SECOND FIVE-YEAR REVIEW REPORT FOR ROSE HILL REGIONAL LANDFILL SUPERFUND SITE WASHINGTON COUNTY SOUTH KINGSTOWN, RHODE ISLAND

PREPARED BY:

U.S. Environmental Protection Agency
Region 1
BOSTON, MASSACHUSETTS

with support from

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Date:

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LIST OF ACRONYMS AND ABBREVIATIONS

AGQS	Ambient Groundwater Quality Standard
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
BWA	Bulky Waste Area
CA	Cooperative Agreement
CDN	composite drainage net
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
CRP	Community Relations Plan
CRSP	Community Relations Support Plan
1,1-DCA	1,1-dichloroethane
1,1,1-DCE	1,1,1-dichloroethylene
DNAPL	dense non-aqueous phase liquid
DQO	Data Quality Objectives
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five-Year Review
GCL	geosynthetic clay liner
gpm	gallons per minute
ICs	Institutional Controls
IDL	Instrument Detection Limit
LEL	Lower Explosive Limit
LLDPE	low linear density polyethylene
LTM	Long Term Monitoring Plan
Louis Berger	The Louis Berger Group, Inc.
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
NA	Not Applicable
ND	None Detected
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration

OSWER	Office of Solid Waste and Emergency Response
OU1	Operable Unit 1
PAH	polyaromatic hydrocarbon
PAL	Project Action Limit
PCBs	polychlorinated biphenyl
PCE	tetrachloroethene
PEL	Permissible Exposure Limit
ppb	parts per billion
PQL	Project Quantitation Limit
PQO	Project Quality Objective
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limit
RA	Remedial Action
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RIDEM	Rhode Island Department of Environmental Management
RIDOH	Rhode Island Department of Health
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
scfm	standard cubic feet per minute
Site	Rose Hill Landfill Superfund site
SSA	Sewage Sludge Area
SVOCs	semi-volatile organic compounds
SWA	Solid Waste Area
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
TMDL	Total Maximum Daily Load
TPH	total petroleum hydrocarbons
VI	vapor intrusion
VOCs	volatile organic compounds
WQC	National Recommended Water Quality Criteria

EXECUTIVE SUMMARY

This is the second Five-Year Review (FYR) for the Rose Hill Landfill Superfund (Site) located in South Kingstown, Washington County, Rhode Island. The purpose of this FYR is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory FYR was the signing of the previous FYR on 8/25/2010.

The Site is located within the Town of South Kingstown, Rhode Island in the village of Peace Dale, all of which are part of Washington County. The Site is bordered by Rose Hill Road to the west, the Saugatucket River to the east and residential private property to the north and south.

The Site encompasses approximately 70 acres, and includes an active solid waste transfer facility zoned as public land; a small area of land zoned for commercial use along Transfer Station Road; and privately owned land which was either formerly used for sand and gravel mining and/or waste disposal, or has remained undeveloped. Land use within one mile of the Site is predominantly agricultural and residential.

Two primary surface water bodies, the Saugatucket River and Mitchell Brook, flow through the Site. An unnamed brook, west of the Site, flows into the Saugatucket River and an unnamed tributary, in the northern portion of the Site, flows into Mitchell Brook. Both Mitchell Brook and the Saugatucket River are classified by the State of Rhode Island as Class B water bodies, designated for fish consumption, aquatic life, and recreational contact (swimming and boating) uses. Wetland and flood plain habitats are also found adjacent to the disposal areas and are subject to runoff and contamination from the disposal areas.

The Record of Decision (ROD) for the Site was signed on December 20, 1999. The ROD describes the first operable unit (OU-1) of a phased approach to remediate contamination caused by the Site, consisting of a source control remedy that will prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. An Explanation of Significant Differences (ESD) was issued on September 2008 documenting modifications to the remedy involving principally the gas collection and thermal destruction system proposed in the ROD. The ROD called for consolidation of waste from the Bulky Waste Area into the Solid Waste Area, containment, leachate collection and treatment (during consolidation), and landfill gas treatment (Solid Waste Area).

A Consent Decree (CD) to perform the Remedial Design/Remedial Action (RD/RA) for OU-1 was entered by the District Court in March 2003. The settlement required the potentially responsible parties, the towns of South Kingstown and Narragansett, RI, to design, construct, and perform operation and maintenance of the remedy,

A Site-specific Cooperative Agreement (CA) was initiated on May 28, 2004 and the State of Rhode Island Department of Environmental Management, Office of Waste Management (RIDEM/OWM) took the lead for oversight of the remedy design and construction. Notice to Proceed for Phase I (consolidation) project construction was issued on April 27, 2005. The consolidation phase was completed in March 29, 2006, and the capping phase (Phase II), which began on September 25, 2006, was completed on September 25, 2007.

The findings of the Second Five Year Review are summarized in the following form.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Rose Hill Regional Landfill		
EPA ID: RID980521025		
Region: 1	**State:** RI	**City/County:** South Kingstown / Washington County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA, Region 1		
Author name (Federal or State Project Manager): David J. Newton; Gary Jablonski		
Author affiliation: U.S. EPA Region I (Lead); Rhode Island Department of Environmental Management, Office of Waste Management (Support); with technical support from The Louis Berger Group, Inc.		
Review period: 8/5/2014 – 8/31/2015		
Date of site inspection: 4/10/2015		
Type of review: Statutory		
Review number: 2		
Triggering action date: 8/25/2010		
Due date ***(five years after triggering action date)*****:** 8/25/2015		

Five-Year Review Summary Form (continued)

Issues and Recommendations Identified in the Five-Year Review:

OU(s): *1*	**Issue Category: Institutional Controls**			
	Issue: Institutional Controls are recorded for all town-controlled property and two private parcels; but are not in place for all identified private property potentially affected by the Site.			
	Recommendation All ICs are to be completed by the Town of South Kingstown.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	Town of South Kingstown	EPA	6/1/2016

OU(s): *1*	**Issue Category: Operations and Maintenance**			
	Issue: Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits when the existing gas flare is not operational. Potential for vapor intrusion, while not posing an unacceptable risk based on available information, remains as a potential threat.			
	Recommendation: Ensure that the landfill gas flare is operated and maintained for continuous active management of landfill gases.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	RIDEM and Towns	EPA	8/1/2020

OU(s): *1*	**Issue Category: Monitoring**
	Issue: Modify the Long-Term Monitoring Program, as needed, to collect sufficient information to determine if the management of migration of contaminants from the Site is effective and collect sufficient data necessary to support a decision document concerning a final groundwater and surface water remedy, if needed.
	Recommendation: Continue Long-Term Monitoring (LTM) program in its present form, with continued landfill gas monitoring, bi-annual groundwater and surface water monitoring. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analyses. The goal of the LTM program is to collect

	the data necessary to support an OU 2 decision document concerning a final MOM remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	RIDEM and Towns	EPA	8/1/2020

Protectiveness Statement(s)

Operable Unit:	*Protectiveness Determination:*
1	Short-term Protective

Protectiveness Statement:
The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste and disturbance of the landfill cap; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands, and surface water bodies; 3) the landfill cap, gas extraction system, and the landfill gas flare is capturing and treating landfill gases to prevent unacceptable exposures beyond the Site boundary; and 4) properties at and surrounding the Site are connected to an alternate water supply to prevent use of groundwater at the Site. However, the remedy cannot be deemed protective in the long term until the following actions are taken: 1) institutional controls are fully implemented; 2) active landfill gas management remains in continued operation unless recurrent monitoring and modeling data indicate that the passive gas venting system can be reinstituted; and 3) the assessment of monitoring results from the Long-Term Monitoring Work Plan are sufficient to support a future and final OU 2 remedy decision for groundwater and surface water, and if further warranted, implementation of the remedy to address the management of migration of contaminants from the Site.

Sitewide Protectiveness Statement

Protectiveness Determination:
Short-term Protective

Protectiveness Statement:
The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste and disturbance of the landfill cap; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands, and surface water bodies; 3) the landfill cap, gas extraction system, and the landfill gas flare is capturing and treating landfill gases to prevent unacceptable exposures beyond the Site boundary; and 4) properties at and surrounding the Site are connected to an alternate water supply to prevent use of groundwater at the Site. However, in order for the remedy to

be protective in the long term the following actions need to be taken: 1) institutional controls are fully implemented; 2) active landfill gas management remains in continued operation unless recurrent monitoring and modeling data indicate that the passive gas venting system can be reinstituted; 3) the assessment of monitoring results from the Long-Term Monitoring Work Plan are sufficient to support a future and final OU 2 remedy decision for groundwater and surface water, and if further warranted, implementation of the remedy to address the management of migration of contaminants from the Site.

I. INTRODUCTION

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

The U.S. Environmental Protection Agency (EPA) prepares FYRs pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Contingency Plan (NCP). CERCLA 121 states:

> *"If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews."*

EPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which states:

> *"If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such actions no less often than every five years after the initiation of the selected remedial action."*

EPA conducted this FYR on the remedy implemented at the Rose Hill Regional Landfill Superfund Site in South Kingstown, Washington County, Rhode Island. EPA is the lead agency for developing and implementing the remedy for the Site. Rhode Island Department of Environmental Management (RIDEM), as the support agency representing the State of Rhode Island, has reviewed all supporting documentation and provided input to EPA during this FYR process.

This is the second FYR for the Rose Hill Regional Landfill Superfund Site. The triggering action for this statutory review is the completion date of the previous FYR. The FYR is required due to the fact that hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. The Site consists of one Operable Unit with a source control remedy, which is addressed in this FYR.

II. PROGRESS SINCE THE LAST REVIEW

Table 1: Protectiveness Determinations/Statements from the 2010 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Short-term Protective	The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands and surface water bodies; and 3) the landfill cap, gas extraction system, and the pilot flare is capturing and treating landfill gases to prevent exposures beyond the Site boundary. However, in order for the remedy to be protective in the long-term, the following actions need to be taken: 1) institutional controls are fully implemented; 2) a decision is rendered concerning active vs. passive landfill gas management based on the ongoing pilot study, continued monitoring and modeling data. If the passive gas venting system is reinstituted, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, in order for the remedy to be deemed protective in the long-term; and 3) management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional studies that are deemed necessary in order to further assess Site impacts. Thus the Long-Term Monitoring Work Plan should continue to be implemented to continue to evaluate contaminant trends.

Table 2: Status of Recommendations from the 2010 FYR

OU #	Issue	Recommendations / Follow-up Actions	Party Responsible	Oversight Party	Original Milestone Date	Current Status	Completion Date (if applicable)
1	Institutional Controls (ICs) are planned but not in place. However, IC documents have been prepared by the Town of South Kingstown and progress is being made to implement these in accordance with the	ICs are to be completed by the Town of South Kingstown in accordance with the current plan and schedule as outlined in the First Five Year Review Report.	Town of South Kingstown	RIDEM/EPA	7/31/2011	Ongoing	

	current IC program.						
1	Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits. Potential for vapor intrusion, while not posing an unacceptable risk based on currently available information, remains as a potential threat and requires further assessment.	Continue active landfill gas pilot study and make a decision within one year concerning active versus passive landfill gas management based on ongoing flare pilot studies, continued monitoring and modeling data. Implementation of the landfill gas pilot study has demonstrated that the active gas collection system can essentially eliminate westward landfill gas migration off-site. If the passive gas venting system is reinstated, the gas probes and the passive venting system must continue to be monitored at the current frequency, at a minimum, until it is known that the threat of gas migration and/or the potential for vapor intrusion is diminished to a level which no longer constitutes a concern.	RIDEM and Towns	EPA	2/27/2011	Complet ed	3/1/2011
1	Management of the migration of contaminants from the Site continues to be based upon data obtained from the first operable unit and any additional	The Long-Term Monitoring Work Plan should continue in its present form, with continued landfill gas monitoring, bi-annual groundwater and surface water monitoring, and annual habitat	RIDEM and Towns	EPA	8/10/2015	Ongoing	Ongoing

	studies that are deemed necessary in order to further assess Site impacts.	assessment and bio-monitoring. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analyses.					

With regard to the first issue/recommendation (above), the Town of South Kingstown has made considerable progress in that town-owned property ICs are recorded. Land uses and changes in ownership of private land, among other factors, have inhibited progress on completing IC work for all identified properties. With regard to the third issue/recommendation (above), periodic monitoring has continued over the period, however additional environmental analysis is needed to further assess Site impacts and address potential management of migration issues. Thus, in each of these cases, expected dates for completing these tasks have been extended accordingly.

Remedy Implementation Activities

Since the first FYR, remedy activities have included periodic site inspections, the installation and operation of an active landfill gas treatment system (flare), periodic monitoring of landfill gas, ground water and surface water, and performing a habitat assessment and biomonitoring study in portions of the Saugatucket River and Mitchell Brook immediately adjacent to the source areas. The Town of South Kingstown has also completed ICs on all town-owned parcels and two private properties. Table 3 below identifies the current status for the properties needing ICs.

Table 3: Summary of Planned and/or Implemented ICs

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	Title of IC Instrument Implemented and Date (or planned)
Groundwater and soils	Yes	Yes	See Appendix D for list of parcels	Use restriction (restrict installation of ground water wells and ground water use).	Declaration of Covenants and Environmental Protection/Conservation and Access Easement

System Operation/Operation and Maintenance Activities

Operation and Maintenance (O & M) activities performed by the Town (South Kingstown) to date have included, the cutting of vegetation in SWA every fall; removal of woody growth;

repair and backfilling of critter burrow holes in top of landfill cap; fence repair; and maintenance/reporting of methane meters at two homes (on-going). Potential future O&M activities over the long term may include fence and gate repair (as needed); access road rut repair (as needed); occasional maintenance of the downchute, swales, culverts, and pond spillway; cutting of vegetation in SWA in the fall; and maintenance/reporting of methane meters at two homes. The Town also cuts back vegetation along the fence line as needed to prevent vegetative growth from damaging the fence.

Operation and Maintenance (O & M) activities performed by RIDEM include overseeing operation and conducting routine maintenance on the landfill gas flare. Operations include checking landfill gas flow, monitoring landfill gas quality, periodically adjusting the valves which control landfill gas flow to the flare and other routine inspection of the gas flare. This work is performed throughout the year under contract to Louis Berger Group, Inc.

III. FIVE-YEAR REVIEW PROCESS

Administrative Components

The Rose Hill Regional Landfill Superfund Site Five-Year Review was led by David J. Newton of the U.S. EPA, Remedial Project Manager for the Site and Sarah White of the U.S. EPA, the Community Involvement Coordinator (CIC). Gary Jablonski, of the Rhode Island Department of Environmental Management (RIDEM), assisted in the review as the representative for the support agency.

The review, which began on 8/5/2014, consisted of the following components:

- Community Notification and Involvement;
- Document Review;
- Data Review;
- Site Inspection and Interviews; and
- Five-Year Review Report Development and Review.

Community Notification and Involvement

Activities to involve the community in the five-year review process were initiated with a meeting in February 2015 between the RPM and CIC for the Site. A notice was published in the local newspaper, the Narragansett Times and South County Independent on March 4, 2015, stating that there was a five-year review and inviting the public to submit any comments to the U.S. EPA. The results of the review and the FYR report will be made available at the Site information repository located at the South Kingstown Public Library at 1057 Kingstown Road, Wakefield, RI, and the EPA OSRR Records and Information Center, 1st Floor, 5 Post Office Square, Suite 100, Boston, MA. EPA maintains a website at **http://www.epa.gov/region1/superfund/sites/rosehill** which provides the Site status, past assessments, cleanup activity and numerous other Site-specific documents.

Document Review

This five-year review consisted of a review of relevant documents including O&M records and annual monitoring data. Groundwater, surface water, and landfill gas Project Action Limits (PALs) were established, as required in the December 1999 Record of Decision and September 2008 ESD (and modified as necessary) to provide a check that the remedy is functioning as designed. These were also reviewed.

Data Review

EPA's ROD defined the selected remedy as a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. This decision is also the first operable unit remedy of a phased clean up approach.

