	NA	NA	NA
1,2-Dibromo-3-Chloropropane	ug/Kg	96-12-8	<2	<4	<3.2 [<2]	NA	NA	NA
1,2-Dibromoethane	ug/Kg	106-93-4	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	ug/Kg	95-50-1	<0.32	<0.62	<0.5 [<0.32]	NA	NA	NA
1,2-Dichloroethane	ug/Kg	107-06-2	<0.2	<0.4	<0.32 [<0.2]	NA	NA	NA
1,2-Dichloropropane	ug/Kg	78-87-5	<2	<4	<3.2 [<2]	NA	NA	NA
1,3,5-Trimethylbenzene	ug/Kg	108-67-8	<0.26	<0.52	<0.4 [<0.26]	NA	NA	NA
1,3-Dichlorobenzene	ug/Kg	541-73-1	<0.22	<0.42	<0.32 [<0.22]	NA	NA	NA
1,3-Dichloropropane	ug/Kg	142-28-9	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	ug/Kg	106-46-7	<0.58	<1.12	<0.88 [<0.58]	NA	NA	NA
1,4-Dioxane	ug/Kg	123-91-1	NA	NA	NA	NA	NA	NA
1-Chlorohexane	ug/Kg	544-10-5	NA	NA	NA	NA	NA	NA
2,2-Dichloropropane	ug/Kg	594-20-7	<0.7	<1.36	<1.06 [<0.7]	NA	NA	NA
2-Butanone	ug/Kg	78-93-3	<1.5	<3	<2.4 [<1.52]	NA	NA	NA
2-Chlorotoluene	ug/Kg	95-49-8	<0.26	<0.52	<0.42 [<0.28]	NA	NA	NA
2-Hexanone	ug/Kg	591-78-6	<2	<4	<3.2 [<2]	NA	NA	NA
4-Chlorotoluene	ug/Kg	106-43-4	<0.48	<0.94	<0.74 [<0.5]	NA	NA	NA
4-Methyl-2-pentanone	ug/Kg	108-10-1	<1.34	<2.6	<2 [<1.36]	NA	NA	NA
Acetone	ug/Kg	67-64-1	<3.4	21	<5.2 [<3.6]	NA	NA	NA
Benzene	ug/Kg	71-43-2	<0.2	<0.4	<0.3 [<0.2]	NA	NA	NA
Bromobenzene	ug/Kg	108-86-1	<0.72	<1.4	<1.1 [<0.74]	NA	NA	NA
Bromochloromethane	ug/Kg	74-97-5	NA	NA	NA	NA	NA	NA
Bromodichloromethane	ug/Kg	75-27-4	NA	NA	NA	NA	NA	NA
Bromoform	ug/Kg	75-25-2	<2	<4	<3.2 [<2]	NA	NA	NA
Bromomethane	ug/Kg	74-83-9	<0.36	<0.72	<0.56 [<0.38]	NA	NA	NA
Carbon Disulfide	ug/Kg	75-15-0	NA	NA	NA	NA	NA	NA
Carbon Tetrachloride	ug/Kg	56-23-5	<0.4	<0.78	<0.6 [<0.4]	NA	NA	NA
Chlorobenzene	ug/Kg	108-90-7	<0.54	<1.06	<0.84 [<0.56]	NA	NA	NA
Chlorobromomethane	ug/Kg	74-97-5	<0.3	<0.58	<0.46 [<0.3]	NA	NA	NA
Chloroethane	ug/Kg	75-00-3	<0.92	<1.8	<1.42 [<0.94]	NA	NA	NA
Chloroform	ug/Kg	67-66-3	<0.26	<0.5	<0.38 [<0.26]	NA	NA	NA
Chloromethane	ug/Kg	74-87-3	<0.24	<0.48	<0.38 [<0.26]	NA	NA	NA
cis-1,2-Dichloroethene	ug/Kg	156-59-2	<0.52	<1.02	<0.8 [<0.54]	NA	NA	NA
cis-1,3-Dichloropropene	ug/Kg	10061-01-5	<0.6	<1.16	<0.9 [<0.6]	NA	NA	NA

**Table 1. Sediment Analytical Results
Barkhamsted Superfund Site**

Parameter	Units	CAS	SED-16 10/15/2013	SED-3 10/15/2013	SED-9 10/15/2013	SED-16 4/17/2014	SED-3 4/17/2014	SED-9 4/17/2014
Dibromochloromethane	ug/Kg	124-48-1	<0.52	<1.02	<0.8 [<0.54]	NA	NA	NA
Dibromomethane	ug/Kg	74-95-3	<0.42	<0.82	<0.64 [<0.42]	NA	NA	NA
Dichlorobromomethane	ug/Kg	75-27-4	<0.56	<1.08	<0.84 [<0.56]	NA	NA	NA
Dichlorodifluoromethane	ug/Kg	75-71-8	NA	NA	NA	NA	NA	NA
Diethyl Ether	ug/Kg	60-29-7	NA	NA	NA	NA	NA	NA
Di-isopropyl ether	ug/Kg	108-20-3	NA	NA	NA	NA	NA	NA
Ethyl tertiary-butyl ether	ug/Kg	637-92-3	NA	NA	NA	NA	NA	NA
Ethylbenzene	ug/Kg	100-41-4	<0.28	<0.56	<0.44 [<0.28]	NA	NA	NA
Ethylene Dibromide	ug/Kg	106-93-4	<0.52	<1.02	<0.8 [<0.54]	NA	NA	NA
Isopropylbenzene	ug/Kg	98-82-8	<0.62	<1.2	<0.94 [<0.62]	NA	NA	NA
m&p-Xylenes	ug/Kg	108-38-3/106-42-3	<0.7	<1.34	<1.06 [<0.7]	NA	NA	NA
Methylene Chloride	ug/Kg	75-09-2	<1.88	<3.6	<2.8 [<1.92]	NA	NA	NA
Methyl-tert-butyl-ether	ug/Kg	1634-04-4	<0.4	<0.78	<0.62 [<0.4]	NA	NA	NA
n-Butylbenzene	ug/Kg	104-51-8	<0.36	<0.7	<0.54 [<0.36]	NA	NA	NA
n-Propylbenzene	ug/Kg	103-65-1	<0.32	<0.64	<0.5 [<0.34]	NA	NA	NA
o-Xylene	ug/Kg	95-47-6	<0.54	<1.04	<0.82 [<0.54]	NA	NA	NA
p-Isopropyltoluene	ug/Kg	99-87-6	<0.32	<0.64	<0.5 [<0.34]	NA	NA	NA
sec-Butylbenzene	ug/Kg	135-98-8	<0.36	<0.7	<0.54 [<0.36]	NA	NA	NA
Styrene	ug/Kg	100-42-5	<0.2	<0.4	<0.32 [<0.2]	NA	NA	NA
tert-Butylbenzene	ug/Kg	98-06-6	<0.42	<0.84	<0.66 [<0.44]	NA	NA	NA
Tertiary-amyl methyl ether	ug/Kg	994-05-8	NA	NA	NA	NA	NA	NA
Tetrachloroethene	ug/Kg	127-18-4	<0.56	<1.08	<0.84 [<0.56]	NA	NA	NA
Tetrahydrofuran	ug/Kg	109-99-9	NA	NA	NA	NA	NA	NA
Toluene	ug/Kg	108-88-3	<0.32	<0.6	<0.48 [<0.32]	NA	NA	NA
trans-1,2-Dichloroethene	ug/Kg	156-60-5	<0.42	<0.82	<0.64 [<0.44]	NA	NA	NA
trans-1,3-Dichloropropene	ug/Kg	10061-02-6	<1.8	<3.6	<2.8 [<1.84]	NA	NA	NA
Trichloroethene	ug/Kg	79-01-6	<0.9	<1.76	<1.38 [<0.92]	NA	NA	NA
Trichlorofluoromethane	ug/Kg	75-69-4	<0.38	<0.76	<0.6 [<0.4]	NA	NA	NA
Vinyl Chloride	ug/Kg	75-01-4	<0.5	<0.98	<0.76 [<0.5]	NA	NA	NA

Notes:

NA = Not analyzed.

< = Not detected. The associated value is the detection limit.

[] = Duplicate result.