As such, no cleanup levels were established under this remedy; instead the remedy will meet the performance standards set out in the 1999 ROD. This first operable unit source control remedy will meet all ARARs including those for Site air emissions, landfill closure, and any process water discharge or reinjection. Management of the migration of contaminants from the Site will be addressed in a future (OU 2) decision document, based upon data obtained from monitoring conducted under the first operable unit, and any additional studies that are deemed necessary to further assess Site impacts, characterize the extent of contamination, and to evaluate contaminant trends to support a future and final OU 2 decision document (for groundwater and surface water).

Data collected during the RI/FS, pre-design investigation, and post-closure were reviewed for this second five year review period from 2010-2015. A discussion of analytical results for groundwater, surface water, landfill gas, soil, sediment, and leachate is presented below.

Project Action Limits

In complying with applicable or relevant and appropriate requirements (ARARs) and other requirements for the Site, Project Action Limits (PALs) were established for environmental monitoring of the various media sampled at the Site as described in various documents including:

- Berger's 2003 Quality Assurance Project Plan (QAPP) for the Remedial Design;
- A 2005 QAPP prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the Remedial Action; and
- Berger's 2008 QAPP prepared for the LTM Work Plan, as appropriately amended.
- Berger's 2011 QAPP prepared for the LTM Work Plan, as appropriately amended.

As stated in these QAPPs, the intent of the PALs is not to supersede the risk assessment or remedial action objective processes which are integral parts of developing cleanup standards for the Site, but to provide a check that the data produced will meet Project Quality Objectives for the contaminants of concern (COCs).

The PALs for groundwater were based on EPA drinking water standards (e.g., Maximum Contaminant Levels (MCLs) for drinking water) and EPA Regional Screening Levels. In 2001 EPA adopted a new standard for arsenic in drinking water of 10 parts per billion (ppb), replacing the old standard of 50 ppb. Public water systems were required to comply with the updated standard by January 23, 2006. The PAL for arsenic in groundwater at the Site is 10 micrograms per liter (μg/l), equivalent to 10 ppb by volume.

Following its review of the vapor intrusion analysis in the First Five Year Review, EPA recommended that the laboratory detection limit for vinyl chloride be lowered so that the data can be evaluated at the appropriate risk-based screening concentration. A 0.145 ug/l detection limit, which corresponds with the 10^{-6} cancer risk, was used by EPA Region 1 as described in its

2002 *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*[1].

The 2011 QAPP states that PALs for surface water were based on RIDEM Ambient Water Quality Criteria (AWQC) and EPA National Recommended Water Quality Criteria (NRWQC, 1999). The Rhode Island Water Quality Regulations include all the federal aquatic life and human health water quality criteria and those criteria are to be used when evaluating waters of the state.

Since NRWQC and AWQC were not available for all analytes and since other more rigorous criteria for some COCs have been established, some PALs were based on other standards (e.g., the PAL for Manganese is based on the 2008 EPA Drinking Water Advisory).

In 2010, RIDEM's Office of Water Resources raised questions about some of the PALs being used for metals in surface water, and their protectiveness with respect to RIDEM's chronic and acute freshwater criteria. Following discussion with RIDEM, Berger prepared new PALs for some surface water metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) and recommended an update to the QAPP following completion of the Five Year Review to reflect the new PALs and identify the source of each PAL. As indicated above, the 2008 QAPP was updated in March 2011 to reflect the revised PALs.

Table 4 provides the previous and revised PALs in the 2011 QAPP for metals in surface water. No other PALs for surface water or other environmental media have changed since the 2008 QAPP. The data review in this Five-Year Review Report compares surface water metals data to the PALs that were revised in the 2011 QAPP.

Further, the following laboratory Quantitation Limits (QL) described in the QAPPs would have to be made more stringent to meet RIDEM guidance as described in its Summary Guidance for Reviewing Environmental Monitoring Data (2007):

- Cadmium (from 5 to 1.0 μg/l);
- Copper (from 10 to 1.0 μg/l);
- Lead (from 10 to 1.0 μg/l); and
- Zinc (from 10 to 2.5 μg/l).

The laboratory was unable to lower the QL for zinc (reporting limit is 5 μg/l), but met the more stringent 2007 RIDEM guidance QLs for the other metals.

PALs for landfill gas are based on RIDEM Air Pollution Control Regulation No. 22 for Air Toxics. This regulation was enacted in 1988, amended in 2004, and again amended in 2008. The 2008 amendment, published after the 2008 QAPP, included the addition of one chemical, n-propyl bromide, to the list of regulated substances. N-propyl bromide is not one of the COCs

[1] This Guidance has been updated in 2015 and risk-based screening concentrations will be revised, as necessary. (http://www.epa.gov/oswer/vaporintrusion/guidance.html#EO12866OSWERVI).

monitored in landfill gas at the Site, and it is not recommended that it be added to the list of analytes at the Site as its primary uses are not consistent with wastes disposed of at the Site.

Table 4: Revised Project Action Limits (PALs) for Metals in Surface Water

Analyte	2003 QAPP (µg/l)	2008 QAPP (µg/l)	2011 QAPP (µg/l)
Aluminum	87	87	87
Arsenic	50	150	150
Dissolved Cadmium	18	18	0.07
Dissolved Chromium III	10	11	16
Dissolved Copper	1,300	1,300	1.77
Total Iron	50	1,000	1,000
Dissolved Lead	15	15	0.3
Manganese	500	300	300
Dissolved Mercury	0.0122	0.77	0.77
Dissolved Nickel	4,600	4,600	10.4
Dissolved Silver	100	100	0.13
Dissolved Zinc	5,000	5,000	24

Notes:
µg /l – micrograms per liter
NE – none established

Summary of Environmental Monitoring

As part of the work conducted in advance of the RD, Berger conducted four quarterly rounds of environmental sampling in 2003-2004. The purpose of the sampling was to provide an updated baseline of environmental sampling prior to initiating the source control remedy, as described in Phases I and II of the RA Report (Berger, 2008). In addition to the environmental sampling conducted by Berger during the RA, MACTEC conducted one round of sampling in 2006 between Phases I and II of the RA. The purpose of the sampling was to document any potential impact (positive or negative) associated with Phase I construction activities.

During the RD, Berger completed a Field Investigation Summary Report (August 2004) that summarized the results of the 2003-2004 quarterly monitoring and made recommendations for future monitoring. The MACTEC sampling round subsequent to the RD obtained results generally consistent with the findings of the quarterly monitoring program performed by Berger. Therefore, the conclusions reached in the Field Investigation Summary Report remained valid.

Based on the results of these environmental monitoring programs, the sampling strategy for the Site has changed since the 1999 ROD. Changes in the sampling regimen were accepted by both EPA and RIDEM and the current sampling regimen for the Site based on these changes is described in the Final LTM Work Plan (Berger, 2008). Changes in the monitoring locations and analytical parameters are described for each medium sampled in this Data Review Section.

The most current validated analytical data used for this FYR was collected during April 2015. The following is a summary of the environmental media (groundwater, surface water, landfill gas, soil, sediment, and leachate) sampling data from the 2003 RD to present, and a description of and rationale for any sampling modifications. Based on the performance data collected to date (both during and after implementation of the source control remedy), contamination at the Site has diminished. Data collected to date indicate that continued monitoring is required to assess the effectiveness of the source control remedy. The monitoring data will also assist the state with TMDL predictions for site-related contaminant concentrations affecting local water bodies.

References are made to Method Quantitation Limit (MQL) in the evaluation of monitoring data. The MQL is defined as the value at which an instrument can accurately measure an analyte at a specific concentration. The MQL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

Groundwater

Groundwater monitoring was conducted in 45 locations during the RI/FS, 20 locations during the pre-design investigation, and 17 locations post-closure. An additional location (RES #12) was added in July 2011, for a total of 18 locations post-closure. Groundwater monitoring wells sampled were installed in shallow overburden, deep overburden, and bedrock. Groundwater monitoring locations are shown on Figure 4, Post-Closure Monitoring Program, Groundwater.

According to the RI, numerous organic compounds were detected in groundwater from shallow and deep overburden and bedrock monitoring wells. Of the three disposal areas, the most elevated concentrations of VOCs were measured in the SWA and the lowest concentrations were found in the SSA. VOC contamination had migrated through groundwater north and northeast of the SWA. The predominant metals detected in groundwater were aluminum, iron, barium, and manganese. Concentrations of metals in bedrock groundwater were significantly lower than in overburden groundwater.

Quarterly groundwater monitoring was performed from 2003 to 2004, during the pre-design investigation. Groundwater samples were analyzed for VOCs, SVOCs, total metals, polycyclic aromatic hydrocarbons (PAHs), and PCBs. Groundwater samples were analyzed for the water-soluble organic (W-SO) acrylamide during the first quarter only, as acrylamide had not been detected historically in groundwater, and was not detected during the first quarter of monitoring. Analytical results indicated that PALs for several parameters were exceeded in one or more monitoring wells. PALs exceeded were those for aluminum, manganese, benzene, vinyl chloride, trichloroethene, tetrahydrofuran, bis(2-ethylhexyl)phthalate, and 1,4-dichlorobenzene. In general, the wells at which concentrations were detected above the PALs in groundwater were downgradient of the SWA and BWA.

Polychlorinated biphenyls were not detected in groundwater above the laboratory detection limits or PALs during the pre-design or subsequent sampling. Therefore, PCBs analysis of groundwater was eliminated from future monitoring programs.

Post-closure groundwater monitoring has been conducted twice yearly, typically in April and July, since 2008. Samples were analyzed for VOCs, SVOCs, and total metals as described in the LTM Work Plan (Berger, 2008). The only analytes detected at concentrations above the PAL at any frequency during the past five years (2010-2015) of monitoring were manganese, which was detected at concentrations exceeding the PAL in the majority of samples collected, and vinyl chloride which exceeded the PAL in only a relatively small number of samples. Single exceedances of the PAL during the past five years of monitoring were found for cadmium, tetrahydrofuran and bis-(2-ethylhexyl)phthalate. Overall, the concentration of analytes in groundwater remained fairly stable during post-closure monitoring; with some fluctuation, including both increasing and downward trends in concentration of analytes at various monitoring wells. Long-term trends are described below and trend graphs for COCs with PAL exceedances during post-closure monitoring are provided in Appendix E

Table 5 summarizes groundwater sampling at the Site since 1991. Groundwater analytical data from the 2003-2004 (RD) and this Five Year (2010-2015) post closure sampling period is provided in Tables 6 through 8. Table 9 summarizes groundwater PAL exceedances at the Site since 2003. Over the past five years, the number of exceedances for total metals and SVOCs has remained fairly consistent, while a reduction of exceedances has been generally been observed for all VOCs except vinyl chloride, which has increased. 1,4-dioxane will be added to the list of VOCs to be analyzed starting with the next monitoring round. This contaminant had been analyzed at the site previously during one sampling round in May 2006. The samples taken in May 2006 were all ND for the Detection Limit of 50 ppb (MACTEC, November 2006).

Table 5: Groundwater Sampling Summary

Phase	RI/FS				RD				Post-Closure														
									First 5-Year Review					Second 5-Year Review									
Date	June 1991	Sept/Oct 1991	Jan/Feb 1992	April 1992	June 2003	August 2003	December 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010	July 2010	April 2011	July 2011	April 2012	July 2012	April 2013	July 2013	April 2014	July 2014	April 2015
Samples (#)	17	45	45	45	21	21	21	21	17	17	17	17	17	16[1]	17	18[2]	18	16[1]	18	18	17[1]	18	16[3]
Monitoring	8	36	36	36	18	18	18	18	14	14	14	14	14	13	14	14	14	13	14	14	13	14	13
Residential	9	9	9	9	3	3	3	3	3	3	3	3	3	3	3	4	4	3	4	4	4	4	3
Analysis																							
VOC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SVOC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
W-SO		•	•	•	•																		
Pesticides	•	•	•	•																			
PCBs	•	•	•	•	•	•	•	•															
Metals (Total)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Metals (Dissolved)	•	•	•	•																			
Cyanide	•	•	•	•																			
Sulfide	•	•	•																				
Ammonia				•																			
TOC	•	•	•	•																			
BOD	•	•	•	•																			
PAHs									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

1: One dry monitoring well in July 2010, July 2012, April 2014. One dry residential well in July 2012.
2: Added RES#12 in July 2011.
3: No access to RES#12 or MW-13 in April 2015.

Table 6: Groundwater Laboratory Analytical Results, Metals in Groundwater

ANALYTE	PAL (mg/l)	MEAN CONCENTRATION[1] (mg/l)													
		RD[2]		Post-Closure (Second 5-Year Review)											
				Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aluminum	3.7	0.08	(9)	0.0272	(7)	0.0601	(17)	0.0360	(10)	0.0392	(12)	0.0332	(11)	0.0551	(5)
Antimony	0.006	<0.0060	(0)	0.0003	(1)	0.0005	(1)	0.0008	(15)	0.0004	(6)	0.0011	(2)	0.0013	(1)
Arsenic	0.01	<0.0040	(0)	0.0007	(7)	0.0006	(15)	0.0005	(14)	0.0003	(10)	0.0007	(13)	0.0005	(4)
Barium	2.0	NA		0.0227	(14)	0.0212	(33)	0.0194	(31)	0.0145	(33)	0.0208	(32)	0.0175	(15)
Beryllium	0.004	<0.0010	(0)	<0.0005	(0)	0.0003	(1)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)
Cadmium	0.005	<0.0020	(0)	<0.0005	(0)	0.0003	(1)	0.0002	(2)	0.0002	(4)	0.0002	(7)	0.009	(4)
Chromium	0.11	0.0054	(1)	0.0003	(1)	0.0005	(18)	0.0005	(1)	0.0005	(2)	0.0007	(3)	0.0006	(1)
Lead	0.15	<0.0050	(0)	0.0004	(3)	0.0003	(3)	0.0006	(4)	0.0005	(4)	0.0045	(6)	0.0006	(1)
Manganese	0.30	**1.35**	(23)	**1.09**	(14)	**1.06**	(32)	**0.99**	(31)	**0.78**	(35)	**1.30**	(32)	**0.89**	(14)
Sodium	NE	23.0	(33)	19.9	(14)	21.8	(35)	20.4	(33)	18.7	(36)	17.6	(34)	20.60	(16)
Thallium	0.002	<0.0010	(0)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)	<0.0005	(0)
Vanadium	0.26	0.0027	(2)	0.0003	(1)	0.0004	(4)	<0.0050	(0)	<0.0050	(0)	<0.0050	(0)	<0.0050	(0)
Zinc	11	0.01	(3)	0.0040	(4)	0.0163	(34)	0.0189	(30)	0.0054	(29)	0.0250	(35)	0.0109	(5)

[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second quarter results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than method quantitation limit
Bold Text indicates exceeds PAL
NA – not analyzed

Table 7: Laboratory Analytical Results, VOCs in Groundwater

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD[2]		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
1,1-Dichloroethane	800	1.55	(14)	0.6033	(4)	0.71	(9)	0.75	(9)	0.74	(9)	0.66	(8)	0.63	(2)
1,2-Dichlorobenzene	600	1.29	(1)	<2.50	(0)	<2.50	(0)	<2.50	(0)	<2.50	(0)	<2.50	(0)	<2.50	(0)
1,2-Dichloroethane	5	0.27	(2)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)
1,2-Dichloroethene	70	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	1.85	(5)	2.72	(7)
1,4-Dichlorobenzene	75	1.69	(4)	<2.50	()	<2.50	(0)	<2.50	(0)	<2.50	(0)	<2.50	(0)	<2.50	(0)
Benzene	5	1.62	(15)	0.3953	(3)	0.37	(6)	0.30	(3)	0.29	(3)	<0.50	(0)	0.27	(1)
Carbon Disulfide	1,000	<5.0	(0)	<5.0	(0)	<5.0	(0)	<5.0	(0)	2.61	(1)	<5.0	(0)	<5.0	(0)
Chlorobenzene	100	2.20	(14)	0.4200	(4)	0.49	(9)	0.37	(5)	0.39	(4)	0.36	(4)	0.53	(3)
Chloroethane	21,000	13.0	(12)	2.01	(3)	1.18	(6)	0.89	(5)	0.93	(6)	0.64	(4)	0.73	(2)
Cis-1,2-Dichloroethene	70	1.86	(9)	0.2707	(1)	0.38	(2)	1.51	(5)	0.93	(5)	3.50	(11)	<0.50	(0)
Ethyl ether	1,200	6.10	(16)	1.37	(1)	1.30	(1)	1.52	(3)	0.58	(2)	1.49	(2)	<2.50	(0)
Isopropylbenzene	660	0.44	(10)	0.3533	(1)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)
Methyl tert-butyl ether	12	0.69	(6)	0.5867	(1)	0.57	(2)	0.54	(1)	0.56	(2)	0.57	(3)	0.57	(1)
Naphthalene	20	<2.5	(0)	<2.5	(0)	<2.5	(0)	<2.5	(0)	<2.5	(0)	1.31	(1)	<2.5	(0)
n-Propylbenzene	NE	0.30	(5)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)
o-Xylene	1,400	0.39	(5)	<1.0	(0)	<1.0	(0)	<1.00	(0)	<1.0	(0)	<1.00	(0)	<1.00	(0)
p/m-Xylene	1,400	0.36	(2)	<1.0	(0)	<1.0	(0)	<1.00	(0)	<1.0	(0)	<1.00	(0)	<1.00	(0)
Tetrahydrofuran	8.8	6.85	(2)	<5.00	(0)	<5.00	(0)	<5.00	(0)	2.63	(1)	2.88	(2)	<5.00	(0)
Toluene	1,000	0.42	(2)	<0.75	(0)	<0.75	(0)	<0.75	(0)	<0.75	(0)	<0.75	(0)	<0.75	(0)
Trichloroethene	5	0.30	(4)	<0.50	(0)	<0.50	(0)	0.42	(1)	0.28	(1)	<0.50	(0)	<0.50	(0)
Vinyl Chloride	2	**3.55**	(8)	0.57	(1)	0.67	(2)	**1.65**	(3)	1.24	(4)	**4.11**	(10)	**3.18**	(6)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second quarter results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than method quantitation limit
Bold Text indicates exceeds PAL
NA – not analyzed

Table 8: SVOCs in Groundwater

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD[2]		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aniline	12	<10.0	(0)	**<20.0**	(0)	**<20.0**	(0)	<2.00	(0)	1.05	(1)	<2.0	(0)	<2.0	(0)
Bis(2-ethylhexyl)phthalate	6	<10.0	(0)	<5.00	(0)	2.73	(1)	2.19	(2)	<3.0	(0)	1.73	(2)	3.18	(6)
NDPA/DPA	NE	<5.00	(0)	<15.0	(0)	<15.0	(0)	<2.00	(0)	1.73	(1)	<2.0	(0)	<2.0	(0)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second quarter results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than method quantitation limit
Bold Text indicates exceeds PAL
NA – not analyzed

Table 9: Project Action Limit (PAL) Exceedances, Groundwater

Analyte	Number of PAL Exceedances																		
	Pre-Design				First 5-Year Review					Second 5-Year Review									
					Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8
	May 2003	August 2003	Nov 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010	July 2010	April 2011	July 2011	April 2012	July 2012	April 2013	July 2013	April 2014	July 2014	April 2015
Metal (Total)	9	-	11	10	8	10	9	7	9	8	8	9	8	8	8	8	10	9	10
Cadmium	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Chromium	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Manganese	9	10	11	10	8	8	9	7	9	8	8	9	8	8	8	8	10	9	9
VOC	6	4	-	6	-	-	-	-	-	-	-	1	2	1	2	2	5	3	3
Benzene	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vinyl chloride	5	3	-	4	-	-	-	-	-	-	-	1	2	1	2	2	4	3	3
Tetrahydrofuran	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
SVOC	1	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-
Bis(2-ethylhexyl) phthalate	1	2	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-

Overall, the post-closure groundwater data indicates a general decrease in concentrations of VOCs and metals. Mean concentrations of benzene, tetrahydrofuran, trichloroethene, p/m-xylene, and vinyl chloride exceeded the PAL during the pre-design. With the exception of vinyl chloride, the mean concentration of these VOCs dropped below the PALs during post-closure monitoring.

The metal manganese was detected above the PAL by two orders of magnitude during the RD at an average concentration of 2.03 mg/l. The mean concentrations of manganese during years 4 through 8 of the post-closure monitoring ranged from a low of 0.78 to a high of 1.30 mg/l.

Trend analysis graphs have been prepared for the following COCs in groundwater: cadmium, manganese, tetrahydrofuran, vinyl chloride, trichloroethene, and bis(2-ethylhexyl)phthalate. These chemicals and respective sampling stations were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected and exceeded the PALs. Graphs showing these trends are provided in Appendix E. Concentrations of trichloroethene and tetrahydrofuran; as well as bis(2-ethylhexyl)phthalate showed a declining trend in all wells from 2003-2010, ultimately to levels below the PALs and/or MQLs.

However, concentrations of vinyl chloride show an increasing trend from 2010-2015. Concentrations of manganese have been generally stable across the site from 2003-2015, with a spike in manganese concentrations observed around the commencement of post-closure monitoring in 2008.

Based on the results of post-closure monitoring, continued semi-annual groundwater monitoring is recommended, and monitoring of additional wells, and/or sampling for additional analytes, throughout the Site may be necessary prior to the next Five Year Review, or in support of any well abandonment procedure. As indicated previously, 1,4-dioxane will be included for sampling and analysis at the Site going forward.

Surface Water

Surface water was sampled at 18 locations during the RI, 12 locations during the RD investigation, and 8 locations during the 2010 – 2015 post-closure monitoring activities. Samples were collected from Mitchell's Brook (MB), an unnamed tributary to Mitchell's Brook (UT), the Saugatucket River (SR), and an unnamed brook (UB) west of the Site that flows into the Saugatucket River. Table 10 below summarizes the samples collected and analyses performed. Surface water monitoring locations are shown on Figure 5, Post-Closure Monitoring Program, Surface Water.

During the RI/FS, surface water samples were analyzed for VOCs, SVOCs, the water-soluble organic (W-SO) acrylamide, pesticides, PCBs, total and dissolved metals, cyanide, sulfide, ammonia, total organic carbon (TOC), and biological oxygen demand (BOD). A few organic compounds were infrequently detected in the three surface water bodies on the Site (Saugatucket River, Mitchell Brook, and the unnamed tributary located west of the Site that flows into Mitchell Brook (UT)). VOCs were the primary contaminant detected. Semi-volatile organic compounds (SVOCs), acrylamide, and pesticides were also detected in surface water. Organic compounds detected included VOCs, SVOCs, pesticides, and acrylamide. Metals detected included aluminum, iron, barium, manganese, zinc, antimony, copper, and lead, and basic cations (calcium, magnesium, sodium, and potassium).

Surface water samples were also collected quarterly during the pre-design, in 2003 and 2004. Samples were analyzed for total and dissolved metals, VOCs, SVOCs, ammonia, BOD, sulfide, nitrate, cyanide, PCBs, pesticides, acrylamide, and TOC. A number of total and dissolved metals, including aluminum, copper, iron, lead, and manganese, were detected at concentrations exceeding the PALs. The detection of metal concentrations above PALs at upgradient surface water monitoring locations suggests some upstream source of these metals.

Post-closure surface water monitoring was conducted twice yearly, typically in April and July, since 2008. Samples were analyzed for total and dissolved metals, TOC, cyanide, sulfide, nitrate, ammonia, phosphorus, and hardness as described in the LTM Work Plan (Berger, 2008) and Quarterly Monitoring Reports. Macroinvertebrate and habitat sampling and analyses were conducted in September 2008 and August 2009, but this monitoring work has since been eliminated due to inconclusive results and difficulty in collecting sufficient data, and as a result, has not been conducted during the past five years.

Results were similar in the Second Five Year post-closure monitoring period in comparison to those between 2008-2010. Several metals were detected in both the total and dissolved metals analysis, including metals that had not been detected during the RD. Laboratory reporting limits were higher in the RD, so these metals may have been present but not detected. Aluminum, cadmium, copper, iron, lead, manganese, nickel, and zinc were detected at concentrations exceeding the PAL in the total metals and dissolved metals analyses.

Overall, the concentration of analytes detected in surface water remained fairly stable during post-closure monitoring; long-term trends are described below and trend graphs for some metals detected above PALs in surface water are provided in Appendix E.

Table 10 summarizes surface water sampling events at the Site since 1991. Surface water analytical data from the 2003-2004 (RD) and the Second Five Year (2010-2015) post closure sampling period is provided in Tables 11 through 16. Table 17 summarizes surface water PAL exceedances at the Site since 2003. Over the past five years, the number of exceedances for total metals and dissolved metals has been inconsistent, and generally has been fairly stable.

Table 10: Surface Water Sampling

Phase	RI/FS				RD				Post-Closure														
									First 5-Year Review					Second 5-Year Review									
Date	June 1991	Sept/Oct 1991	Jan/Feb 1992	April 1992	June 2003	August 2003	December 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010	July 2010	April 2011	July 2011	April 2012	July 2012	April 2013	July 2013	April 2014	July 2014	April 2015
Samples (#)	15	16	15	17	12	12	12	12	8	8	8	8	8	8	8	8	8	8	8	8	8	8	6[1]
MB	7	7	7	7	5	5	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
SR	6	7	7	9	6	6	6	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
UB	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Analysis																							
VOC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
SVOC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
W-SO		•	•	•																			
Pesticides	•	•	•	•																			
PCBs	•	•	•	•	•	•	•	•															
Metals (Total)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Metals (Dissolved)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Cyanide	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Sulfide	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Ammonia				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
TOC	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
BOD	•	•	•	•																			
Nitrate					•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Phosphorus									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Hardness									•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Macro-invertebrate										•		•											
Habitat assessment										•		•											

1: No access to two sampling locations in April 2015.
2: macroinvertebrate sampling and habitat assessment were conducted in September 2008 and August 2009.
MB – Mitchell Brook
SR – Saugatucket River
UB – unnamed brook
UT – unnamed tributary to Mitchell's Brook

Table 11: Laboratory Analytical Results, Total Metals in Surface Water (Mitchell's Brook)

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aluminum	87	**171**	(7)	**95.8**	(4)	**147**	(8)	**129**	(8)	**190**	(8)	**132**	(8)	**162**	(3)
Arsenic	150	<4.00	(0)	0.44	(1)	1.39	(2)	0.41	(2)	1.02	(5)	0.58	(2)	<MQL	(0)
Cadmium	0.07	**<2.00**	(0)	**<0.50**	(0)	**1.52**	(1)	**<0.50**	(0)	**0.32**	(2)	**0.16**	(2)	**0.28**	(1)
Chromium	16	<10.0	(0)	<0.50	(0)	0.69	(4)	0.59	(1)	2.78	(2)	0.57	(1)	<1.00	(0)
Copper	1.77	**<10.0**	(0)	**3.03**	(4)	**6.26**	(8)	**2.88**	(8)	**11.0**	(7)	**4.25**	(8)	**3.29**	(3)
Iron	1,000	**1,569**	(8)	**1,877**	(4)	**1,427**	(8)	**1,111**	(8)	**1,833**	(8)	807	(8)	275	(3)
Lead	0.3	**7.31**	(2)	**4.73**	(4)	**12.7**	(8)	**7.00**	(6)	**24.51**	(6)	**9.53**	(8)	**2.91**	(2)
Manganese	300	230	(8)	298	(4)	157	(8)	196	(8)	285	(8)	111	(8)	46.8	(3)
Nickel	10.4	<10.0	(0)	1.05	(4)	0.96	(8)	0.96	(5)	1.13	(7)	1.00	(8)	0.80	(2)
Zinc	24	6.88	(1)	**49.1**	(3)	**71.7**	(8)	**82.7**	(8)	**37.4**	(7)	**30.8**	(8)	**33.8**	(2)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2]Mean concentration calculated from first and second quarter positive results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than laboratory reporting limit
Bold Text indicates exceeds PAL

Table 12: Laboratory Analytical Results, Dissolved Metals in Surface Water (Mitchell's Brook)

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD[2]		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aluminum	87	**171**	(7)	38.8	(2)	85.0	(8)	**98.6**	(7)	84.4	(8)	82.0	(8)	63.1	(2)
Arsenic	150	**<4.00**	(0)	0.39	(1)	1.24	(2)	0.44	(3)	0.50	(2)	0.48	(2)	<MQL	(0)
Cadmium	0.07	**<2.00**	(0)	**<5.0**	(0)	**1.53**	(1)	<0.50	(0)	**0.24**	(1)	**0.16**	(1)	**0.41**	(1)
Chromium	16	<10	(0)	<0.50	(0)	<MQL	(0)	<0.50	(0)	2.41	(1)	0.56	(0)	<1.00	(0)
Copper	1.77	**5.62**	(1)	3.10	(4)	**2.25**	(8)	**2.55**	(8)	**7.28**	(8)	**3.91**	(8)	**2.67**	(2)
Iron	1,000	401	(7)	482	(4)	620	(8)	408	(8)	429	(8)	375	(7)	135	(2)
Lead	0.3	**11.0**	(3)	1.03	(4)	**3.29**	(5)	**4.11**	(4)	**2.22**	(4)	**4.10**	(4)	**2.25**	(1)
Manganese	300	179	(7)	258	(4)	119	(8)	154	(8)	81.2	(8)	74.2	(8)	**41.8**	(3)
Nickel	10.42	<10	(0)	0.99	(3)	0.84	(8)	1.14	(6)	0.66	(5)	0.48	(4)	0.57	(3)
Zinc	24	8.13	(3)	19.4	(4)	**183**	(8)	**44.3**	(8)	**37.9**	(8)	**23.0**	(7)	**55.9**	(2)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2]Mean concentration calculated from first and second quarter positive results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than laboratory reporting limit
Bold Text indicates exceeds PAL

Table 13: Laboratory Analytical Results, Total Metals in Surface Water (Saugatucket River)

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD[2]		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aluminum	87	**269**	(8)	178	(4)	**124**	(8)	**142**	(8)	98.7	(8)	**88.0**	(8)	**146**	(3)
Arsenic	150	<4.0	(0)	<0.50	(0)	1.13	(1)	0.28	(1)	<0.50	(0)	<0.50	(0)	<0.50	(0)
Cadmium	0.07	<2	(0)	2.58	(2)	<MQL	(0)	<0.50	(0)	<0.50	(0)	**0.18**	(1)	<0.50	(0)
Chromium	16	<10	(0)	0.19	(1)	0.47	(5)	<1.0	(0)	<1.0	(0)	<1.0	(0)	<1.0	(0)
Copper	1.77	<10	(0)	2.60	(4)	1.49	(8)	**2.25**	(8)	**2.19**	(8)	**2.96**	(7)	1.52	(2)
Iron	1,000	**1,075**	(8)	856	(4)	588	(8)	**1,227**	(8)	579	(8)	267	(8)	322	(3)
Lead	0.3	**<5.00**	(0)	**1.24**	(3)	**2.05**	(3)	**1.70**	(6)	**0.85**	(2)	**1.38**	(3)	**1.21**	(1)
Manganese	300	114	(8)	259	(4)	204	(8)	271	(8)	172	(8)	84.7	(8)	172	(3)
Nickel	10.4	<10	(0)	1.05	(4)	0.74	(7)	0.74	(6)	0.54	(4)	0.63	(7)	0.56	(1)
Zinc	24	5.63	(1)	38.6	(4)	**200**	(8)	**157**	(8)	**42.7**	(8)	**48.1**	(8)	11.6	(2)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second quarter positive results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than laboratory reporting limit
Bold Text indicates exceeds PAL

Table 14: Laboratory Analytical Results, Dissolved Metals in Surface Water (Saugatucket River)