Table 2. Sediment Ecological Data Screen
Barkhamsted Superfund Site

Parameter	Units	CAS	Screening Value [1]	Detection Frequency	Detection Frequency (%)	Minimum Detect	Maximum Detect	Max Detect Location	Minimum Non-Detect	Maximum Non-Detect	Median	Arithmetic Average	Geometric Mean	Standard Deviation	Hazard Quotient
Inorganics															
Aluminum	mg/Kg	7429-90-5	NA	18/18	100	3300	31000	SED-3 04/20/07			5500	11500	8100	10400	NA
Antimony	mg/Kg	7440-36-0	2	6/18	33.3	0.53	3.1	SED-9 04/20/07	2.65	33	1.5	1.54	1.34	0.881	0.77
Arsenic	mg/Kg	7440-38-2	9.8	12/18	66.7	0.635	14.75	SED-3 04/18/06	1.3	6.9	3.1	4.31	2.57	4.61	0.44
Barium	mg/Kg	7440-39-3	NA	18/18	100	28	165	SED-3 04/18/06			44	68.5	56.3	47.9	NA
Beryllium	mg/Kg	7440-41-7	NA	6/18	33.3	0.101	1.6	SED-3 06/17/04	0.18	1.5	0.8	0.82	0.537	0.636	NA
Cadmium	mg/Kg	7440-43-9	0.99	10/18	55.6	0.18	1.15	SED-3 04/18/06	0.235	1.5	0.335	0.516	0.406	0.378	0.52
Calcium	mg/Kg	7440-70-2	NA	18/18	100	520	4500	SED-3 06/17/04			1100	1760	1340	1450	NA
Chromium	mg/Kg	7440-47-3	43.4	18/18	100	5.85	340	SED-16 04/18/06			12.8	37.2	18.7	76.6	0.86
Cobalt	mg/Kg	7440-48-4	50	18/18	100	2.6	23	SED-3 04/20/05, SED-3 04/18/06			4.65	8.3	6.16	7.36	0.17
Copper	mg/Kg	7440-50-8	31.6	17/18	94.4	4.3	51	SED-16 04/18/06	14	14	10.1	13.7	11	11.2	0.43
Iron	mg/Kg	7439-89-6	20000	18/18	100	7200	36500	SED-3 04/18/06			13000	18300	15900	10200	0.92
Lead	mg/Kg	7439-92-1	35.8	15/15	100	3	62	SED-3 04/20/05			6.45	19.3	11	21.2	0.54
Magnesium	mg/Kg	7439-95-4	NA	18/18	100	1400	4600	SED-3 06/17/04			2100	2510	2340	1020	NA
Manganese	mg/Kg	7439-96-5	460	18/18	100	200	4450	SED-3 04/18/06			400	1020	563	1390	2.2
Mercury	mg/Kg	7439-97-6	0.18	7/18	38.9	0.072	0.35	SED-16 10/15/13	0.023	0.27	0.19	0.201	0.176	0.101	1
Nickel	mg/Kg	7440-02-0	22.7	18/18	100	4.5	85	SED-16 04/18/06			7.85	16	11	19	0.70
Potassium	mg/Kg	7440-09-7	NA	18/18	100	470	2200	SED-16 10/15/13			1600	1520	1440	447	NA
Selenium	mg/Kg	7782-49-2	2	6/18	33.3	0.66	22	SED-9 04/18/06	0.59	6.9	3.35	7.08	3.48	8.44	3.5
Silver	mg/Kg	7440-22-4	1	0/18	0				0.59	9.5					NA
Sodium	mg/Kg	7440-23-5	NA	12/18	66.7	12	1170	SED-3 04/18/06	130	560	48	210	72.4	354	NA
Thallium	mg/Kg	7440-28-0	NA	5/18	27.8	0.11	1	SED-3 04/25/08	1.3	19	0.25	0.408	0.31	0.353	NA
Vanadium	mg/Kg	7440-62-2	NA	18/18	100	9.5	58	SED-3 06/17/04			15.3	24.7	20	18	NA
Zinc	mg/Kg	7440-66-6	121	18/18	100	23	145	SED-3 04/18/06			31	56	44.1	44.3	0.46
Pesticides/PCBs															
4,4'-DDT	ug/Kg	50-29-3	NA	2/27	7.41	0.57	2.6	SED-16 10/15/13	3.2	54	1.59	1.59	1.22	1.44	NA
4,4'-DDD	ug/Kg	72-54-8	4.88	1/24	4.17	2.2	2.2	SED-3 04/17/14	1.34	54	2.2	2.2	2.2	2010	0.45
4,4'-DDE	ug/Kg	72-55-9	3.16	2/27	7.41	1.2	2.4	SED-16 04/17/14	2.038	54	1.8	1.8	1.7	0.849	0.57
Aldrin	ug/Kg	309-00-2	2	0/27	0				1.68	54					NA
alpha-BHC	ug/Kg	319-84-6	6	1/27	3.7	2.3	2.3	SED-3 04/17/14	1.24	54	2.3	2.3	2.3	2010	0.38
alpha-Chlordane	ug/Kg	5103-71-9	NA	0/3	0				2.89	9.06					NA
beta-BHC	ug/Kg	319-85-7	5	0/27	0				0.74	54					NA
Chlordane, total	ug/Kg	57-74-9	3.24	0/27	0				15.2	3300					NA
Dieldrin	ug/Kg	60-57-1	1.9	1/27	3.7	0.87	0.87	SED-3 10/15/13	2.21	54	0.87	0.87	0.87	2010	0.46
Endosulfan I	ug/Kg	959-98-8	2.9	0/21	0				0.86	48					NA
Endosulfan II	ug/Kg	33213-65-9	14	0/21	0				1.24	48					NA
Endosulfan Sulfate	ug/Kg	1031-07-8	5.4	0/27	0				1.28	54					NA
Endrin	ug/Kg	72-20-8	2.22	0/27	0				0.94	54					NA
Endrin Aldehyde	ug/Kg	7421-93-4	NA	0/27	0				1.76	54					NA
Endrin Ketone	ug/Kg	53494-70-5	NA	0/21	0				1.68	50					NA
gamma-BHC (Lindane)	ug/Kg	58-89-9	2.37	2/27	7.41	0.97	2.1	SED-3 04/17/14	2.6	54	1.54	1.54	1.43	0.799	0.65
gamma-Chlordane	ug/Kg	5103-74-2	NA	0/3	0				2.72	8.54					NA
Heptachlor	ug/Kg	76-44-8	68	0/27	0				1.08	54					NA
Heptachlor Epoxide	ug/Kg	1024-57-3	2.47	0/27	0				1.76	54					NA
Methoxychlor	ug/Kg	72-43-5	18.7	1/27	3.7	1.6	1.6	SED-3 10/15/13	2.8	106	1.6	1.6	1.6	2010	0.086
PCB-1260	ug/Kg	11096-82-5	NA	0/24	0				0.48	460					NA
PCB-1254	ug/Kg	11097-69-1	NA	0/24	0				0.68	650					NA
PCB-1221	ug/Kg	11104-28-2	NA	0/24	0				0.68	650					NA
PCB-1232	ug/Kg	11141-16-5	NA	0/24	0				0.68	650					NA
PCB-1248	ug/Kg	12672-29-6	NA	0/24	0				0.68	650					NA
PCB-1016	ug/Kg	12674-11-2	NA	0/24	0				0.54	194					NA
PCB-1242	ug/Kg	53469-21-9	NA	0/3	0				28.5	90.6					NA
Toxaphene	ug/Kg	8001-35-2	0.1	0/27	0				40	3300					NA