ANALYTE	PAL (µg/l)	MEAN CONCENTRATION[1] (µg/l)													
		RD		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)	Mean	(#)
Aluminum	87	**119**	(6)	54.3	(4)	70.9	(8)	40.2	(7)	65.5	(8)	67.4	(8)	98.9	(2)
Arsenic	150	<4.00	(0)	<0.50	(0)	<MQL	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)	<0.50	(0)
Cadmium	0.07	<2.00	(0)	**1.89**	(1)	<MQL	(0)	**<0.50**	(0)	**<0.50**	(0)	**0.15**	(1)	<0.20	(0)
Chromium	16	<10.0	(0)	<0.50	(0)	<MQL	(0)	<1.0	(0)	<1.0	(0)	<1.0	(0)	<1.0	(0)
Copper	1.77	**5.63**	(1)	**2.60**	(4)	1.65	(8)	**1.81**	(7)	**2.25**	(8)	**3.41**	(8)	1.15	(1)
Iron	1,000	293	(7)	263	(4)	197	(8)	244	(8)	220	(8)	230	(8)	142	(3)
Lead	0.3	**<10.0**	(0)	**<0.50**	(0)	**1.39**	(3)	**<1.0**	(0)	0.50	(1)	**0.75**	(1)	**<1.0**	(0)
Manganese	300	100	(8)	170	(4)	159	(8)	169	(8)	121	(8)	72.0	(8)	96.0	(3)
Nickel	10.4	<10.0	(0)	0.98	(4)	0.75	(8)	0.74	(6)	0.41	(4)	0.41	(4)	0.61	(2)
Zinc	24	5.63	(1)	**29.4**	(4)	**221**	(8)	**107**	(7)	**82.4**	(7)	35.7	(7)	21.6	(3)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second quarter positive results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
<# = Less than laboratory reporting limit
Bold Text indicates exceeds PAL

Table 15: Laboratory Analytical Results, Other Analytes in Surface Water (Mitchell's Brook)

ANALYTE	PAL (mg/l)	MEAN CONCENTRATION[1] (mg/l)													
		RD		Year 3 (Q2)		Year 4 (Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)
Total Organic Carbon	NE	5.71	(8)	6.28	(4)	5.80	(8)	4.98	(8)	5.80	(8)	5.44	(8)	4.90	(3)
Ammonia	NE	0.41	(4)	0.47	(3)	0.20	(5)	0.24	(7)	0.26	(7)	0.10	(3)	0.07	(2)
Nitrate	10	0.08	(2)	0.66	(3)	0.37	(7)	0.55	(7)	0.86	(7)	0.24	(7)	0.10	(2)
Phosphorus	NE	NA		0.06	(4)	0.04	(8)	0.06	(8)	0.05	(7)	0.04	(6)	0.01	(2)
Hardness	NE	NA		18.0	(4)	14.9	(8)	17.9	(8)	15.9	(8)	13.8	(8)	12.8	(3)
Cyanide	0.0052	<0.005	(0)	**0.009**	(1)	<0.005	(0)	<0.005	(0)	<0.005	(0)	<0.005	(0)	<0.005	(0)
Sulfide	0.11	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
Bold Text indicates exceeds PAL
TOC = Total Organic Carbon
NE = not established
NA = not analyzed

Table 16: Laboratory Analytical Results, Other Analytes in Surface Water (Saugatucket River)

ANALYTE	PAL (mg/l)	MEAN CONCENTRATION[1] (mg/l)													
		RD		Year 3 (Q2)		Year 4 Q1 – Q2)		Year 5 (Q1 – Q2)		Year 6 (Q1 – Q2)		Year 7 (Q1 – Q2)		Year 8 (Q1)	
		Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)	Mean[2]	(#)
Total Organic Carbon	NE	6.14	(8)	6.38	(4)	5.20	(8)	5.09	(8)	5.75	(8)	4.66	(8)	5.37	(3)
Ammonia	NE	0.36	(5)	0.23	(4)	0.15	(5)	0.15	(8)	0.18	(7)	0.11	(5)	0.06	(1)
Nitrate	10	0.38	(8)	0.91	(4)	0.78	(8)	0.78	(8)	1.28	(8)	1.06	(8)	0.71	(3)
Phosphorus	NE	NA		0.06	(4)	0.03	(8)	0.03	(8)	0.03	(7)	0.02	(8)	0.01	(2)
Hardness	NE	NA		20.5	(4)	20.4	(8)	20.4	(8)	18.9	(8)	18.7	(8)	17.7	(3)
Cyanide	0.0052	<0.005	(0)	0.01	(1)	<0.005	(0)	<0.005	(0)	<0.005	(0)	<0.005	(0)	<0.005	(0)
Sulfide	0.11	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)	<0.10	(0)

Notes:
[1] Mean concentration calculated from positive results and one-half of laboratory reporting limits for non-detections.
[2] Mean concentration calculated from first and second results from locations sampled both pre-design and post closure.
(#) = Number of positive analytical results
Bold Text indicates exceeds PAL
TOC = Total Organic Carbon
NE = not established

Table 17: Project Action Limit (PAL) Number of Exceedances, Surface Water

Analyte	Number of PAL Exceedances																		
	Pre-Design				First 5-Year Review					Second 5-Year Review									
					Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8
	June 2003	August 2003	Nov 2003	April 2004	April 2008	July 2008	April 2009	July 2009	April 2010	July 2010	April 2011	July 2011	April 2012	July 2012	April 2013	July 2013	April 2014	July 2014	April 2015
Total Metals	12	16	8	8	12	24	26	28	27	30	17	28	22	35	22	30	28	22	15
Aluminum	8	6	6	8	8	5	8	7	9	5	8	4	4	4	7	5	8	2	6
Cadmium	-	-	-	-	-	-	1	3	-	2	-	1	-	-	-	2	2	1	1
Chromium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Copper	-	-	-	-	-	-	3	2	3	6	3	5	5	6	6	4	5	7	2
Iron	1	5	2	-	1	6	3	4	2	4	-	3	1	5	-	4	-	2	-
Lead	2	1	-	-	2	7	7	8	9	7	5	6	5	7	4	4	7	4	3
Manganese	1	4	-	-	-	3	1	-	1	3	-	3	-	5	-	5	-	1	1
Zinc	-	-	-	-	1	3	3	4	3	3	1	6	7	8	5	5	6	5	2
Dissolved Metals	11	11	5	9	13	20	17	22	13	17	13	20	14	12	21	17	24	15	11
Aluminum	6	-	4	7	8	3	5	6	5	1	2	1	1	1	3	2	8	1	4
Cadmium	-	-	-	-	-	-	-	3	-	1	-	1	-	-	6	1	1	1	1
Copper	2	-	-	2	1	1	3	5	1	6	3	2	4	3	6	4	5	8	2
Iron	-	7	1	-	-	2	-	1	-	-	-	2	-	1	-	1	-	-	-
Lead	2	1	-	-	2	5	5	6	4	4	2	5	3	1	2	2	4	1	1
Manganese	1	3	-	-	-	3	-	-	1	2	-	2	-	2	-	2	-	1	-
Zinc	-	-	-	-	2	6	4	1	2	3	6	7	6	4	4	5	6	3	3
Other Analytes	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Cyanide	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

The post-closure surface water data shows relatively similar concentrations of metals and other analytes to the pre-design data. Mean concentrations of both total and dissolved metals remained similar or increased from 2003 to 2015. Aluminum, copper, iron, lead, and manganese concentrations had exceeded the PALs during the pre-design. These same metals, as well as cadmium and zinc, had mean concentrations in excess of the PALs during post-closure monitoring. Several of the surface water sampling locations (e.g. SW-01 and SW-13 on Mitchell Brook) are upstream or cross-gradient from the Site and the presence of metals at these locations may be attributed to sources other than Site discharges.

Trend analysis graphs have been prepared for the following COCs (metals) in surface water: aluminum, lead, copper, cadmium, chromium, zinc, iron, and manganese. These chemicals and sampling stations on Mitchell's Brook and Saugatuck River and their respective tributaries were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected and exceeded the PALs.

Graphs showing these trends are provided in Appendix E. The trend analysis graphs are presented for both dissolved metals and total metals. All of these metals show fairly similar results during post-closure monitoring except for concentration spikes detected in the July 2013 monitoring round. It is noted that concentrations typically trend higher in July than in April. The reason for this even greater spike in metals concentration across the site in July 2013 is unclear; however, metals concentrations in surface water have remained fairly constant on average from 2003-2015.

Based on the results of post-closure monitoring, continued biannual surface water monitoring is recommended.

Landfill Gas

Landfill gas was monitored and sampled during the RI/FS, RD, and post-closure investigations. Samples were monitored in the field for percent carbon dioxide, (CO_2), methane (CH_4), oxygen (O_2), percent lower explosive limit (LEL), hydrogen sulfide (H_2S), VOCs, and in some cases, flow and temperature. Samples were also laboratory analyzed for VOCs. Sampling locations differed among the three sampling events. Table 18 summarizes samples collected.

During the RI, samples were collected from on- Site and off- Site monitoring points in June and July 1991; and off- Site points were monitored in September 1991, as shown in Table 18. During the RI, methane was detected at one off-Site location (LFG-LHR), the location of the building which was demolished and replaced by the new slab on-grade clubhouse at the golf course property at 220 Rose Hill Road. A single VOC, acetone, was detected above the sample quantitation limit in this location. Several other VOCs were detected in another sample collected from this location in May 1992. Across the three disposal areas, landfill gas was shown to have elevated concentrations of methane, carbon dioxide, and VOCs. Concentrations and types of VOCs varied among the disposal areas.

During the 2003-2004 RD, landfill gas samples were collected from the permanent landfill gas sampling locations installed around the perimeter of the SWA. Landfill gas monitoring stations were established at various locations to the north and south of the SWA. The RD Work Plan had called for a larger number of landfill gas monitoring points; however, a reduced number of wells were located and determined to be functional during sampling activities. SUMMA canisters were used to collect samples from four monitoring locations for laboratory analysis of samples for VOCs.

Concentrations of the 1,1-dichloroethane, vinyl chloride, and trichloroethene exceeded the PALs during all four quarterly monitoring rounds of the RD. The concentration of benzene exceeded the PAL in one sample during the fourth quarterly monitoring round only. Average concentrations of the following VOCs exceeded the PALs during the pre-design: 1,1-dichloroethane, 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, dichlorodifluoromethane, trans-1,2-dichloroethene, trichloroethene, 1,2,4-trimethylbenzene, and vinyl chloride.

The landfill gas samples collected during the RD were to establish baseline conditions for comparison with post-closure quarterly perimeter monitoring and to evaluate landfill gas generation for design of the gas collection system. However, the stations sampled during the RD are no longer active due to cap construction activities. During the RA, new landfill gas monitoring probes and gas vents were installed (see Figure 5). The gas vents were part of the original passive landfill gas collection and venting system. The landfill gas system was expected to behave differently under capped conditions with numerous gas collection wells.

Post-closure (2008 to present) landfill gas monitoring has been conducted quarterly. Landfill gas samples were monitored in the field for methane, carbon dioxide, oxygen, hydrogen sulfide, and percent LEL as described in the LTM Work Plan (Berger, 2008) and Quarterly Monitoring Report (Berger, August 2009). A subset of five sample locations, GP-11, GP-12, GP-16, GP-21 and the Gas Flare (GF) were also selected for laboratory analysis for VOCs. Starting in July 2014, one sampling point location was changed at DEM's request from the GP-18 location to GP-12, in order to be closer to a residence. The landfill gas monitoring locations are presented in Figure 5, Post-Closure Monitoring Program, Landfill Gas.

The average concentrations of several VOCs detected in landfill gas samples within the capped area were above the PALs during post-closure monitoring. These VOCs included 1,1-dichloroethane, 1,1-dichloroethene, benzene, chloroform, cis-1,2-dichloroethene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, dichlorodifluoromethane, ethylbenzene, methylene chloride, n-hexane, tetrachloroethene, trichloroethene, and vinyl chloride. These are the same compounds that exceeded the PALs in average concentration during the RD, except chloroform and tetrachloroethene. The samples collected during the RD were not analyzed for n-hexane, cyclohexane and 2-butanone, so it is unknown whether these VOCs were present in the RD samples. In some cases the laboratory detection limit for VOCs was set above the PAL, and therefore additional exceedances of the PALs may have occurred.

Table 18 summarizes landfill gas sampling at the Site since 1991. Landfill gas analytical data from the 2003-2004 (RD) and the Second Five Year (2010-2015) post closure sampling period is provided in Table 19. Table 20 summarizes landfill gas PAL exceedances at the Site since 2008. Over the past five years, the number of exceedances for VOCs has been decreasing.

Due to updated landfill gas sampling results and landfill gas modeling just following cap completion, a change to active landfill gas collection system operation was made as described in the Explanation of Significant Differences (EPA, 2008). The Explanation of Significant Differences documents the basis for a design decision to build the landfill gas collection system such that it could be operated in either a passive (venting) or active (combustion) mode. The ROD had initially specified an active landfill gas collection system. Landfill gas monitoring during 2003-2004 indicated that this system could operate passively while providing adequate protection from the ambient air risks identified in the ROD, therefore the landfill was originally operated using a passive venting system after closure and capping was complete.

Post-closure monitoring of gas probes indicated the presence of methane in concentrations above the LEL off-Site at certain locations, particularly along Rose Hill Road. The landfill gas flare pilot study was designed in 2009 to determine if active gas collection would lower the off-Site methane concentration levels. Since the initial gas flare startup in February 2010, monitoring results clearly indicate that operation of the gas flare maintains the off-Site methane concentrations below the LEL. During occasional periods of gas flare down-time, it has been observed that off-Site methane concentrations slowly begin to increase due to landfill gas migration.

Monthly monitoring of the gas flare has indicated that the quantity of landfill gas being delivered to the gas flare has been slowly trending downward since the startup. Operation of the landfill gas flare remains on-going and any future decisions to shut down or remove the gas flare will be made based upon various criteria, including landfill gas quality, gas flow rate and measured levels of landfill gas off-Site.

In addition, due to some of the laboratory air sampling results being above the PALs, and in accordance with the LTM Work Plan, AERSCREEN Dispersion Modeling was conducted based on the analytical results from the post-closure monitoring. The following steps were taken to develop the maximum 1-hour concentration, emission rates for each pollutant, and maximum annual concentration:

- Calculated 90th percentile values for three sampling events for the two points sampled (GV-03, GV-09) prior to instituting the active system. The gas flare has been used as a sampling location since then. Values below the Method Detection Limit (MDL) were established at 50% of the MDL for purposes of calculating the 90th percentile.
- LandGem Model was run based on the input of the new values into the pollutant tab. The model was run using assumptions used during the RD.
- AERSCREEN Dispersion Model was run to obtain the maximum 1-hour emission concentration.
- Maximum annual concentrations for the pollutants were calculated based on the results of the AERSCREEN dispersion model and emission rate from LandGem.
- Maximum concentrations were then compared to the established PALs for each of the contaminants of concern.

Results of the AERSCREEN Model concluded that none of the pollutants exceeded the PALs established for the Site for dispersion modeling.

Table 18: Landfill Gas Sampling

Phase	RI/FS				RD				Post-Closure																												
									First 5-Year Review									Second 5-Year Review																			
									Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8
	June 1991	Sept/Oct 1991	Jan/Feb 1992	April 1992	June 2003	August 2003	December 2003	April 2004	April 2008	July 2008	October 2008	January 2009	April 2009	July 2009	October 2009	January 2010	April 2010	July 2010	October2010	January 2011	April 2011	July 2011	October 2011	January 2012	April 2012	July 2012	October 2012	January 2013	April 2013	July 2013	October 2013	January 2014	April 2014	July 2014	October 2014	January 2015	April 2015
Samples (#)	168	32	16	30	4	4	4	4	4	4	4	4	4	5	6	6	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
BWA	29	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SSA	22	-	-	1		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PSWA (GP)	32	32	16	24	4	4	4	4	1	1	1	3	1	2	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
SWA(GP)	85	-	-	3	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SWA(GV)	-	-	-	-	-	-	-	-	2	2	2	-	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SWA(GF)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Analysis																																					
[1]VOC (GC)	•	•	•	•																																	
[2]VOC (S)				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
[3]Reduced Sulfur				•																																	

NOTES
BWA – Bulky Waste Area
PSWA – Perimeter of Solid Waste Area
SSA – Sewage Sludge Area
SWA – Solid Waste Area

GP – Gas Probe
GV – Gas Vent
GF – Gas Flare
VOC – Volatile Organic Carbon
GC – Gas Chromatograph
S- Summa

1 – Sampled with portable gas chromatograph
2 – Sampled with SUMMA canister
3 – Sampled with impinger

Table 19: Laboratory Analytical Results, Volatile Organic Compounds in Landfill Gas

ANALYTE	PAL (ppbv)	Screening Level[2] (ppbv)	MEAN CONCENTRATION[1] (ppbv)													
			RD		Post-Closure											
					Year 3 (Q2)		Year 4 (Q1 – Q4)		Year 5 (Q1 – Q4)		Year 6 (Q1 – Q4)		Year 7 (Q1 – Q4)		Year 8 (Q1)	
			Mean[1]	(#)	Mean[1]	(#)	Mean[1]	(#)	Mean[1]	(#)	Mean[1]	(#)	Mean[1]	(#)	Mean[1]	(#)
1,1,1-Trichloroethane	700	95.3 N	2.07	(2)	34.6	(3)	13.3	(4)	18.0	(3)	22.4	(5)	5.90	(2)	2.86	(1)
1,1-Dichloroethane	0.1	0.44 C	**9.23**	(3)	**36.1**	(3)	**17.2**	(3)	**19.5**	(2)	**13.6**	(3)	**3.99**	(3)	**11.4**	(1)
1,1-Dichloroethene	50	5.3 N	12.2	(1)	14.7	(3)	1.66	(3)	2.07	(1)	2.12	(1)	1.70	(2)	2.96	(1)
1,2,4-Trimethylbenzene	60	0.15 N	**2.59**	(3)	**15.4**	(1)	1.05	(4)	**1.47**	(6)	**1.96**	(2)	0.32	(9)	0.28	(4)
1,3,5-Trimethylbenzene	60	NE	**2.29**	(3)	**9.32**	( )	0.62	(1)	1.04	(1)	**1.92**	(2)	0.16	(2)	0.23	(1)
1,3-Butadiene	0.01	0.04 C / 0.09 N	<MQL	(0)	<MQL	(0)	<MQL	(0)	<MQL	(0)	**1.88**	(1)	**0.14**	(1)	**0.56**	(4)
2-Butanone	1,000	176 N	NA		65.3	(5)	56.7	(20)	77.6	(19)	101	(20)	62.5	(20)	383	(5)
Benzene	9	0.11 C / 0.97 N	**14.1**	(3)	26.6	(4)	4.71	(17)	**8.35**	(15)	**9.15**	(18)	6.16	(14)	7.11	(5)
Carbon disulfide	200	40.6 N	<MQL	(0)	8.50	(4)	2.76	(16)	2.17	(12)	4.17	(13)	1.56	(13)	13.8	(5)
Chlorobenzene	200	1.13 N	<MQL	(0)	30.5	(1)	<MQL	(0)	<MQL	(0)	2.73	(1)	<MQL	(0)	7.83	(1)
Chloroethane	4,000	379 N	18.4	(3)	269	(3)	84.7	(5)	112	(6)	123	(8)	67.0	(5)	93.5	(3)
Chloroform	0.04	0.03 C / 2.05 N	<MQL	(0)	**4.31**	(3)	**0.61**	(5)	**0.98**	(1)	**1.91**	(2)	**0.16**	(1)	<MQL	(0)
Chloromethane	200	4.55 N	6.71	(7)	5.75	(4)	1.75	(18)	1.95	(19)	2.99	(17)	1.23	(19)	1.60	(5)
cis-1,2-Dichloroethene	200	NE	**49.1**	(3)	**2,213**	(2)	**270**	(3)	**432**	(2)	**844**	(5)	**176**	(7)	**790**	(3)
Cyclohexane	2,000	183 N	NA		87.8	(3)	24.2	(6)	16.5	(7)	18.0	(7)	8.10	(6)	11.7	(2)
Dichlorodifluoromethane	100	2.38 N	**83.7**	(9)	**105**	(5)	9.09	(19)	9.11	(18)	11.2	(19)	2.55	(19)	1.93	(5)
Ethylbenzene	200	0.25 C / 23 N	<MQL	(0)	**94.9**	(3)	**1.74**	(5)	**1.04**	(2)	**2.62**	(4)	**1.06**	(2)	**11.6**	(3)
Freon-113	NE	405 N	<MQL	(0)	13.6	(1)	0.52	(1)	0.96	(1)	15.0	(1)	<MQL	(0)	<MQL	(0)
Freon-114	NE	NE	<MQL	(0)	44.0	(4)	5.61	(6)	5.94	(4)	9.59	(7)	2.08	(5)	4.59	(3)
Methyl tert-butyl ether	800	3.05 C / 86 N	<MQL	(0)	5.45	(2)	<MQL	(0)	<MQL	(0)	<MQL	(0)	0.26	(1)	<MQL	(0)
Methylene Chloride	300	28.8 C / 18 N	<MQL	(0)	<MQL	(0)	0.46	(4)	<MQL	(0)	**8.55**	(1)	0.64	(17)	0.65	(1)
n-hexane	50	20.7 N	NA	(0)	**200**	(5)	16.1	(19)	45.4	(15)	41.2	(16)	18.3	(16)	23.5	(5)
o-Xylene	700	2.3 N	5.48	(4)	26.0	(4)	0.67	(4)	1.10	(4)	2.12	(2)	0.25	(4)	3.52	(3)
p/m-Xylene	700	2.3 N	4.45	(4)	120	(2)	10.1	(4)	2.32	(5)	1.97	(5)	0.93	(8)	19.7	(3)
Propylene	2,000	1,801 N	NA	(0)	54.8	(5)	37.0	(20)	48.2	(19)	55.8	(19)	39.4	(20)	121	(5)
Styrene	200	23.5 N	<MQL	(0)	4.24	(1)	0.17	(3)	0.17	(1)	0.15	(3)	<MQL	(0)	0.15	(1)
Tetrachloroethene	0.03	1.62 C / 166 N	<MQL	(0)	**4.21**	(1)	**2.83**	(1)	<MQL	(0)	<MQL	(0)	0.15	(2)	0.30	(2)
Toluene	100	138 N	38.1	(8)	41.2	(5)	3.64	(19)	3.85	(15)	6.81	(17)	3.62	(19)	14.6	(5)
trans-1,2-Dichloroethene	20	NE	10.3	(3)	6.01	(1)	1.83	(3)	2.24	(1)	3.38	(2)	1.26	(2)	2.20	(1)
Trichloroethene	90	0.09 C / 0.04 N	**60.4**	(4)	**467**	(3)	**132**	(5)	**333**	(1)	**607**	(5)	**70.7**	(9)	**838**	(5)
Trichlorofluoromethane	200		<MQL	(0)	4.24	(2)	0.72	(14)	1.04	(10)	2.55	(15)	0.67	(13)	0.37	(4)
Vinyl chloride	40	0.07 C / 3.91 N	**1,185**	(8)	**2,772**	(4)	**994**	(6)	**571**	(5)	**2,346**	(7)	**785**	(3)	**5,330**	(1)

Notes:

[1] Mean concentration calculated from positive results and one-half of laboratory detection limits for non-detections.

2 Carcinogenic (C) or noncarcinogenic (N) Screening levels form the EPA Regional Screening Level (RSL) Resident Ambient Air Table

(#) = Number of positive analytical results NA = Not Analyzed NE = Not established

Bold Text indicates exceeds PAL < MQL= Less than method quantitation limit

Table 20: Laboratory Analytical Results, Landfill Gas

Phase	Post-Closure																																
	First 5-Year Review									Second 5 –Year Review																							
	Year 1				Year 2					Year 3			Year 4				Year 5				Year 6				Year 7				Year 8
	April 2008	July 2008	October 2008	January 2009	April 2009	July 2009	October 2009	January 2010	April 2010	July 2010	October2010	January 2011	April 2011	July 2011	October 2011	January 2012	April 2012	July 2012	October 2012	January 2013	April 2013	July 2013	October 2013	January 2014	April 2014	July 2014	October 2014	January 2015	April 2015
Total Exceedances	12	15	11	11	17	22	18	11	1	19	2	9	0	8	12	5	0	9	2	-	8	6	1	5	-	2	-	2	14
1,1-Dichloroethane	2	2	2	3	3	3	3	2	-	2	1	1	-	1	1	1	-	1	1	-	1	1	-	1	-	-	-	-	1
1,1-Dichloroethene	1	1	1	-	-	1	1	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3-Butadiene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
2-Butanone	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Benzene	1	2	1	2	2	3	2	1	-	1	-	1	-	1	1		-	1	-	-	-	1	1	1	-	-	-	-	1
Chloroform	1	1	-	1	2	1	3	1	1	3	1		-	2	3	1	-	1	-	-	-	1		1	-	1	-	-	1
Cis-1,2-Dichloroethene	2	1	1	-	2	2	1	1	-	1	-	1	-	1	1	1	-	1	-	-	1	1	-	-	-	-	-	-	1
Dichlorodifluoromethane	-	-	-	-	1	2	2	1	-	2	-	1	-				-	1	-	-	1	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
n-Hexane	2	2	2	3	2	3	2	2	-	2	-	1	-	1	1		-	1	-	-	-	-	-	-	-	-	-	-	1
Tetrachloroethene	-	1	1	-	-	1	-	-	-	1	-	-	-		1		-		-	-	-	-	-	-	-	1		1	2
Toluene	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Trans-1,2-Dichloroethene	-	1	-	-	-	1	1		-	-	-	1	-		1		-	1	-	-	1	-	-	-	-	-	-	-	-
Trichloroethene	-	1	1	-	2	2	1	1	-	2	-	1	-	1	1	1	-	1	-	-	2	1		1	-	-	-	-	1
Vinyl Chloride	3	3	2	1	3	3	2	2	-	2	-	1	-	1	1	1	-	1	1		1	1		1	-	-	-	-	1

In addition to the dispersion modeling, an assessment of the potential for vapor intrusion was conducted in nearby residences from groundwater and landfill gas. This assessment was performed using EPA Region 1 Guidance for indoor air intrusion calculations. Results of that assessment were provided in a separate memorandum (June 9, 2010) from Berger to EPA. Further review of this issue at the Site was performed by EPA regarding screening of the vapor intrusion pathway, with results reported in an EPA memorandum (June 22, 2010). Based on the vapor intrusion analysis, EPA concluded that vapor intrusion did not pose an unacceptable risk at this time. No further information has been reported since that would cause EPA to revise this conclusion.

Trend analysis graphs were also prepared for the following COCs (VOCs) in landfill gas: chloroform, benzene, dichlorodifluoromethane, n-hexane, toluene, trichloroethene, vinyl chloride, 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, and tetrachloroethene. Landfill gas sampling is conducted at four gas probes and the gas flare. These chemicals and sampling locations were selected as representative of chemicals and locations where elevated contaminant concentrations have been detected and exceeded the PALs.

Graphs showing these trends are provided in Appendix E. All of these VOCs showed an overall general decreasing trend between 2010 and 2015. A similar result for reduction in methane concentrations is also observed, with all off-Site measurements of methane concentrations at or below 1% since the start-up of the gas flare.

Quarterly landfill gas sampling and methane monitoring is presently scheduled to continue. Sampling of VOCs has been conducted at the gas flare since the system was switched from passive to active. Continued sampling of VOCs at specific gas probe locations remains unchanged except for the switch from GP-18 to GP-12 starting in July 2014.

Soil

No soils were sampled and analyzed during this 5-year review period because soils were fully addressed earlier in the investigation phase and remedial actions for soil have been undertaken as described in the RI/FS Reports (Metcalf & Eddy, 1994 and 1998).

Sediment

No sediment sampling has been conducted during post-closure monitoring. Results from sampling during the RI and the pre-design investigation showed that VOCs and cyanide were not detected in sediment at concentrations above the PALs during any of the pre-design quarterly sampling rounds. Sediment was sampled at the same locations as surface water samples. Sediment was sampled at 18 locations during the RI, of which 12 locations were sampled during the pre-design investigation. Samples were collected from Mitchell Brook (MB), the unnamed tributary to Mitchell Brook (UT), the Saugatucket River (SR), and the unnamed brook (UB) west of the site. Sediment monitoring locations are shown on Figure 4, Post-Closure Monitoring Program, Surface Water. Sediment monitoring locations are identified in Figure 4 as SW and are the same locations as surface water monitoring.

During the RI, sediment samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, cyanide, sulfide, ammonia, TCO, and grain size. Pesticides, VOCs, SVOCs, metals, PAHs, ammonia, and sulfide were detected in Mitchell Brook and UT sediment. Metals, VOCs, PAHs, sulfide, and ammonia were detected in Saugatucket River sediment. Pesticides, VOCs, metals, and sulfide were detected in sediments of the unnamed brook.

During the pre-design investigation (2003-2004), sediment samples were analyzed for total metals, TOC, cyanide, sulfide, nitrate, ammonia, BOD, VOCs, SVOCs, PAHs, PCBs, and pesticides. Analytes detected included cyanide, ammonia, nitrate, sulfide, metals, VOCs, and SVOCs. The metals arsenic, iron, and lead were detected above the PAL in one or more samples. The SVOCs benzo(a)anthracene, benzo(a)pyrene, chrysene, benzo(ghi)perylene, and dibenzo(a,h)anthracene were each detected at concentrations exceeding PALs in one sample. No other analytes were detected at concentrations above PALs.

No contaminants in sediment exceeded the PALs at sample locations SE-02, SE-03, SE-05, SE-07, SE-09, SE-12, SE-13, SE-15, and SE-17 during the pre-design. Although elevated concentrations (above the PALs) had been detected in surface water samples at these same locations, it was apparent that contaminants were not affecting sediments at these locations at levels of concern. It was recommended that sediment sampling at these locations be eliminated from future monitoring programs.

Leachate

Leachate sampling was not performed during the post-closure investigation as the SWA was capped as a measure intended to eliminate/minimize leachate seepage. Visual examinations for the presence of leachate seeps are conducted as part of the post-closure inspections and no leachate seeps have been observed to date. No leachate analysis has been conducted during post-closure monitoring.

During the RI, leachate was collected from six leachate seeps, five along the Saugatucket River (LE-02 – LE-06) and one near Mitchell Brook (LE-01). The Saugatucket River locations and the Mitchell Brook location were sampled in June 1991 and April 1992. Samples were analyzed for VOCs, SVOCs, pesticides, PCBs, total and dissolved metals, cyanide, sulfide, TOC, and BOD. Chlorinated and aromatic VOCs, metals, and cyanide were detected in leachate samples. Three composite samples were collected from one of the leachate seeps (LE-05) in April 1992 to supplement ecological toxicity testing; these samples were analyzed for the same analytes as the June 1991, except for sulfide; these samples were also analyzed for water-soluble organics and ammonia. VOCs, metals, ammonia, and TOC were detected in these composite samples.

In the pre-design investigation, leachate was collected from four seeps, collected at locations generally to the east and southeast of the BWA: LE-02, LE-03, LE-05, and LE-06. Leachate samples were analyzed for total metals, dissolved metals, TOC, cyanide, sulfide, nitrate, ammonia, BOD, VOCs, SVOCs, PCBs, and pesticides. Analytes detected included total and dissolved metals, cyanide, TOC, ammonia, nitrate, sulfide, BOD, and VOCS. The metals aluminum, arsenic, cadmium, chromium, iron, lead, manganese, and mercury were detected above the PAL in the total metals analysis. In the dissolved metals analysis, the analytes aluminum, iron, and zinc were detected above the PAL. Ammonia, cyanide, and sulfide concentrations also exceeded the PALs in some samples. The only VOC detected above the PAL was naphthalene during one quarter of sampling.

In addition to the quarterly analysis of leachate samples, a one-time leachate toxicity test was conducted during the RD in June 2003. The results of the toxicity test indicated a significant reduction in daphnid (planktonic crustacean indicator species) survival was observed in one of five leachate samples (sample LE-04). No survival reduction was observed in diluted leachate samples, indicating that reduced concentrations of leachate (e.g. through contamination source removal and dilution via percolating precipitation) would represent reduced toxicity. Concentrations of SVOCs, PCBs, and pesticides were not detected in leachate above the laboratory detection limits or PALs during any of the quarterly RD monitoring rounds. It was therefore recommended that SVOCs, PCBs, and pesticides analysis of leachate be eliminated from future monitoring programs.

Site Inspection

The inspection of the Site was conducted on 4/10/2015. In attendance were David J. Newton Remedial Project Manager, U.S. EPA; Gary Jablonski, Principal Engineer, RIDEM; Jon Schock, Director of Public Services, Town of South Kingstown; and Jeff Ceasrine, Town Engineer, Town of Narragansett. The purpose of the inspection was to assess the protectiveness of the remedy.