Table 2. Sediment Ecological Data Screen
Barkhamsted Superfund Site

Parameter	Units	CAS	Screening Value [1]	Detection Frequency	Detection Frequency (%)	Minimum Detect	Maximum Detect	Max Detect Location	Minimum Non-Detect	Maximum Non-Detect	Median	Arithmetic Average	Geometric Mean	Standard Deviation	Hazard Quotient
Semivolatile Organics															
2,4,5-Trichlorophenol	ug/Kg	95-95-4	NA	0/6	0				10.8	159.4					NA
2,4,6-Trichlorophenol	ug/Kg	88-06-2	213	0/6	0				8.4	159.4					NA
2,4-Dichlorophenol	ug/Kg	120-83-2	117	0/6	0				11.2	159.4					NA
2,4-Dimethylphenol	ug/Kg	105-67-9	29	0/12	0				10.4	426					NA
2,4-Dinitrophenol	ug/Kg	51-28-5	NA	0/6	0				31	106.4					NA
2,4-Dinitrotoluene	ug/Kg	121-14-2	41.6	0/6	0				2.6	53.2					NA
2,6-Dinitrotoluene	ug/Kg	606-20-2	NA	0/6	0				1.89	159.4					NA
2-Chloronaphthalene	ug/Kg	91-58-7	NA	0/6	0				1.94	106.4					NA
2-Chlorophenol	ug/Kg	95-57-8	31.2	0/6	0				26	106.4					NA
2-Methylnaphthalene	ug/Kg	91-57-6	20.2	0/12	0				5	190					NA
2-Methylphenol	ug/Kg	95-48-7	NA	0/12	0				11	190					NA
2-Nitroaniline	ug/Kg	88-74-4	NA	0/6	0				7.7	53.2					NA
2-Nitrophenol	ug/Kg	88-75-5	NA	0/6	0				10.8	106.4					NA
3 & 4 Methylphenol	ug/Kg	108-39-4/106-44-5	NA	2/12	16.7	34.7	130	SED-16 04/26/12	11.8	123	82.4	82.4	67.2	67.4	NA
3,3'-Dichlorobenzidine	ug/Kg	91-94-1	127	0/6	0				4.1	532					NA
3-Nitroaniline	ug/Kg	99-09-2	NA	0/6	0				10	159.4					NA
4,6-Dinitro-2-Methylphenol	ug/Kg	534-52-1	NA	0/3	0				83.9	266					NA
4-Bromophenyl-phenylether	ug/Kg	101-55-3	1230	0/6	0				3.1	106.4					NA
4-Chloro-3-Methylphenol	ug/Kg	59-50-7	NA	0/6	0				14.3	106.4					NA
4-Chloroaniline	ug/Kg	106-47-8	NA	0/6	0				8.2	478					NA
4-Chloro-phenyl-phenyl ether	ug/Kg	7005-72-3	NA	0/6	0				1.33	159.4					NA
4-Nitroaniline	ug/Kg	100-01-6	NA	0/6	0				29	106.4					NA
4-Nitrophenol	ug/Kg	100-02-7	NA	0/6	0				9.8	212					NA
Acenaphthene	ug/Kg	83-32-9	6.7	0/6	0				1.69	106.4					NA
Acenaphthylene	ug/Kg	208-96-8	5.9	0/6	0				1.51	106.4					NA
Acetophenone	ug/Kg	98-86-2	NA	0/3	0				16.77	53.2					NA
Aniline	ug/Kg	62-53-3	NA	0/6	0				46	372					NA
Anthracene	ug/Kg	120-12-7	57.2	0/6	0				1.82	106.4					NA
Azobenzene	ug/Kg	103-33-3	NA	0/3	0				67.1	212					NA
Benzo(a)anthracene	ug/Kg	56-55-3	108	1/18	5.56	50.2	50.2	SED-9 08/15/03	1.66	460	50.2	50.2	50.2	2010	0.46
Benzo(a)pyrene	ug/Kg	50-32-8	150	0/18	0				1.38	480					NA
Benzo(b)fluoranthene	ug/Kg	205-99-2	NA	0/18	0				3.3	650					NA
Benzo(ghi)perylene	ug/Kg	191-24-2	170	0/6	0				2.6	1594					NA
Benzo(k)fluoranthene	ug/Kg	207-08-9	240	0/6	0				4.6	266					NA
Benzoic Acid	ug/Kg	65-85-0	650	1/12	8.33	310	310	SED-16 04/26/12	8.4	3500	310	310	310	2010	0.48
Benzyl Alcohol	ug/Kg	100-51-6	NA	0/6	0				9.2	159.4					NA
bis(2-Chloroethoxy)methane	ug/Kg	111-91-1	NA	0/6	0				1.82	159.4					NA
bis(2-Chloroethyl)ether	ug/Kg	111-44-4	NA	0/6	0				1.33	106.4					NA
bis(2-chloroisopropyl)Ether	ug/Kg	108-60-1	NA	0/6	0				17.7	106.4					NA
bis(2-Ethylhexyl)phthalate	ug/Kg	117-81-7	180	2/12	16.7	499	590	SED-3 04/26/12	12.5	744	545	545	543	64.3	3.0
Butylbenzylphthalate	ug/Kg	85-68-7	10900	1/6	16.7	47.5	47.5	SED-9 08/15/03	3.3	106.4	47.5	47.5	47.5	2010	0.0044
Carbazole	ug/Kg	86-74-8	NA	0/3	0				33.6	106.4					NA
Chrysene	ug/Kg	218-01-9	166	1/6	16.7	58.4	58.4	SED-9 08/15/03	1.69	318	58.4	58.4	58.4	2010	0.35
Dibenzo(a,h)Anthracene	ug/Kg	53-70-3	33	0/6	0				2.2	266					NA
Dibenzofuran	ug/Kg	132-64-9	415	0/6	0				8.4	106.4					NA
Diethylphthalate	ug/Kg	84-66-2	603	0/12	0				2.1	426					NA
Dimethylphthalate	ug/Kg	131-11-3	NA	0/6	0				1.1	106.4					NA
Di-n-butylphthalate	ug/Kg	84-74-2	6470	0/6	0				2.8	106.4					NA
Di-n-octylphthalate	ug/Kg	117-84-0	NA	1/12	8.33	60	60	SED-9 10/15/13	4.9	190	60	60	60	2010	NA
Fluoranthene	ug/Kg	206-44-0	423	1/6	16.7	85.2	85.2	SED-9 08/15/03	2.3	318	85.2	85.2	85.2	2010	0.20
Fluorene	ug/Kg	86-73-7	77.4	0/6	0				2.2	106.4					NA
Hexachlorobenzene	ug/Kg	118-74-1	20	0/6	0				2.2	159.4					NA
Hexachlorobutadiene	ug/Kg	87-68-3	NA	0/24	0				0.48	159.4					NA
Hexachlorocyclopentadiene	ug/Kg	77-47-4	NA	0/6	0				4.3	159.4					NA
Hexachloroethane	ug/Kg	67-72-1	1027	0/6	0				2.2	106.4					NA
Indeno[1,2,3-cd]pyrene	ug/Kg	193-39-5	17	0/18	0				2.4	1382					NA
Isophorone	ug/Kg	78-59-1	NA	0/6	0				1.59	53.2					NA
Naphthalene	ug/Kg	91-20-3	176	0/24	0				1.81	33.6					NA
Nitrobenzene	ug/Kg	98-95-3	NA	0/6	0				1.69	106.4					NA
N-Nitrosodimethylamine	ug/Kg	62-75-9	NA	0/3	0				16.77	53.2					NA
N-Nitroso-Di-n-Propylamine	ug/Kg	621-64-7	NA	0/6	0				1.25	426					NA
N-nitrosodiphenylamine	ug/Kg	86-30-6	2680	0/6	0				2.8	106.4					NA
Pentachlorophenol	ug/Kg	87-86-5	504	0/6	0				14.5	744					NA
Phenanthrene	ug/Kg	85-01-8	204	1/18	5.56	54.3	54.3	SED-9 08/15/03	1.59	500	54.3	54.3	54.3	2010	0.27
Phenol	ug/Kg	108-95-2	420	0/12	0				5.7	190					NA
Pyrene	ug/Kg	129-00-0	195	1/18	5.56	92.1	92.1	SED-9 08/15/03	1.53	610	92.1	92.1	92.1	2010	0.47
Pyridine	ug/Kg	110-86-1	NA	0/3	0				100.7	318					NA
Volatile Organics															

Table 2. Sediment Ecological Data Screen
Barkhamsted Superfund Site

Parameter	Units	CAS	Screening Value [1]	Detection Frequency	Detection Frequency (%)	Minimum Detect	Maximum Detect	Max Detect Location	Minimum Non-Detect	Maximum Non-Detect	Median	Arithmetic Average	Geometric Mean	Standard Deviation	Hazard Quotient
1,1,1,2-Tetrachloroethane	ug/Kg	630-20-6	NA	0/24	0				0.42	16.8					NA
1,1,1-Trichloroethane	ug/Kg	71-55-6	30.2	0/24	0				0.284	20					NA
1,1,2,2-Tetrachloroethane	ug/Kg	79-34-5	1360	0/24	0				0.51	21.4					NA
1,1,2-Trichloroethane	ug/Kg	79-00-5	1240	0/24	0				0.51	14.2					NA
1,1-Biphenyl	ug/Kg	92-52-4	1220	0/3	0				33.6	106.4					NA
1,1-Dichloroethane	ug/Kg	75-34-3	NA	0/24	0				0.5	17.8					NA
1,1-Dichloroethene	ug/Kg	75-35-4	31	0/24	0				0.5	17.8					NA
1,1-Dichloropropene	ug/Kg	563-58-6	NA	0/24	0				0.284	21.4					NA
1,2,3-Trichlorobenzene	ug/Kg	87-61-6	858	0/24	0				0.44	16					NA
1,2,3-Trichloropropane	ug/Kg	96-18-4	NA	0/24	0				0.42	28.4					NA
1,2,4-Trichlorobenzene	ug/Kg	120-82-1	2100	0/24	0				0.24	37					NA
1,2,4-Trimethylbenzene	ug/Kg	95-63-6	NA	2/24	8.33	2.5	4.3	SED-9 08/15/03	0.78	14.2	3.4	3.4	3.28	1.27	NA
1,2-Dibromo-3-Chloropropane	ug/Kg	96-12-8	NA	0/24	0				2	26					NA
1,2-Dibromoethane	ug/Kg	106-93-4	NA	0/9	0				2	14.2					NA
1,2-Dichlorobenzene	ug/Kg	95-50-1	16.5	0/24	0				0.32	159.4					NA
1,2-Dichloroethane	ug/Kg	107-06-2	NA	0/24	0				0.2	17.8					NA
1,2-Dichloropropane	ug/Kg	78-87-5	NA	0/24	0				0.51	17.8					NA
1,3,5-Trimethylbenzene	ug/Kg	108-67-8	NA	0/24	0				0.26	17.8					NA
1,3-Dichlorobenzene	ug/Kg	541-73-1	4430	0/24	0				0.22	106.4					NA
1,3-Dichloropropane	ug/Kg	142-28-9	NA	0/8	0				0.284	14.2					NA
1,4-Dichlorobenzene	ug/Kg	106-46-7	599	0/24	0				0.58	55.6					NA
1,4-Dioxane	ug/Kg	123-91-1	NA	0/3	0				77.4	394					NA
1-Chlorohexane	ug/Kg	544-10-5	NA	0/3	0				2	10.6					NA
2,2-Dichloropropane	ug/Kg	594-20-7	NA	0/24	0				0.284	17.8					NA
2-Butanone	ug/Kg	78-93-3	NA	2/24	8.33	16	97	SED-3 04/20/05	1.5	220	56.5	56.5	39.4	57.3	NA
2-Chlorotoluene	ug/Kg	95-49-8	NA	0/24	0				0.26	12.6					NA
2-Hexanone	ug/Kg	591-78-6	NA	0/24	0				2	220					NA
4-Chlorotoluene	ug/Kg	106-43-4	NA	0/24	0				0.284	12.6					NA
4-Methyl-2-pentanone	ug/Kg	108-10-1	NA	0/24	0				1.34	186					NA
Acetone	ug/Kg	67-64-1	NA	9/24	37.5	21	1100	SED-3 04/20/05	3.4	400	108	297	152	363	NA
Benzene	ug/Kg	71-43-2	NA	0/24	0				0.2	17.8					NA
Bromobenzene	ug/Kg	108-86-1	NA	0/24	0				0.51	14.2					NA
Bromochloromethane	ug/Kg	74-97-5	NA	0/9	0				2.28	21.4					NA
Bromodichloromethane	ug/Kg	75-27-4	NA	0/9	0				2	17.8					NA
Bromoform	ug/Kg	75-25-2	654	0/24	0				0.284	14.2					NA
Bromomethane	ug/Kg	74-83-9	NA	0/24	0				0.284	28.4					NA
Carbon Disulfide	ug/Kg	75-15-0	0.851	0/3	0				4.2	21.4					NA
Carbon Tetrachloride	ug/Kg	56-23-5	64.2	0/24	0				0.4	18.2					NA
Chlorobenzene	ug/Kg	108-90-7	8.42	0/24	0				0.54	14.2					NA
Chlorobromomethane	ug/Kg	74-97-5	NA	0/15	0				0.3	10.6					NA
Chloroethane	ug/Kg	75-00-3	NA	0/24	0				0.51	28.4					NA
Chloroform	ug/Kg	67-66-3	NA	0/24	0				0.26	17.8					NA
Chloromethane	ug/Kg	74-87-3	NA	0/24	0				0.24	21.4					NA
cis-1,2-Dichloroethene	ug/Kg	156-59-2	NA	0/24	0				0.52	21.4					NA
cis-1,3-Dichloropropene	ug/Kg	10061-01-5	NA	0/24	0				0.51	14.2					NA
Dibromochloromethane	ug/Kg	124-48-1	NA	0/24	0				0.51	14.2					NA
Dibromomethane	ug/Kg	74-95-3	NA	0/24	0				0.42	15.6					NA
Dichlorobromomethane	ug/Kg	75-27-4	NA	0/15	0				0.56	10.6					NA
Dichlorodifluoromethane	ug/Kg	75-71-8	NA	0/3	0				4.2	21.4					NA
Diethyl Ether	ug/Kg	60-29-7	NA	0/3	0				2.8	14.2					NA
Di-isopropyl ether	ug/Kg	108-20-3	NA	0/3	0				2	10.6					NA
Ethyl tertiary-butyl ether	ug/Kg	637-92-3	NA	0/3	0				2	10.6					NA
Ethylbenzene	ug/Kg	100-41-4	1100	1/24	4.17	2.4	2.4	SED-9 08/15/03	0.28	14.2	2.4	2.4	2.4	2010	0.0022
Ethylene Dibromide	ug/Kg	106-93-4	NA	0/15	0				0.52	12.2					NA
Isopropylbenzene	ug/Kg	98-82-8	86	0/24	0				0.62	14.6					NA
m&p-Xylenes	ug/Kg	108-38-3/106-42-3	NA	1/24	4.17	12.4	12.4	SED-9 08/15/03	0.7	26	12.4	12.4	12.4	2010	NA
Methylene Chloride	ug/Kg	75-09-2	NA	0/24	0				0.51	17.8					NA
Methyl-tert-butyl-ether	ug/Kg	1634-04-4	NA	0/24	0				0.4	17.8					NA
n-Butylbenzene	ug/Kg	104-51-8	NA	0/24	0				0.36	15.8					NA
n-Propylbenzene	ug/Kg	103-65-1	NA	0/24	0				0.32	17.8					NA
o-Xylene	ug/Kg	95-47-6	NA	0/21	0				0.54	10.6					NA
p-Isopropyltoluene	ug/Kg	99-87-6	NA	1/24	4.17	19.2	19.2	SED-16 08/14/03	0.32	15.6	19.2	19.2	19.2	2010	NA
sec-Butylbenzene	ug/Kg	135-98-8	NA	0/24	0				0.36	15					NA
Styrene	ug/Kg	100-42-5	559	0/24	0				0.2	10.6					NA
tert-Butylbenzene	ug/Kg	98-06-6	NA	0/24	0				0.42	15.6					NA
Tertiary-amyl methyl ether	ug/Kg	994-05-8	NA	0/3	0				2	10.6					NA
Tetrachloroethene	ug/Kg	127-18-4	468	0/24	0				0.56	15					NA
Tetrahydrofuran	ug/Kg	109-99-9	NA	0/3	0				5.6	28.4					NA
Toluene	ug/Kg	108-88-3	NA	2/24	8.33	2	9	SED-16 08/14/03	0.284	14.2	5.5	5.5	4.24	4.95	NA