The attendees inspected the Site, including the SWA and BWA as well as the retention ponds and Mitchell Brook. Observations made during the Site inspection included the following:

Landfill Cap

- Observed wildlife holes or burrows occasionally around the SWA soil surface, particularly at the top of the landfill downchute. When kept in check to a minimum number, animal holes are a minor issue and do not impact the functionality of the capping remedy or compromise the integrity of the cap.

- Vegetation on top of the cap is lush and no bare soil is observed. Mowing of the cap vegetation is conducted once per year in the fall to allow natural reseeding and avian habitat.

Drainage Structures

- No issues observed. In general, the drainage swales and the downchute in the SWA are working properly.

Site Plantings

- Vegetative growth is acceptable and looks healthy around the Site. Excessive vegetative growth near property fencing was cut back in Fall 2014 by the Town of South Kingstown DPW.

Surface Waters

- Surface waters including Mitchell Brook and the Saugatucket River wetlands were inspected. No excessive erosion was observed in the low lying area downstream of the South Pond discharge point between Mitchell Brook and South Pond.

- Iron staining was observed in the wetland area near the Saugatucket River at monitoring well MW-03 and along the east bank of Mitchell Brook near the Transfer Station Road culvert.

No other issues were identified.

During the Site inspection, the operation of the gas flare was discussed briefly. The flare was not in operation on the day of the inspection due to high condensate level in the condensate tank, which cuts off the flow of landfill gas to the flare. The tank was pumped out within a few weeks after the inspection took place and flare operations were restored back to normal. The flare initially started operating in February 2010 and since that time, the flare has been running in a continuous operating mode, except for occasional outage due to high winds blowing the flare out or high condensate levels. The flare continues to draw landfill gas from the capped landfill and is continuously monitored for methane quality and blower vacuum. The flare operates on a vacuum in the range of 0.5" to 1.5" water column, with the methane concentration in the landfill gas around 40% by volume and greater.

The flare has been operating in the 30-40 scfm range over the past couple of years, which is about half of the initial flow rate for the first year of operation. The monitoring of landfill gas probes throughout the Site has demonstrated a significant reduction in methane concentrations in the soil since the start of the gas flare operation, particularly on the west side of the landfill and beyond the Site property boundary.

Interviews

During the FYR process, interviews were conducted with parties impacted by the Site, including some adjacent property owners as well as the towns of South Kingstown and Narragansett, involved in Site activities or aware of the Site. The purpose of the interviews was to document any perceived problems or successes with the remedy that has been implemented to date. Interviews with representatives from the towns of South Kingstown and Narragansett were conducted on 4/10/2015. Interviews with the other parties impacted by the Site were conducted on 4/23/2015. Interviews are summarized below and complete records of the interviews are included in Appendix C.

Interview #1 – Towns of South Kingstown and Narragansett
Representatives of EPA, RIDEM, the towns of South Kingstown and Narragansett were interviewed on April 10, 2015 in a meeting held at the Public Services Building conference room in South Kingstown, RI. The attendees at the interview meeting were:

- David Newton — EPA Remedial Project Manager
- Gary Jablonski — RIDEM Remediation Project Manager
- Jon Schock — Town of South Kingstown, Director of Public Services
- Jeffry Ceasrine — Town of Narragansett, Town Engineer

Discussions included reviewing the towns' perspective on the implementation of the access and ICs as well as the construction of the remedy and on-going O&M. The towns did not indicate any unusual situations or problems at the site. The town of South Kingstown provides in-house O&M services at the site, including:

- Annual cutting of vegetation in SWA
- Fence and Gate repair (as needed)
- Access road rut repair (as needed)
- Fallen tree removal
- Occasional maintenance of downchute, swales, culverts, and pond spillway
- Maintenance/reporting of methane meters at two homes (on-going)

The towns inquired if the methane detection systems in the two private residences are still necessary. The towns would like to see the meters removed from the homes in the future, pending results of the flare gas operation. This request remains under review.

Cutting vegetation in the SWA annually in the fall was discussed as being appropriate, as long as any woody growth is continually eliminated. The town of South Kingstown may also cut along the fence line to prevent vegetative growth from damaging the fence.

The town of South Kingstown has not encountered any difficulties or issues conducting current O&M efforts. In general, the towns do not have any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented.

Regarding future Site use, the town of South Kingstown is interested in the potential installation of photovoltaic solar panels in the SWA and plans to issue a Request for Proposals within the next six months. The town is reviewing various financing and operational options to determine the best arrangement for the town if the Site is developed for solar energy production. The town is also developing a municipal Debris Management Plan (DMP) that will identify debris staging areas for catastrophic storm related debris. The BWA will be one location being evaluated as a debris staging area during development of the Town DMP.

The towns indicated that there is not any new information that might call into question the protectiveness of the remedy.

The towns were asked about the status of Institutional Control (IC) implementation and schedule for the Site. It was indicated that the town of South Kingstown has completed ICs for the three town-owned properties. The ICs were recorded on 9/24/2013. It was also indicated that the town held a meeting with Rose Hill IC property owners on 7/10/14, although only two IC property owners attended. Town legal counsel has mailed the most current version of the IC to property owners on 3/9/15. Town legal counsel is actively discussing ICs with two property owners and awaiting response from the balance of the property owners. The town legal counsel will continue with property owner outreach, including individual meetings with property owner(s) if necessary. The town states that actual implementation of ICs is predicated on the willingness of the property owners.

No other issues were identified in the interview meeting.

In addition, local residents were interviewed by Berger via telephone.

<u>Interview #2 through 5 – Property Owners in Vicinity of the Site</u>
Property owners in the vicinity of the Site were interviewed by telephone. The property owners are:

- Ms. Patricia Gagne, 349 Rose Hill Road, (Plat 33, Lot 36). Her property is adjacent to the northwest corner of the Site. Gas probe GP-19 is located on the north side of Pearls Way next to the Gagne property line. The Gagne residence also has a methane detector inside the house.

- Mr. Myron Duffin, 278 Rose Hill Road, (Plat 33, Lot 42). His property is on the west side of Rose Hill Road across from GV-18. Gas probes GP-40C, GP-40D and GP-40E are located on the Duffin property and GP-12 is located on the west side of Rose Hill Road next to the Duffin property line. The Duffin residence also has a methane detector inside the house.

- Ms. Cynthia Knight, 75 Pearls Way, (Plat 33, Lot 33). Her property is northeast of the SWA and is adjacent to the gas flare location and North Pond.

- Mr. David Webster, 938 Broad Rock Road, (Plat 33, Lot 21). His property is located on the eastern side of the Saugatucket River, east of the BWA. Mr. Webster's residential (bedrock) well is monitored periodically.

These four property owners were interviewed as part of the first Five Year Review. Their responses are consistent with those provided five years ago. In general, all persons interviewed indicated that no odors were detected traveling from the Site onto their property. The two property owners with methane detection systems installed in their homes are amenable to removal of the detection meters.

IV. TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents?

YES. All aspects of the Site remedy, except the ICs, have been implemented or are being conducted on an on-going basis, in accordance with the 1999 ROD, and are operating and functioning as designed.

The source control remedy selected in the ROD for the Site (Alternative 4B) was intended to control the sources of contamination at the Site by limiting the extent to which precipitation would percolate and infiltrate through waste materials and minimizing further migration of the contaminated groundwater and landfill gas plume. The remedy is observed to be controlling the source of contamination; contaminant concentrations in groundwater and surface water have generally decreased or stabilized since implementation of the remedy and contaminant concentrations in landfill gas have decreased significantly since start-up of the active landfill gas collection system.

The components of the landfill capping remedy which have been completed consist of the following:

- Excavate and consolidate the BWA landfill materials onto the SWA landfill;
- Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the BWA;
- Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the SWA landfill and consolidated BWA materials;
- Assess, control, collect and treat landfill gas emissions by an active internal and perimeter gas collection system and thermal treatment of such gases through the use of an enclosed flare and continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary; and
- Install a chain link fence and/or other physical barriers where necessary to prevent Site access, injury, and/or exposure.

The active landfill gas collection and combustion system, although originally included in the ROD, was later revised to a combination active and passive gas collection system design and was initially operated as a passive gas venting system. The basis for this revision is presented in the September 2008 ESD. The ESD also indicated that, if ambient air monitoring or modeling identifies a potential risk to the nearby residents, the constructed remedy could be converted from the passive landfill gas migration system to an active landfill gas migration system. Landfill gas monitoring after completion of Phase II construction indicated methane was in fact detected off-Site in concentrations above the LEL. Accordingly, the decision was made to install a landfill gas flare. The landfill gas flare has been operating since February 2010 and as a result, methane concentrations have consistently been below 1.0% methane at all gas probes located off-Site since installation of the flare.

The on-going components of the remedy include the following:

- Inspect, maintain, and monitor the integrity and performance of the landfill cap over time;
- Long-Term monitoring of surface water, groundwater, and air;
- Perform operation and maintenance activities throughout the life of the remedy; and
- Conduct statutory five year reviews as required.

These components will continue to be implemented at the Site. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analysis. Operation and maintenance activities at the Site continue to be performed. The conducting of the five year reviews, of which this document is the second, is expected to continue in the future.

The implementation of ICs, as described in the selected remedy, consists of the following:

- Implement access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

Institutional Control determinations continue to be a critical component in the implementation of the remedy. As the lead agent for initiating the IC mechanisms and tracking the development of the IC determinations, the town of South Kingstown is currently in the process of ICs implementation. While considerable progress has been made in that town-owned property and two private property ICs are recorded, land uses and changes in ownership of private land, among other factors, have inhibited progress on completing IC work for all identified properties. The town will continue to update the IC Tracking Chart presented in Appendix D with new information regarding the parcels, parcel owners, and Site issues, and as additional ICs are recorded. Despite the fact that ICs are currently not fully in place at the Site, fences are in place around the perimeter of the capped area and public water supply is available to all area residents to prevent disturbance of the landfill cap and use of groundwater at the Site.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy section still valid?

YES. Although there have been changes in some toxicity factors, default exposure factors, recommended cleanup levels, and some risk assessment methods, the remedy remains protective because exposure is being prevented by access restrictions and institutional controls for most of the potentially impacted properties, vapor intrusion is unlikely, and monitoring of surface water indicates that concentrations of contaminants of concern are decreasing. There have been no remarkable changes in physical conditions of the Site (other than changes due to the implemented remedy) that would affect the protectiveness of the remedy. As described previously, 1, 4-dioxane will be analyzed in groundwater at a lower detection limit because such analysis is now recommended for any site that has chlorinated VOCs. Previous analyses of groundwater were non-detect but the detection limit was higher than currently recommended remedial goals. In 2010 and 2013, EPA finalized the toxicity assessment for 1,4-dioxane. The new values indicate that 1,4-dioxane is considered to be more toxic from both cancer and non-cancer health effects since the last five year review. The EPA Regional Screening Level for residential tapwater is 0.46 ug/L for a cancer risk of 1×10^{-6}, and 56.7 ug/L for a non-cancer hazard quotient of 1 for a residential child.

ARARs

The Federal and State ARARs were first identified in the ROD (EPA, 1999) and were detailed in the Demonstration of Compliance Plan (2007). The purpose of the source control remedy was to control sources of contamination; therefore, no numeric clean-up levels were established in the ROD. A full description of the ARARs is also located in the 1998 Feasibility Study. Table 76, in Appendix B of the ROD provides a brief synopsis of the ARARs and an explanation of the actions necessary to meet the ARARs. In addition to ARARs, the table describes standards that are To-Be-Considered (TBC) with respect to remedial actions. The changes in standards which have been made to the ARARs since the ROD was signed do not affect the remedy protectiveness. Relevant changes to PALs are described in Section III, Data Review.

The surface water ARARs consist of the Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC), 40 CFR 122.44; RIDEM Water Quality Regulations; and Proposed CWA AWQC, 40 CFR Part 120, with the point of compliance being where discharge from the Site enters receiving waters. Point source discharges of pollutants to a Water of the State are required to comply with the Rhode Island Water Quality Regulations and the Regulations for the Rhode Island Pollutant Discharge Elimination System (RIPDES).

No groundwater cleanup levels were established in the ROD. Since no cleanup levels were established, no chemical specific ARARs for groundwater have been identified.

The action specific ARARs for source control include groundwater requirements set out in the Rhode Island Rules and Regulations for Groundwater Quality, and the more stringent of the Rhode Island Rules and Regulations for Hazardous Waste, or the federal hazardous waste rules at 40 CFR 264 Subtitle F, and 40 CFR 258 Subtitle E. Because groundwater cleanup levels were not established in the 1999 ROD, only those provisions related to implementing a groundwater monitoring program will be complied with. In addition, maximum contaminant levels and non-zero maximum contaminant level goals (MCLs/non-zero MCLGs) in the Safe Drinking Water Act have been identified as action specific ARARs solely for the purpose of measuring the performance of the source control remedy.

The ARARs for air consist of Rhode Island Air Pollution Control Regulations and Guidance for Air Quality/Air Toxics Substances, and Clean Air Act (CAA) National Emissions Standards for

Hazardous Air Pollutants (NESHAP) (40 CFR Part 61) and CAA Standards of Performance for Municipal Solid Waste Landfills. These ARARs apply to air emissions during construction and/or landfill gas emissions. Monitoring of landfill gas probes is used to demonstrate compliance. With the inclusion of the landfill gas flare, the gas flare is also monitored for compliance. Permanent use of the gas flare would require registration with RIDEM Office of Air Resources and compliance with applicable RIDEM Air Pollution Regulations after meeting certain emissions thresholds. In the event that the gas flare is discontinued, the Site will revert back to a passive gas venting system and the gas vents will be monitored to demonstrate compliance.

The ARARs that apply to solid waste include Rhode Island Solid Waste Regulation No. 2, Solid Waste Landfills, Section 2.1.09 (b) and (c). These ARARs are met through quarterly landfill inspections and maintenance of the landfill cap.

There have been regulatory changes that have impacted the location-specific ARARs relating to floodplain management and wetlands protection. The regulations that incorporated requirements of Executive Orders 11988 (Management of Floodplain) and 11990 (Protection of Wetlands) at 40 CFR Part 6, Appendix A, as cited in the 1999 ROD, no longer exist. Federal Emergency Management Agency (FEMA) regulations at 44 CFR § 9, which set forth the policy, procedure and responsibilities to implement and enforce these Executive Orders, are considered relevant and appropriate. The FEMA regulations require critical actions, including landfills, to meet 500-year floodplain standards. As the toe of the landfill is outside of the 500-year floodplain, the remedy remains protective in light of this new standard. FEMA flood plain mapping available for the area around the Site is presented on Figure 6, FEMA Special Flood Hazard Areas.

Standards and Standards Changes To Be Considered

The PALs were established for environmental media on the Site as described in Berger's 2008 Quality Assurance Project Plan (QAPP); a 2005 QAPP prepared by MACTEC Engineering and Consulting, Inc. (MACTEC) for the Remedial Action; a 2003 QAPP prepared by Berger for the Remedial Design; and an updated 2011 QAPP prepared by Berger for Post-Closure Monitoring. As stated in these QAPPs, the intent of the PALs is not to supersede the risk assessment or remedial action objective processes which are integral parts of developing cleanup standards for the Site, but to provide a check that data produced will meet Project Quality Objectives for COCs.

The changes in standards which have been made to the PALs since the 1999 ROD are the following:

Groundwater PALs

- Adoption of a new standard for arsenic in drinking water of 10 parts per billion (ppb), replacing the old standard of 50 ppb (EPA, 2001).

Surface water PALs

- Changes to EPA National Recommended Water Quality Criteria (NRWQC) based upon recalculation of human health criteria based on EPA's Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000) (EPA-822-B-00-004), (NRWQC, 2002).
- Additional revised human health criteria for fifteen chemicals (EPA, 2003[2]).

Since NRWQC and AWQC were not available for all analytes and since other more rigorous criteria for some contaminants of concern (COCs) have been established, some PALs were based on other standards including the following:

- Manganese: EPA Drinking Water Advisory 2008;
- Cadmium, chromium, copper, lead, nickel silver, zinc: RIDEM Ambient Water Quality Criteria (Water Quality Regulations, 2009).