Table 2. Sediment Ecological Data Screen
Barkhamsted Superfund Site

Parameter	Units	CAS	Screening Value [1]	Detection Frequency	Detection Frequency (%)	Minimum Detect	Maximum Detect	Max Detect Location	Minimum Non-Detect	Maximum Non-Detect	Median	Arithmetic Average	Geometric Mean	Standard Deviation	Hazard Quotient
trans-1,2-Dichloroethene	ug/Kg	156-60-5	1050	0/24	0				0.284	17.8					NA
trans-1,3-Dichloropropene	ug/Kg	10061-02-6	NA	0/24	0				0.8	14.2					NA
Trichloroethene	ug/Kg	79-01-6	96.9	0/24	0				0.284	17.8					NA
Trichlorofluoromethane	ug/Kg	75-69-4	NA	0/24	0				0.284	21.4					NA
Vinyl Chloride	ug/Kg	75-01-4	NA	0/24	0				0.5	21.4					NA

Notes:
[1] USEPA Region 3 BTAG for freshwater sediment
NA = not applicable

MEMO

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Margaret Gentile and Allen Walker
Arcadis

Date:

October 13, 2017

Arcadis Project No.:

BN012392.2014

Subject:

Monitoring Program for Compliance with Groundwater Remedial Action
Objectives and Proposed Monitoring Plan Revision
Barkhamsted-New Hartford Landfill, Barkhamsted, Connecticut

Arcadis U.S., Inc. (Arcadis) has prepared this memorandum (memo) to define a revised monitoring program for compliance with the groundwater Remedial Action Objectives (RAOs) for the Barkhamsted-New Hartford Landfill in Barkhamsted, New Hartford, Connecticut (Site). The second of two RAOs for groundwater in the Record of Decision (ROD) for the Site is to:

“Restore groundwater beyond the compliance boundary (limits of the landfill) to MCLs or any more stringent CT Remediation Standards (background concentrations), or in their absence, the more stringent of an excess cancer risk of 1×10^{-6} for each substance or a hazard quotient of 1 for each non-carcinogenic substance.”

This memo defines the compliance boundary and identifies a monitoring well network around the perimeter of the landfill for demonstration of compliance with this RAO. This recommendation was presented in the Conclusions and Recommendations section of the Arcadis' December 29, 2016 memo: *“Revised Monitored Natural Attenuation Timeframe to Cleanup Assessment Technical Memorandum”*.

The selected remedy for the Site includes monitored natural attenuation (MNA) for restoration of contaminated groundwater. The United States Environmental Protection Agency (USEPA) directives on the implementation of MNA (USEPA 1999, 2009) provide guidance for defining the point of compliance, citing the National Contingency Program, “remediation levels generally should be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when waste is left in place.”

In the case of a landfill leachate site, waste left in place is considered to be the residual non-regulated organics from leachate. The release of these organics from leachate to groundwater generates reducing conditions and liberates metals such as arsenic and manganese. The reducing conditions are analogous to waste left in place and may persist for relatively long timeframes after the organic constituents of concern (COCs) have attenuated. As such, the definition of the limits of the landfill and waste management area for the purposes of compliance need to recognize the area of residual reducing conditions beyond the edge of the landfill.

Figures 1 and 2 attached present a proposed compliance boundary that considers the limits of the landfill as the footprint of the landfill, as well as a waste management area downgradient of the footprint of the landfill where residual reducing conditions are present as described above. Within this area are monitoring wells where geochemical conditions are reducing and manganese and/or arsenic concentration are predicted to persist, such as: MW-4S, MW-101S, MW-103S, MW-4R, MW-5B, MW-101B. Outside of the compliance boundary, a suite of sentry wells have been designated to demonstrate compliance with the above listed RAO for groundwater, shown on Figures 1 and 2 and listed in Table 1 below. Arsenic and manganese concentrations are less than cleanup criteria in the sentry wells or are anticipated to decline to less than cleanup criteria in the near term. Organic COCs are anticipated to be less than cleanup criteria at the sentry wells by 2017 or shortly thereafter.

Table 1. Proposed Sentry Wells

Location
MW-5S
MW-106S
MW-108S
MW-120S
MW-102B
MW-120B

With regards to remedial objectives and risk to groundwater, the first RAO is:

“Prevent ingestion or dermal contact with groundwater having constituent concentrations exceeding USEPA Safe Drinking Water Act Maximum Contaminant Levels (MCLs), or in their absence, the more stringent of an excess cancer risk of 1×10^{-6} for each substance or a hazard quotient of 1 for each non-carcinogenic substance.”

This first RAO is being achieved as there is no groundwater use on Site, no use of groundwater within the plume and monitoring of potable well water for the three nearby wells (DW-1, DW-2 and DW-3) have indicated that the well water is not affected. In addition:

1. For the four properties owned by the RRDD, Town Garage, MDC and Mr. Timothy Morris, there are Environmental Land Use Restrictions (ELURs) in place to restrict the use of groundwater for drinking or other purposes. The proposed new compliance boundary is within the ELUR areas, so no groundwater use is to occur.

2. The three initial potable water wells and the newer Garage Well included in the sampling program are cross gradient and outside of the plume emanating from the landfill and the landfill plume is shrinking and receding to the landfill. These potable water wells have not been impacted and are not expected to be impacted by the plume.
3. The plume is clearly defined and stable.

Proposed Monitoring Changes and Boundary Revision

As trends develop over time, it is appropriate to revise the sampling program. Based on the long history of sampling since 2003 and Arcadis' December 29, 2016 memo "*Revised Monitored Natural Attenuation Timeframe to Cleanup Assessment Technical Memorandum*", the following revisions to the sampling program are proposed:

1. Implement the proposed revisions to analytes and frequency for the groundwater sampling program provided in Table 2, attached.
2. Remove semi-volatile organic compound (SVOCs) analysis from locations where there have not been detections in the past and that are not positioned immediately downgradient of the locations with detections.
3. Remove sulfide from the sampling program as it has generally not been detected, it is not a COC, but is an indicator for MNA and there are other lines of evidence indicating that MNA is occurring.
4. Reduce the sampling frequency from semi-annual to annual as the long history of sampling indicates the plume is clearly defined, stable, and that several COCs are projected to take considerably longer to achieve cleanup criteria and that annual sampling will still provide sufficient data to monitor and analyze the trends.
5. Surface water, sediment, seep and potable water sampling are also proposed to be annual.

In closing, the sampling program initiated in 2003 has been protective of human health and the environment and will continue to be protective with these modifications.

Attachments:

Figure 1: Revised Compliance Boundary – Overburden

Figure 2: Revised Compliance Boundary – Bedrock

Table 2: Revised Sampling Program

References

United States Environmental Protection Agency (USEPA). 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P. April 21.

USEPA. 2009. Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration. OSWER Directive 9283.1-33. June 26.

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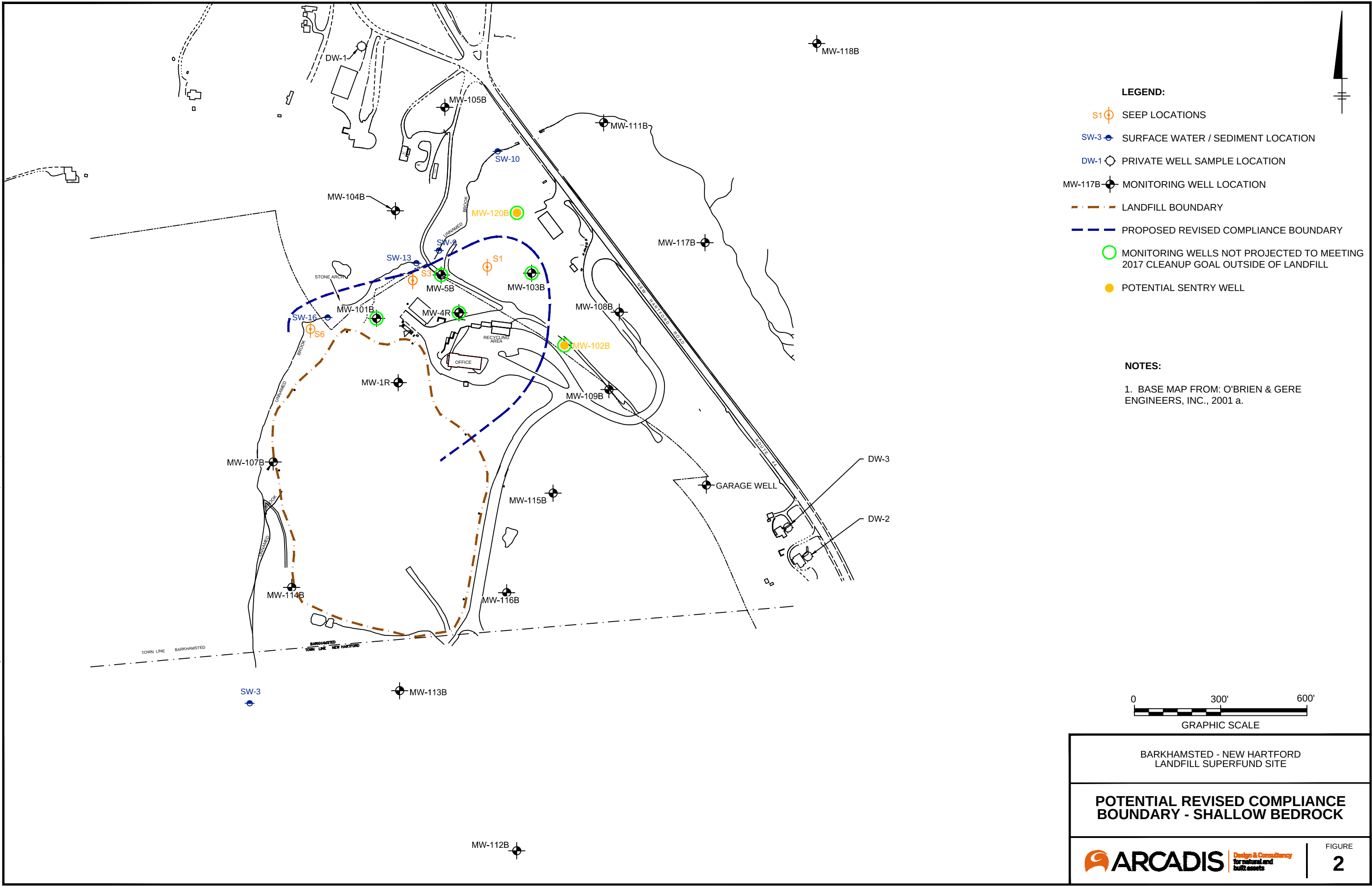


Table 2. Revised Sampling Program

Sample Location	Current Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Initial Rationale	Revised Rationale for 2017
Groundwater Monitoring Wells						
S-3	Semi-Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Well is located in the vicinity of the eastern edge of the overburden ground water plume.	Remove SVOCs, because not detected and not downgradient of detections. Annual sampling sufficient to describe long term trends.
MW-1S*	Semi-Annual	Annual	Detection	VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Well is located in the landfill.	Annual sampling sufficient to describe long term trends.
MW-4S	Semi-Annual	Annual	Detection	VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Well is located in central portion of overburden plume.	Annual sampling sufficient to describe long term trends.
MW-4R	Semi-Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Well is located at western edge of shallow bedrock plume.	Annual sampling sufficient to describe long term trends.
MW-5S*	Semi-Annual	Annual	Performance	MNA Parameters, VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Wells are located at western edge of overburden and shallow bedrock plumes.	Annual sampling sufficient to describe long term trends.
MW-5B*	Semi-Annual Sentry	Annual	Performance	MNA Parameters, VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Wells are located at western edge of overburden and shallow bedrock plumes.	Annual sampling sufficient to describe long term trends.

Table 2. Revised Sampling Program

Sample Location	Current Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Initial Rationale	Revised Rationale for 2017
MW-101S*	Semi-Annual	Annual	Performance	MNA Parameters , VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Wells are located at the western edge of overburden and shallow bedrock plumes.	Annual sampling sufficient to describe long term trends.
MW-101B*	Semi-Annual	Annual	Performance	MNA Parameters , Metals - Total, Landfill leachate indicators	Wells are located at the western edge of overburden and shallow bedrock plumes.	Remove VOCs and SVOCs, because not detected and not downgradient of detections. Annual sampling sufficient to describe long term trends.
MW-101I	not sampled		Detection	N/A	Ground water in intermediate and deep bedrock zones not impacted; monitor for vertical migration.	
MW-101D						
MW-102S*	Annual-fall	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Ground water in overburden not impacted at this location. Well to monitor potential plume migration in eastern direction.	Remove SVOCs, because not detected in well or vicinity. Annual sampling sufficient to describe long term trends.
MW-102B*	Semi-Annual	Annual	Detection Sentry	VOCs, Metals - Total, Landfill leachate indicators	Well is located at eastern edge of shallow bedrock plume.	Remove SVOCs, because not detected in bedrock. Annual sampling sufficient to describe long term trends.

Table 2. Revised Sampling Program

Sample Location	Current Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Initial Rationale	Revised Rationale for 2017
MW-103S*	Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Well is located at eastern edge of overburden plume.	Remove SVOCs, because not detected in well or vicinity Annual sampling sufficient to describe long term trends.
MW-103B*	Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Well is located near the center of the shallow bedrock plume.	Remove SVOCs, because not detected in bedrock Annual sampling sufficient to describe long term trends.
MW-104S	Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Wells are approx. 225 ft northwest of overburden and shallow bedrock plumes. Wells to monitor plume migration in northern direction.	Remove SVOCs, because not detected and not downgradient of detections Annual sampling sufficient to describe long term trends.
MW-104B						
MW-104I	not sampled		Detection	N/A		
MW-106S*	Annual-fall	Annual	Detection Sentry	VOCs, Metals - Total, Landfill leachate indicators	Well is located upgradient, southwest of overburden plume. Well to monitor plume migration in western direction.	Remove SVOCs, because not detected in well or vicinity. Annual sampling sufficient to describe long term trends.
MW-108S	Not Sampled	Annual	Sentry	Manganese		Add sentry well to demonstrate compliance boundary for manganese.
MW-110I	not sampled		Detection	N/A	Well is located at the northeastern edge of the landfill cap.	

Table 2. Revised Sampling Program

Sample Location	Current Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Initial Rationale	Revised Rationale for 2017
MW-111S*	Annual	Annual	Detection	VOCs, Metals - Total, Landfill leachate indicators	Wells are located at downgradient edge of overburden and shallow bedrock plumes. Wells to monitor plume migration in northeastern direction.	Remove SVOCs, because not detected in well or vicinity. Annual sampling sufficient to describe long term trends.
MW-111B*	Semi-Annual	Annual	Detection	MNA Parameters, VOCs, Metals - Total, Landfill leachate indicators		Remove SVOCs, because not detected in bedrock Annual sampling appropriate given lack of detections historically.
MW-111I	Semi-Annual	Annual	Detection	MNA Parameters, VOCs, Metals - Total, Landfill leachate indicators		Remove SVOCs, because not detected in well or vicinity Annual sampling sufficient to describe long term trends.
MW-112S	not sampled not sampled		Ambient	N/A	Wells are located upgradient, south of plume, and represent background data.	
MW-112B						
MW-113S*	Annual in fall		Ambient	MNA Parameters, VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Wells are located upgradient, south of plume, and represent background data.	
MW-113B*						
MW-113I	not sampled		Ambient	N/A		
MW-113D						

Table 2. Revised Sampling Program

Sample Location	Current Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Initial Rationale	Revised Rationale for 2017
MW-115S*	Semi-Annual	Not sampled	Ambient	VOCs, SVOCs, Metals - Total, Landfill leachate indicators	Wells are located southeast of plume, and represent background data.	Not impacted and MW-113 provides background data.
MW-115B*						
MW-120S	Annual	Annual	Detection or Performance Sentry	MNA Parameters, VOCs, SVOCs, Metals – Total, Landfill leachate indicators	Location To Be Determined, likely between MW-5 and MW-117.	
MW-120B (new wells)	Semi-Annual					Annual sampling sufficient to describe long term trends.