Berger proposed new PALs for some metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) in surface water and recommended an update to the 2008 QAPP following completion of the first Five Year Review to reflect the new PALs and clarify the source of each PAL. The PALs were revised and the QAPP updated in March 2011. The revised surface water PALs are presented in Table 4.

Landfill gas PALs

The VOC n-propyl bromide was added to the list of regulated substances under the RIDEM Air Pollution Control Regulation No. 22 for Air Toxics (RIDEM APC No. 22 amendment, 2008) in 2008. N-propyl bromide was not one of the COCs monitored in landfill gas at the Site, however its primary uses are not consistent with wastes disposed of at the Site and therefore this chemical was not added to the list of analytes monitored at the Site.

During the RD, Berger completed a Field Investigation Summary Report (August 2004) that summarized the results of the 2003-2004 quarterly monitoring and made recommendations for future monitoring. The MACTEC sampling round subsequent to the RD obtained results generally consistent with the findings of the quarterly monitoring program. Therefore, the conclusions reached in the Field Investigation Summary Report remained valid.

Based on the results of the environmental monitoring programs conducted in 2003-2004, the sampling strategy for the Site has changed since the 1999 ROD. Changes in the sampling regimen were accepted by both EPA and RIDEM and the current sampling regiment for the Site based on these changes is described in the Final LTM Work Plan (Berger, 2008). Changes in monitoring locations and analytical parameters are described for each media sampled in Section

[2] In June 2015, EPA updated its national recommended water quality criteria for human health for 94 chemical pollutants to reflect the latest scientific information and EPA policies. PALs will be updated accordingly in response to this latest update. http://water.epa.gov/scitech/swguidance/standards/criteria/current/hhfinal.cfm

III.

Based on examination of the EPA Integrated Risk Information System (www.epa.gov/iris) and related sources, during the last five years no changes have occurred to the toxicity values of the Site COCs that might affect the protectiveness of the remedy.

Remedial Action Performance

The Remedial Action was performed between April 2005 and September 2007. Documentation of the performance of the work is provided in the Final Remedial Action Report, Phase II Landfill Closure (Berger, September 2008).

The RA Report indicates that the RA was completed according to the Design Documents, which were prepared in accordance with the remedy selected in the ROD.

Based on the performance data collected to date (both during and after implementation of the source control remedy), contamination at the Site has diminished. Analyses of chemical concentration trends are provided in Section III.

System Operations/O&M

The Post-Closure Operations and Maintenance Plan (O&M Plan) was prepared as a component of the Remedial Action Project Operations Plan (RA POP) in accordance with the Remedial Action Statement of Work (RA SOW) in the May 28, 2004 CA. The O&M Plan provides a written understanding and commitment of how various post-closure aspects such as operations and anticipated use of areas, access, security, contingency procedures, maintenance responsibilities, evaluation and assessment of landfill components, monitoring and inspection programs, record keeping and reporting and the well maintenance program are being managed by the town of South Kingstown and the Supervising Contractor responsible for Environmental Engineering Services to RIDEM.

The post-closure programs related to maintenance, monitoring and inspection of the Site have been and will continue to be performed in accordance with the remedy selected in the ROD.

Opportunities for Optimization

There is no information available which indicates or suggests opportunities for optimization.

Early Indicators of Potential Remedy Problems

There are no early indicators of potential remedy problems.

The detection of methane in gas probes beyond the Site property boundaries resulted in the installation and operation of the landfill gas flare. Operation of the gas flare and gas probe monitoring continue to demonstrate that the active gas collection system and gas flare prevents landfill gas migration off-Site. It is likely that as the landfill gas supply continues to decline, the landfill gas flare may operate under a programmed sequence such as one day on/two days off timing sequence and the results monitored as part of the landfill gas monitoring. This interim step is necessary at the Site to determine if the landfill can safely revert back to passive gas venting operation.

Implementation of Institutional Controls

The implementation of ICs in the selected remedy is discussed above and includes access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.

The town of South Kingstown is currently in the process of the ICs implementation. The town will continue to update the IC Tracking Chart presented in Appendix D, with new information regarding the parcels, parcel owners, and Site issues, and as additional ICs are recorded.

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

NO. There is no other information that calls into question the protectiveness of the remedy.

Technical Assessment Summary

According to the data reviewed, the Site inspection, and the interviews, the remedy is generally functioning as intended by the ROD. There have been no changes in the physical conditions of the Site that would affect the protectiveness of the remedy. Except as noted previously, most of the ARARs identified in the ROD remain applicable or relevant and appropriate and either have been met or are being complied with. However, this is not true for the NRWQC and RI surface water standards that are ARARs in that some contaminants remain above established PALs.

Gas probe monitoring in Years 1 through 3 detected the presence of methane beyond the Site property boundaries, but not on a consistent basis at any one location. After the landfill gas flare was installed and began operating on a continuous basis, methane was no longer detected at elevated concentrations in off-site gas probes, demonstrating the ability of the active gas collection system to lower the off-Site methane concentrations to below LEL levels. Successful operation of the active gas collection and gas flare operation clearly indicate the need for active gas collection at the Site. The gas flare continues to operate at a steady state condition and the gas collection system is continually monitored to ensure proper operation of the landfill gas management system. Landfill gas flow has been slowly declining over the past five years of landfill gas flare operation, with gas flow currently approximately 30-40% lower than when initial gas flare operations began.

Although the vapor intrusion pathway does not currently pose an unacceptable risk based on available information, it is recommended that concentrations of VOCs in groundwater, along with the depth to groundwater in monitoring wells, continues to be monitored so that vapor intrusion pathway can be reassessed annually in residential areas and in the future should structures be built in other areas or until it is known that the threat of gas migration and/or the potential for vapor intrusion is diminished to a level which no longer constitutes a concern. The Long-Term Monitoring Work Plan should continue to be implemented to further assess or characterize the management of migration, or site impacts from, landfill gas, contaminated groundwater and surface water at the Site. Modifications to the site–specific monitoring program may be needed over time based upon the results of the monitoring completed and the trends observed.

Finally, the town of South Kingstown is currently in the process of performing the required IC implementation activities. As indicated by Table D-1, a number of Institutional Controls (ICs) are now in place (e.g., on town-owned properties that incorporate the source area), but not all planned ICs are complete. IC documents have been prepared by the town of South Kingstown and progress is being made to implement all remaining ICs in accordance with the current IC program. Other protective or restrictive controls are in place. These controls include fencing (and maintenance thereof) around the perimeter of the capped area, and a public water supply that is available to all area residents.

V. ISSUES/RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 21: Issues and Recommendations/Follow-up Actions

OU #	Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
						Current	Future
1	Institutional Controls are recorded for all town-controlled property and two private parcels; but are not in place for all identified private property potentially affected by the Site.	ICs are to be completed by the Town of South Kingstown.	Town of South Kingstown, RI	EPA	6/1/2016	No	Yes
1	Sporadic methane concentrations above the LEL have been detected at monitoring points on the western side of Rose Hill Road outside of the Site property limits when the existing gas flare is not operational. Potential for vapor intrusion, while not posing an unacceptable risk based on available information, remains as a potential threat.	Ensure that the landfill gas flare is operated and maintained for continuous active management of landfill gases.	RIDEM and Towns	EPA	8/1/2020	No	Yes

OU #	Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
						Current	Future
1	Modify the Long-Term Monitoring Program, as needed, to collect sufficient information to determine if the management of migration of contaminants from the site is effective and collect sufficient data necessary to support a decision document concerning a final groundwater and surface water remedy, if needed.	Continue Long-Term Monitoring (LTM) program in its present form, with continued landfill gas monitoring, bi-annual groundwater and surface water monitoring. Modifications to the long term monitoring program for the Site may be made in the future based upon monitoring results and analyses. The goal of the LTM program is to collect the data necessary to support an OU 2 decision document concerning a final MOM remedy.	RIDEM and Towns	EPA	8/1/2020	No	Yes

In addition, the following recommendation is noted in this Five Year Review as technical improvement in monitoring, but does not affect the short-term protectiveness of the remedy:

- Since 1,4-dioxane detection limits and concentrations have been revised downward since the 2006 sampling, this VOC will be added to the list of parameters besting tested for groundwater.

VI. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: 1	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste and disturbance of the landfill cap; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands, and surface water bodies; 3) the landfill cap, gas extraction system, and the landfill gas flare is capturing and treating landfill gases to prevent unacceptable exposures beyond the Site boundary; and 4) properties at and surrounding the Site are connected to an alternate water supply to prevent use of groundwater at the Site. However, the remedy cannot be deemed protective in the long term until the following actions are taken: 1) institutional controls are fully implemented; 2) active landfill gas management remains in continued operation unless recurrent monitoring and modeling data indicate that the passive gas venting system can be reinstituted; 3) the assessment of monitoring results from the Long-Term Monitoring Work Plan are sufficient to support a future and final OU 2 remedy decision for groundwater and surface water, and if further warranted, implementation of the remedy to address the management of migration of contaminants from the Site.	

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter a date.
Protectiveness Statement: The remedy for OU-1 currently protects human health and the environment in the short term because: 1) access to the Site is restricted to prevent direct exposures to the waste and disturbance of the landfill cap; 2) the vegetative cover and the drainage system are constructed and maintained to prevent erosion of soil and deposition into the surrounding detention ponds, wetlands, and surface water bodies; 3) the landfill cap, gas extraction system, and the landfill gas flare is capturing and treating landfill gases to prevent unacceptable exposures beyond the Site boundary; and 4) properties at and surrounding the Site are connected to an alternate water supply to prevent use of groundwater at the Site. However, in order for the remedy to be protective in the long term the following actions need to be taken: 1) institutional controls are fully implemented; 2) active landfill gas management remains in continued operation unless recurrent monitoring and modeling data indicate that the passive gas venting system can be reinstituted; 3) the assessment of monitoring results from the Long-Term Monitoring Work Plan are sufficient to support a future and final OU 2 remedy decision for groundwater and surface water, and if further warranted, implementation of the remedy to address the	

management of migration of contaminants from the Site.

VII. NEXT REVIEW

The next five-year review report for the Rose Hill Regional Landfill Superfund Site is required five years from the completion (signature) date of this review.

APPENDIX A

EXISTING SITE INFORATION

A. SITE CHRONOLOGY

Table A-1: Site Chronology

Event	Date
Initial discovery of problem or contamination	January 1983
Pre-NPL responses: Site Inspection Report issued	September 1985
Final NPL listing	**October 4, 1989**
Negotiations to conduct Remedial Investigation / Feasibility Study initiated	June 19, 1990
Initiate Remedial Investigation / Feasibility Study (Fund Lead)	September 30, 1990
Removal Action: Lateral migration of Landfill Gas (LFG)	November 8, 1991
Unilateral Order to Town of South Kingstown taking action concerning LFG (alarms and venting)	March 26, 1993
Remedial Investigation/Feasibility Study complete	November 1998
ROD signature	December 12, 1999
ELUR recorded for Plat 32, Lot 10 (State action)	May 8, 2000
Negotiations to conduct Remedial Design and Remedial action initiated	September 28, 2000
ELUR recorded for Plat 33, Lot 45 (State action)	March 13, 2001
Cooperative Agreement for Remedial Design	July 12, 2001
Consent Decree to implement remedy entered	March 13, 2003
Beneficial Reuse Study completed	November 2003
Cooperative Agreement for Remedial Action	May 28, 2004
Remedial design approved (Phase I Waste Consolidation)	January 5, 2005
On-site remedial action construction start (Phase I)	May 26, 2005
RA Construction Substantially Complete (Phase I)	March 29, 2006
Remedial design approved (Phase II Landfill Capping)	May 30, 2006
On-site remedial action construction start (Phase II)	September 25, 2006
RA Construction Substantially Complete (Phase II)	September 25, 2007
Explanation of Significant Differences (ESD)	September 19, 2008
Preliminary Close-out Report	September 26, 2008
Pilot Study for Landfill Gas – System Start-up	February 10, 2010
First Five Year Review	August 25, 2010
Completed CERCLA ICs for Town-owned parcels (Plat 33, Lots 32, 34, and 46)	August 29, 2013

B. BACKGROUND

The Site is located within the Town of South Kingstown, Rhode Island in the village of Peace Dale, all of which are part of Washington County. It lies approximately five miles inland from Narragansett Bay and two miles north of Wakefield, Rhode Island. The Site is bordered by Rose Hill Road to the west, the Saugatucket River to the east and residential private property to the north and south. The Site location is shown on Figures 1 and 2 in Appendix A. Figure 1 illustrates the Site location with reference to the Town of South Kingstown and the abutting Towns.

The Site encompasses approximately 70 acres, and includes an active solid waste transfer facility zoned as public land; a small area of land zoned for commercial use along Transfer Station Road; and privately owned land which was either formerly used for sand and gravel mining and/or waste disposal, or has remained undeveloped. Land use within one mile of the Site is predominantly agricultural and residential.

Several environmental investigations have been conducted at the Site since 1975 and were summarized in Metcalf & Eddy's 1994 Remedial Investigation (RI) and Feasibility Study (FS) Reports and 1991 RI/FS Work Plan. The RI investigated the extent of contamination and impact of the Site to public health and the environment. The FS analyzed source control (SC) and management of migration (MOM) alternatives for the Site. A Record of Decision (ROD) was signed by EPA in December 1999. Following negotiations for the Remedial Design/Remedial Action (RD/RA), a Consent Decree (CD) to conduct the remedy was entered into by the settling defendants. In May 2003, Berger (working for the State of Rhode Island under a cooperative agreement between EPA and RIDEM) began the quarterly monitoring program as part of the Remedial Design (RD) for Rose Hill Landfill. The results of the 2003-2004 sampling events were presented in Berger's Field Investigation Summary Report (August 2004). In 2008, Berger began quarterly post-closure monitoring; results were presented in Berger's Landfill Closure – Rose Hill Landfill Superfund Site Quarterly Monitoring Reports (2008-2009). Also in 2008, the ESS Group of East Providence, Rhode Island began annual stream habitat assessment and macroinvertebrate biomonitoring at the site.

Physical Characteristics

The Site previously consisted of three distinct areas formerly used for waste disposal: a Solid Waste Area (SWA), a Bulky Waste Area (BWA), and a Sewage Sludge Area (SSA). The locations of these three separate and inactive disposal areas are shown in Figure 2 of Appendix A. The SWA is a 27.7-acre area located immediately east of Rose Hill Road between an unnamed tributary to the Saugatucket River and Mitchell Brook. The BWA is a 9.4-acre area located east of the SWA and southwest of the SSA. The SSA is a 9-acre area located in the northeast section of the Site, between Mitchell Brook and the Saugatucket River. The waste materials within these areas were consolidated within the SWA as part of the landfill remedial action conducted between 2004 and 2007.

Hydrology

Two primary surface water bodies, the Saugatucket River and Mitchell Brook, flow through the Site. An unnamed brook, west of the Site, flows into the Saugatucket River and an unnamed tributary, in the northern portion of the Site, flows into Mitchell Brook. Both Mitchell Brook and the Saugatucket River are classified by the State of Rhode Island as Class B water bodies, designated for fish consumption, aquatic life, and recreational contact (swimming and boating) uses. Wetland and flood plain habitats are also found adjacent to the disposal areas and are subject to runoff and contamination from the disposal areas. An open excavated area approximately 400 feet north of the disposal areas is currently used for target and skeet shooting.

A former sand and gravel bank exists approximately 200 feet west of the disposal areas.

Land and Resource Use

Efforts related to re-use of the Site have been limited to preliminary studies. In August 2003, CDM was engaged by the Town of South Kingstown to prepare a beneficial reuse study. The CDM report, Rose Hill Landfill Beneficial Reuse Study (November 2003), identified potential future uses of the Site following completion of Site remediation activities. The report noted that any anticipated reuse options at the Site would need to factor in the inherent limitations that arise from land use restrictions placed on the property in order to protect the constructed remedy. The CDM report indicated possible uses for the Site including a golf range (SWA), nature trails, and a dog park, with the BWA potentially envisioned as recreational fields, but no efforts have been made by the Town to pursue any Site re-use to date. The SSA is privately owned and has returned back to its previous use as part of a shooting range operation. Any future development opportunities for the Site would be included under the Town's capital improvement program (CIP) budget process. EPA and RIDEM remain open to discussions with the Town concerning reasonably anticipated reuse opportunities which are not inconsistent with the identified land use restrictions, maintain the integrity of the constructed cap, and do not otherwise interfere with the operations and maintenance (O&M) of the remedy over the long term.