Sample Location	Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Rationale
	Surface Water				
SW-3*		Annual - fall	N/A	VOCs SVOCs Metals – Total Hardness Pesticides Landfill leachate indicators	Annual sampling sufficient to describe long term trends. Surface water samples will be obtained at locations where groundwater is discharging to surface water. Sample locations will correspond to locations sampled previously, using the existing designations for those locations
SW-16*		Annual - fall			
SW-9*		Annual - fall			
	Sediment				
SED-3	Every 5 th year in year prior to Five-Year		N/A	VOCs Metals - Total, SVOCs	Sediment samples will be collected in areas underlying surface water sampling points.
SED-16					

Table 2. Revised Sampling Program

Sample Location	Frequency	Proposed Frequency 2017	MNA Monitoring Type	Analytical Parameters	Rationale
SED-9	Review, in fall.			PCBs Pesticides	Changed to every 5 th year as no significant affects.
	Potable Water				
DW-1*		Annual	N/A	VOCs, Acetone, MEK SVOCs, Metals - Total, Landfill leachate indicators	Annual sampling sufficient to describe long term trends and prior impacts have been below criteria. Potable water wells are located at residential/commercial properties.
DW-2*		Annual			
DW-3*		Annual			
Garage Well		Annual			
	Seeps				
S6*	Annually in fall.		N/A	VOCs, SVOCs, Metals - Total, Total sulfate Pesticides	Seep sample locations will correspond to locations sampled previously. Reduced to annual as no significant affects.
S3*					
S1*					

Notes:

- * denotes sample locations specified by the OMM Plan (CTDEP) for the landfill.
- N/A = not applicable.
- Groundwater samples will be collected from different depths based on the well identification as follows:
S = overburden well, B or R = shallow bedrock, I = intermediate bedrock, D = deep bedrock.
- Landfill leachate indicators (per Landfill OMM and amendments) include: alkalinity, ammonia, chemical oxygen demand (COD), chloride, nitrate, total dissolved solids (TDS), total suspended solids (TSS), specific conductivity, hardness, pH and total sulfate.

A P P E N D I X H

Table H-1. Current and 2013 Previous Cancer Toxicity Values - Oral Cancer Slope Factors

				June 2017		May 2013	
Chemical	CAS No.	VOC?	Mutagen?			CSF	Source
Acetone	67-64-1						
Aldrin	309-00-2			1.7E+01	IRIS	1.7E+01	IRIS
Aluminum	7429-90-5						
Ammonia	7664-41-7	*					
Antimony (metallic)	7440-36-0						
Arsenic, Inorganic	7440-38-2			1.5E+00	IRIS	1.5E+00	IRIS
Barium	7440-39-3						
Benzene	71-43-2			5.5E-02	IRIS	5.5E-02	IRIS
Benzoic Acid	65-85-0						
Beryllium and compounds	7440-41-7						
Butylbenzene, n-	104-51-8						
Butylbenzene, sec-	135-98-8						
Chlordane	12789-03-6			3.5E-01	IRIS	3.5E-01	IRIS
Chlorobenzene	108-90-7						
Chloroform	67-66-3			3.1E-02	CalEPA	3.1E-02	CalEPA
Chloromethane	74-87-3			No Value	N/A	No Value	N/A
Chromium(III), Insoluble Salts	16065-83-1						
Chromium (VI)	18540-29-9			5.0E-01	CalEPA	5.0E-01	J
Chromium, Total	7440-47-3						
Cobalt	7440-48-4						
Copper	7440-50-8						
Cresol, m-	108-39-4						
Cresol, o-	95-48-7						
Cresol, p-	106-44-5						
DDD	72-54-8			2.4E-01	IRIS	2.4E-01	IRIS
DDE, p, p	72-55-9			3.4E-01	IRIS	3.4E-01	IRIS
DDT	50-29-3			3.4E-01	IRIS	3.4E-01	IRIS
Dibromochloromethane	124-48-1	Yes		8.40E-02	IRIS	8.4E-02	IRIS
Dichlorobenzene, 1,2-	95-50-1						
Dichlorobenzene, 1,4-	106-46-7			5.4E-03	CalEPA	5.4E-03	CalEPA
Dichloroethane, 1,1-	75-34-3			5.7E-03	CalEPA	5.7E-03	CalEPA
Dichloroethane, 1,2-	107-06-2			9.1E-02	IRIS	9.1E-02	IRIS
Dichloroethylene, 1,2-cis-	156-59-2						
Dichloropropane, 1,2-	78-87-5	Yes		3.7E-02	PPRTV	3.6E-02	CalEPA
Dimethylphenol, 2,4-	105-67-9						
Endrin	72-20-8						
Ethyl Chloride	75-00-3			No Value	N/A	No Value	N/A
Ethylbenzene	100-41-4						
Hexachlorocyclohexane, Alpha-	319-84-6			6.3E+00	IRIS	6.3E+00	IRIS
Hexachlorocyclohexane, Beta-	319-85-7			1.8E+00	IRIS	1.8E+00	IRIS
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9			1.1E+00	CalEPA	1.1E+00	CalEPA
Iron	7439-89-6						
~Lead and Compounds	7439-92-1						
Manganese (Diet)	7439-96-5						
Manganese (Non-diet)	7439-96-5						
~Mercury (elemental)	7439-97-6	Yes					
Methoxychlor	72-43-5						
Methyl Ethyl Ketone (2-Butanone)	78-93-3	Yes					
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	Yes					
Methyl-tert Butyl Ether (MTBE)	1634-04-4	Yes		1.8E-03	CalEPA	1.8E-03	CalEPA
Methylene Chloride	75-09-2	Yes	Yes	2.0E-03	IRIS	2.0E-03	IRIS
Nickel Soluble Salts	7440-02-0						
Nitrate	14797-55-8						
Phenol	108-95-2						
~Bis(2-ethylhexyl)phthalate	117-81-7			1.4E-02	IRIS	1.4E-02	IRIS
~Diethyl Phthalate	84-66-2						
~Octyl Phthalate, di-N-	117-84-0						
~Methylnaphthalene, 2-	91-57-6	Yes					
~Naphthalene	91-20-3	Yes					
Propyl benzene	103-65-1	Yes					
Selenium	7782-49-2						
Silver	7440-22-4						
Tetrachloroethylene	127-18-4	Yes		2.1E-03	IRIS	2.1E-03	IRIS
Thallium (Soluble Salts)	7440-28-0						
Toluene	108-88-3	Yes					
Trichloroethylene	79-01-6	Yes	Yes	4.6E-02	IRIS	4.6E-02	IRIS
Trimethylbenzene, 1,2,4-	95-63-6	Yes					

Table H-1. Current and 2013 Previous Cancer Toxicity Values - Oral Cancer Slope Factors							
				June 2017		May 2013	
Chemical	CAS No.	VOC?	Mutagen?			CSF	Source
Trimethylbenzene, 1,3,5-	108-67-8	Yes					
Vanadium and Compounds	7440-62-2						
Vinyl chloride	75-01-4	Yes	Yes	7.2E-01	IRIS	<u>7.2E-01</u>	<u>IRIS</u>
Xylene, P-	106-42-3	Yes					
Xylene, m-	108-38-3	Yes					
Xylene, o-	95-47-6	Yes					
Xylenes	1330-20-7	Yes					
Zinc and Compounds	7440-66-6						

Notes:

Values for June 2017 and May 2013 are as found in the EPA Regional Screening Levels tables for each month/year reported.

Highlighted cells indicate a constituent with year-to-year varying entries.

Bolded entries indicate the chemical is classified as a volatile organic compound (VOC).

Underlined entries indicate the chemical is classified as a mutagen.

If an entry is neither bolded nor underlined it was not classified as either a VOC or mutagen, respectively, that year.

* Indicates the chemical was classified as a VOC or mutagen at one time but is not currently classified as a VOC or mutagen based on the June 2017 Regional Screening Levels table.

- A = ASTDR
- CalEPA = California Environmental Protection Agency
- E or N = Environmental Criteria and Assessment Office (formerly National Center for Environmental Assessment)
- H = HEAST
- IRIS = Integrated Risk Information System
- J = New Jersey
- N/A = Not applicable
- New York = New York State Department of Environmental Conservation
- O = Other
- OPP = Office of Pesticide Program
- PPRTV = Provisional Peer Reviewed Toxicity Values
- R = Route Extrapolation
- S = See RSL User's Guide
- W = World Health Organization
- X = Appendix PPRTV Screen

Table H-2. Current and 2013 Previous Non-Cancer Toxicity Values - Oral Reference Doses

				June 2017		May 2013	
Chemical	CAS No.	VOC?	Mutagen?			RfD	Source
Acetone	67-64-1			9.0E-01	IRIS	9.0E-01	IRIS
Aldrin	309-00-2			3.0E-05	IRIS	3.0E-05	IRIS
Aluminum	7429-90-5			1.0E+00	PPRTV	1.0E+00	PPRTV
Ammonia	7664-41-7						
Antimony (metallic)	7440-36-0			4.0E-04	IRIS	4.0E-04	IRIS
Arsenic, Inorganic	7440-38-2			3.0E-04	IRIS	3.0E-04	IRIS
Barium	7440-39-3			2.0E-01	IRIS	2.0E-01	IRIS
Benzene	71-43-2			4.0E-03	IRIS	4.0E-03	IRIS
Benzoic Acid	65-85-0			4.0E+00	IRIS	4.0E+00	IRIS
Beryllium and compounds	7440-41-7			2.0E-03	IRIS	2.0E-03	IRIS
Butylbenzene, n-	104-51-8			5.0E-02	PPRTV	5.0E-02	PPRTV
Butylbenzene, sec-	135-98-8			1.0E-01	X	1.0E-01	X
Chlordane	12789-03-6			5.0E-04	IRIS	5.0E-04	IRIS
Chlorobenzene	108-90-7			2.0E-02	IRIS	2.0E-02	IRIS
Chloroform	67-66-3			1.0E-02	IRIS	1.0E-02	IRIS
Chloromethane (methyl chloride)	74-87-3			No value	N/A	No value	N/A
Chromium(III), Insoluble Salts	16065-83-1			1.5E+00	IRIS	1.5E+00	IRIS
Chromium(VI)	18540-29-9			3.0E-03	IRIS	3.0E-03	IRIS
Chromium, Total	7440-47-3						
Cobalt	7440-48-4			3.0E-04	PPRTV	3.0E-04	PPRTV
Copper	7440-50-8			4.0E-02	H	4.0E-02	H
Cresol, m-	108-39-4			5.0E-02	IRIS	5.0E-02	IRIS
Cresol, o-	95-48-7			5.0E-02	IRIS	5.0E-02	IRIS
Cresol, p-	106-44-5			1.0E-01	A	1.0E-01	A
DDE, p,p'-	72-55-9						
DDT	50-29-3			5.0E-04	IRIS	5.0E-04	IRIS
Dibromochloromethane	124-48-1	Yes		2.0E-02	IRIS	2.0E-02	IRIS
Dichlorobenzene, 1,2-	106-37-6			9.0E-02	IRIS	9.0E-02	IRIS
Dichlorobenzene, 1,4-	106-46-7			7.0E-02	A	7.0E-02	A
Dichloroethane, 1,1-	75-34-3			2.0E-01	PPRTV	2.0E-01	PPRTV
Dichloroethane, 1,2-	107-06-2			6.0E-03	X	6.0E-03	X
Dichloroethylene, 1,2-cis-	156-59-2			2.0E-03	IRIS	2.0E-03	IRIS
Dichloropropane, 1,2-	78-87-5	Yes		4.0E-02	PPRTV	9.0E-02	A
Dimethylphenol, 2,4-	105-67-9			2.0E-02	IRIS	2.0E-02	IRIS
Endrin	72-20-8			3.0E-04	IRIS	3.0E-04	IRIS
Ethylbenzene	100-41-4			1.0E-01	IRIS	1.0E-01	IRIS
Hexachlorocyclohexane, Alpha-	319-84-6			8.0E-03	A	8.0E-03	A
Hexachlorocyclohexane, Beta-	319-85-7			No value	N/A	No value	N/A
Hexachlorocyclohexane, Gamma- (Lindane)	58-89-9			3.0E-04	IRIS	3.0E-04	IRIS
Iron	7439-89-6			7.0E-01	PPRTV	7.0E-01	PPRTV
~Lead and Compounds	7439-92-1						
Manganese (Diet)	7439-96-4			1.4E-01	IRIS	1.4E-01	IRIS
Manganese (Non-diet)	7439-96-5			2.4E-02	S	2.4E-02	S
~Mercuric Chloride (and other Mercury salts)	7487-94-7			3.0E-04	IRIS	3.0E-04	IRIS
~Mercury (elemental)	7439-97-6	Yes		No value	N/A	No value	N/A
~Mercury, Inorganic Salts	N/A			No value	N/A	No value	N/A
Methoxychlor	72-43-5			5.0E-03	IRIS	5.0E-03	IRIS
Methyl Ethyl Ketone (2-Butanone)	78-93-3	Yes		6.0E-01	IRIS	6.0E-01	IRIS
Methyl Isobutyl Ketone (4-methyl-2-pentanone)	108-10-1	Yes		No Value	N/A	8.0E-02	H
Methyl tertbutyl ether (MTBE)	1634-04-4	Yes		No value	N/A	No value	N/A
Methylene Chloride	75-09-2	Yes	Yes	6.0E-03	IRIS	6.0E-03	IRIS
Nickel Soluble Salts	7440-02-0			2.0E-02	IRIS	2.0E-02	IRIS
Nitrate	14797-55-8			1.6E+00	IRIS	1.6E+00	IRIS
Phenol	108-95-2			3.0E-01	IRIS	3.0E-01	IRIS
~Bis(2-ethylhexyl)phthalate	117-81-7			2.0E-02	IRIS	2.0E-02	IRIS
~Diethyl Phthalate	84-66-2			8.0E-01	IRIS	8.0E-01	IRIS
~Octyl Phthalate, di-N-	117-84-0			1.0E-02	PPRTV	1.0E-02	PPRTV
~Methylnaphthalene, 2-	91-57-6	Yes		4.0E-03	IRIS	4.0E-03	IRIS
~Naphthalene	91-20-3	Yes		2.0E-02	IRIS	2.0E-02	IRIS
Propyl benzene	103-65-1	Yes		1.0E-01	X	1.0E-01	X
Selenium	7782-49-2			5.0E-03	IRIS	5.0E-03	IRIS
Silver	7440-22-4			5.0E-03	IRIS	5.0E-03	IRIS
Tetrachloroethylene	127-18-4	Yes		6.0E-03	IRIS	6.0E-03	IRIS

Table H-2. Current and 2013 Previous Non-Cancer Toxicity Values - Oral Reference Doses

				June 2017		May 2013	
Chemical	CAS No.	VOC?	Mutagen?			RfD	Source
Thallium (Soluble Salts)	7440-28-0			1.0E-05	X	1.0E-05	X
Toluene	108-88-3	Yes		8.0E-02	IRIS	8.0E-02	IRIS
Trichloroethylene	79-01-6	Yes	Yes	<u>5.0E-04</u>	<u>IRIS</u>	<u>5.0E-04</u>	<u>IRIS</u>
Trimethylbenzene, 1,2,4-	95-63-6	Yes		No Value	N/A	No Value	N/A
Trimethylbenzene, 1,3,5-	108-67-8	Yes		1.0E-02	IRIS	1.0E-02	X
Vanadium and Compounds	N/A			5.0E-03	S	5.0E-03	S
Vinyl Chloride	75-01-4	Yes	Yes	<u>3.0E-03</u>	<u>IRIS</u>	<u>3.0E-03</u>	<u>IRIS</u>
Xylene, P-	106-42-3	Yes		2.0E-01	S	2.0E-01	S
Xylene, m-	108-38-3	Yes		2.0E-01	S	2.0E-01	S
Xylene, o-	95-47-6	Yes		2.0E-01	S	2.0E-01	S
Xylenes	1330-20-7	Yes		2.0E-01	IRIS	2.0E-01	IRIS
Zinc and Compounds	7440-66-6			3.0E-01	IRIS	3.0E-01	IRIS

Notes:

Values for June 2017 and May 2013 are as found in the EPA Regional Screening Levels tables for each month/year reported.

1: Contaminant removed from RSL table.

Highlighted cells indicate a constituent with year-to-year varying entries.

Bolded entries indicate the chemical is classified as a volatile organic compound (VOC).

Underlined entries indicate the chemical is classified as a mutagen.

If an entry is neither bolded nor underlined it was not classified as either a VOC or mutagen, respectively, that year.

* Indicates the chemical was classified as a VOC or mutagen at one time but is not currently classified as a VOC or mutagen based on the June 2017 Regional Screening Levels table.

A = ASTDR

CalEPA = California Environmental Protection Agency

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