Presently, the Town of South Kingstown is interested in the potential installation of photovoltaic solar panels in the SWA and plans to issue a Request for Proposals in 2015. The Town is reviewing various financing and operational options to determine the best arrangement for the Town if the site is developed for solar energy production. The Town is also developing a municipal Debris Management Plan (DMP) that will identify debris staging areas for catastrophic storm related debris. The BWA will be one site evaluated as a debris staging area during development of the Town DMP.

History of Contamination

Prior to 1941, the Site was used for agricultural purposes. Sand and gravel operations were conducted at the Site from at least 1948 through 1963. The Site began landfill operations in 1967 and was operated by the Town of South Kingstown under State permit from RIDEM which was renewed annually. For approximately 16 years, the Site received domestic and industrial wastes from residents and industries in the Towns of South Kingstown and Narragansett. In October 1983, the Site reached its State permitted maximum capacity and active landfilling operations ceased.

Landfills in the three disposal areas (SWA, BWA and SSA) began operations in 1967, 1978 and 1977, respectively. The SWA landfill was closed in 1982 and the BWA and SSA landfills were closed in 1983. In 1983, a transfer station for municipal waste was constructed south of the BWA and the municipality began waste transfer operations that have been continuous since that time. Municipal solid waste is unloaded from collection trucks and private vehicles and transferred to vehicles that transport it off site to the Central Landfill in Johnston, RI for final disposal.

In 1967, when activity at the Site officially commenced, a court order prohibited the disposal of combustibles at the Site. In 1978, the order was amended to allow the disposal of combustibles in the BWA. In 1979, the State of Rhode Island ordered cities and towns to establish facilities for the collection of waste oil. There is evidence that a waste oil collection facility at the Site was established during this time.

A known waste handling problem at the Site concerns the disposal of liquid waste from the Peacedale Processing Company, specifically in the form of a urethane adhesive. A letter from the State Division of Solid Waste Management dated January 8, 1970 to the Town of South Kingstown Director of Public Works identified the agreed upon disposal method for liquid waste from the Peacedale Processing Company, whereby drummed waste would be disposed of daily by dumping it onto other wastes deposited at the landfill each day. This method was intended to utilize the absorptive characteristics of the waste material as the urethane adhesive was disposed.

Correspondence dated March 16, 1971 from the State Division of Solid Waste Management to the Town of South Kingstown Town Manager notified the Town that the liquid waste from the Peacedale Processing Company was being improperly disposed of at the landfill and reiterated that the agreed upon method of spreading the liquid waste over the surface of the landfill must be followed.

In 1979, a resident observed and reported to RIDEM that a number of barrels, with lids intact, were being dumped on the SWA landfill slope within a few feet of Rose Hill Road. The truck transporting these drums was reported to be from the Peacedale Processing Company. The resident further reported that at least one barrel was labeled "slop glue", with all drums being buried intact with the exception of one. RIDEM investigated this report and found a drum labeled "DALTOSLEX 535" and "DRANO 21". Daltoslex is a polyurethane fabric coating dissolved in trichloroethylene (TCE), dimethyl formamide (N, N-DMF), and cellosolve solvent. Cellosolve is the trademark for mono- and dialkyl ethers of ethylene glycol and their derivates. Analysis of samples collected from these drums identified hexane, 2-butanone (MEK), trichloroethylene (TCE), and toluene as components of the liquid. All of these chemicals are widely used industrial solvents. Dimethyl formamide and cellosolve cannot be detected by the common methods used to analyze for volatile organic compounds.

The State Division of Solid Waste Management wrote a letter to Kenyon Piece Dyeworks (a subsidiary of Peacedale Processing) on December 6, 1979, to confirm an analysis of the waste adhesive procured from the Peacedale plant on November 19, 1979. The analysis indicated that the sample contained TCE at 29,000 parts per billion (ppb), toluene at 400 ppb, and tetrachloroethylene at 4 ppb. An analysis of the waste itself revealed that it contained TCE in the amount of 0.35%. Based upon the analyses, the waste adhesive produced at the plant was deemed not hazardous (as a solid), as defined by Rhode Island regulations, and could be disposed of at any licensed solid waste management facility. The State added that the waste adhesive was to be in a solid form when taken to the landfill and exposed to the air for at least a week prior to its disposal. Within the same time frame, Kenyon Piece Dyeworks notified the State that the company had suspended shipment of the above-mentioned waste adhesive to the Site pending further investigation of its environmental reactivity.

In 1981, Peacedale Processing notified EPA, Region 1 that the company had disposed of laminating adhesive at the Site from 1971 to 1979. Although other volatile organics, inorganics and phthalate compounds have been detected at the Site, little is known about the disposal practices associated with these contaminants.

The SWA operated from 1967 through 1982 covering approximately 27.7 acres. The exact depth of deposited solid waste materials varies, but has been identified as to be to bedrock in some locations. Refuse has also been deposited in areas above, below and at the water table. Review of historical aerial photographs has indicated that the sand and gravel pit was filled in with solid waste material starting in the southernmost portion and progressing in a northerly direction. By 1988, waste materials were present throughout the pit, with all remnants of the sand and gravel pit no longer existing. Several possible leachate seeps were observed in the review of 1988 aerial photographs, particularly in the northern, eastern and southern portions of the disposal area. The SWA was closed with a cover of 0.5 to 2 feet of sandy soil and subsoil in 1982.

The SSA is located in the northeast corner of the Site, between Mitchell Brook and the Saugatucket River and north of the BWA. This area, approximately 9 acres in size, was operated from 1977 to 1983, for the disposal of sewage sludge generated by the Town of South Kingstown wastewater treatment plant. The sludge was deposited in trenches and backfilled. Review of 1981 aerial photographs show a series of trenches running the entire length of the area in a north-south direction, as well as two small trenches in the northern section. Reported problems with high moisture content of the sludge prompted the Town of South Kingstown to initiate the hauling of sludge to the Central Landfill in Johnston, RI. In a July 15, 1993 letter to the Utilities Director of the Town of South Kingstown, RIDEM, Division of Water Resources confirmed that the SSA has been properly closed, poses no threat to public health as long as the area is not excavated and a closed Order of Approval No. 490 was issued for the sludge disposal area.

The BWA is a 9.9 acre area which was used by the Town of South Kingstown primarily for the disposal of large bulky materials, such as appliances, tree stumps and other debris. The BWA is located east of the SWA and southwest of the SSA, approximately 200 feet east of Mitchell Brook and 250 feet west of the Saugatucket River. The BWA was operated from 1978 to 1983. During Remedial Action (RA) activities, complete excavation of the BWA revealed that the area was filled primarily with textile remnants deposited by local industries, with very little conventional bulky waste materials.

The original property owners of the Site were Edward L. Frisella, Sr. and Pearl F. Frisella, who are now both deceased. In 1967, the Town of South Kingstown entered into a lease with Edward Frisella, Sr. for the operation of a solid waste landfill. After the establishment of the landfill, in February 1973, the Town of Narragansett entered into an agreement with the Town of South Kingstown for joint use and operation of the landfill. In 1977, Edward Frisella, Sr. and the Town of South Kingstown reached an agreement regarding the continued use of the property as a landfill facility. This amendment to the lease provided additional landfill areas for expansion of the landfill facility to utilize the SSA and BWA. In 1982, the Town of South Kingstown purchased 15 acres from Edward Frisella, Sr. for the location of the Town's new transfer station. The Town of South Kingstown is now the owner of the parcels containing the SWA and BWA portions of the Site. The SSA parcel remained in the Frisella family under the ownership of

Richard Frisella, until it was sold in 2014 to BWJW, LLC, an entity operating the site as the Peace Dale Shooting Preserve.

Initial Response

The Preliminary Assessment Report for the Site was completed in January 1983, followed by a Site Inspection Report completed in September 1985. The Site was proposed for inclusion on the National Priority List (NPL) on June 24, 1988. On October 4, 1989, the Site qualified for final listing on the NPL.

Historical sampling data gathered in support of the Preliminary Assessment Report and Site Investigation Report indicated the presence of contaminants in groundwater, landfill leachate, surface water, and sediments within the vicinity of the Site. This information was summarized in the Preliminary Health Assessment (ATSDR, 1990).

1975: Town of South Kingstown hired a consultant to perform a groundwater study, due to the discovery of contamination in an off-site private well.

1971-1979: laminating adhesive containing TCE disposed of at the Site.

1978-1981: High concentrations of copper and zinc detected in sludge.

1982: High concentrations of VOCs detected; 1,2-dichloroethene has the highest concentration level. The VOCs 1,1,-trichloroethane, methylene chloride, 1,2-dichloroethylene, 1,1-dichloroethane, and toluene were detected in samples collected from Mitchell Brook.

1983: Sampling indicates contamination in the Saugatucket River, below the confluence with Mitchell Brook.

1987-1988: Volatile and extractable organic compounds detected in soil and surface water samples.

1990: Preliminary Health Assessment (ATSDR, 1990)

1992-1993 Remedial Investigation (May 1994): Gas migration from landfill to nearby residences detected.

Feasibility Study (November 1998): Feasibility Study issued and presenting findings.

Residences from South Kingstown obtain water from both public and private wells. Private wells within a 3-mile radius of the Site consist of overburden or bedrock wells. Three supply wells for the University of Rhode Island are located approximately 2.7 miles northwest of the Site. Two municipal supply wells for the Kingston District are located approximately 3-miles northwest of the Site. The University and the District use each other's water systems as backup water supply sources. Due to well contamination issues, in 1985, the Town of South Kingstown extended the municipal water line to adjacent residences located on Rose Hill Road and those dwellings abutting the immediate northern portion of the Site. By 1989, water service was provided by the Town to residences on Broad Rock Road. Residences that abut the Site along Rose Hill Road and Pearl's Way north, west, east and south of the Site are all connected to municipal water.

EPA investigations during the winter and spring of 1993 indicated gas migration from the landfill to nearby residences, with initial sampling results indicating the presence of explosive levels of combustible and hazardous gases in the vicinity of specific residential dwellings abutting the Site. In response to this information, the Town of South Kingstown installed gas alarms in two of the residences (278 and 349 Rose Hill Road), and, in June 1993, razed a third problematic dwelling (220 Rose Hill Road). A new single story structure (Rose Hill golf course clubhouse) utilizing a slab on-grade design with an underground methane interception system was constructed on the lot where the razed building was once located.

In 1994, the Town installed a bentonite clay dam around the municipal water service supply line before the pipe entered the residence at 278 Rose Hill Road to prevent landfill gases from seeping into the house. The Town also relocated the methane sensor from the outside basement wall to inside the basement to record methane concentrations inside the dwelling. Since that time, the Town has continued to maintain the methane monitoring equipment and submit data reports to EPA and RIDEM.

EPA began an investigation into the nature and extent of contamination in the three separate disposal areas in 1990. The scope of the investigation included sampling of groundwater, surface water, soils, and sediments. Expanded studies included an ecological impact assessment, a landfill gas migration evaluation, and a revised assessment of alternatives that included the feasibility of using several innovative cleanup technologies. EPA evaluated several cleanup alternatives through 1999, and following a public comment period, selected a final cleanup remedy for the Site and issued a Record of Decision on December 12, 1999.

Basis for Taking Action

Groundwater: The analytes trans-1,2-dichloroethylene, TCE, di-n-butyl phthalate, and diethyl phthalate were detected in off-site residential wells in sampling performed in November 1984.

Surface Water: The analytes 1,1,1,-trichloroethane, methylene chloride, 1,2-dichloroethylene, 1,1-dichloroethane, and toluene were detected in samples collected from Mitchell Brook in September 1982. Various volatile and extractable organic compounds were also detected in surface water samples collected from Mitchell Brook in the period from November 1987 – March 1988.

Soil: Various volatile and extractable organic compounds were detected in soil samples collected in the period November 1987 - March 1988 at several locations at the Site. The 1990 Preliminary Health Assessment document was not specific as to the actual soil sampling locations.

Leachate: The analytes 1,1-dichloroethylene, trans-1,2-dichloroethylene, cis-1,2 TCE, benzene, toluene, ethylbenzene, and m-xylene were detected in leachate sampled primarily from the SWA in the period from November 1987 - March 1988.

Landfill Gas: The presence of landfill gas was detected in soil gas wells in the vicinity of residential dwellings abutting the landfill. Elevated levels of vinyl chloride were also detected in soil gas wells.

Table A-2: Operable Unit 1 Contaminants of Concern

Groundwater	Leachate	Surface Water	Soil	Landfill Gas
Contaminants of Concern identified in RI Final Report, Volume II, May 1994				
Benzene	Chloroethane	Acrylamide	Acetone	Acetone
Chloroethane	cis-1,2-Dichloroethene	NN dimethylformamide	Vinyl chloride	Benzene
1,1 Dichloroethane	Bis (2-ethylhexyl) pthlalate	Aluminum	Benzo(a) anthracene	Carbon Disulfide
cis-1,2-Dichloroethene	cis-1,2-Dichloroethene	Antimony	Benzo(a) pyrene	1,1 Dichloroethane
Vinyl chloride	Aluminum	Barium	Benzo(b) fluoranthene	1,1 Dichloroethene
2-Methylnapthalene	Arsenic	Manganese	Benzo(k) fluoranthene	cis-1,2-Dichloroethene
Bis (2-ethylhexyl) pthlalate	Barium	Ammonia	Chrysene	trans-1,2-Dichloroethene
4-Chloro-3-methylphenol	Beryllium	Sulfide	Indeno (1,2,3-c,d) pyrene	Dichlorodifluoromethane
Pentachlorophenol	Chromium		Aluminum	Ethylbenzene
Acrylamide	Cobalt		Arsenic	4-Methyl-2-pentanone
NN dimethylformamide	Copper		Barium	Methylene Chloride
Aluminum	Lead		Beryllium	Toluene
Antimony	Manganese		Chromium	1,2,4-Trichlorobenzene
Arsenic	Vanadium		Cobalt	Trichloroethene
Barium	Zinc		Copper	1,2,4-Trimethylbenzene
Beryllium	Ammonia		Lead	1,3,5-Trimethylbenzene
Cadmium			Manganese	Vinyl chloride
Chromium			Mercury	m,p-Xylene

Cobalt			Nickel	
Copper			Selenium	
Lead			Thallium	
Manganese			Vanadium	
Nickel			Zinc	
Vanadium			Ammonia	
Zinc			Sulfide	
Ammonia				
Sulfide				
Additional Contaminants of Concern identified subsequent to RI Final Report, Volume II, May 1994				
Iron				Methane
				Vinyl chloride

C. REMEDIAL ACTIONS

Remedy Selection

The ROD for the Site was signed on December 12, 1999. The remedial action objectives (RAOs) listed in the ROD are:

- To reduce the potential exposure of area residents and those at the landfill to landfill gases (i.e., vinyl chloride, benzene, 1,1-dichloroethene, and 1,1,2,2-tetrachloroethane) in ambient and indoor air via inhalation that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for non-carcinogenic compounds with similar toxic endpoints.

- To reduce the potential exposure of area residents to organic and inorganic contaminants of concern (i.e., vinyl chloride, 1,2-dichloroethene, acrylamide, benzene, pentachlorophenol, bis (2-ethylhexyl)phthalate, antimony, arsenic, cadmium, manganese, beryllium, chromium, and lead) in groundwater via ingestion that may present a human health risk in excess of the EPA target risk range of 10^{-6} to 10^{-4} for carcinogenic compounds or with a total HI>1 for non-carcinogenic compounds with similar toxic endpoints through institutional controls.

- To reduce contaminant migration via leachate to surface waters and sediments of Mitchell Brook in order to improve water quality and designated use, including aquatic life support.

- To reduce contaminant migration via leachate to surface waters and sediments of the Saugatucket River in order to improve water quality and designated uses, including aquatic life support.

The source control remedy selected in the ROD for the Site was Alternative 4B, which would control the sources of contamination at the Site by limiting the extent to which precipitation would percolate and infiltrate through waste materials and minimizing further migration of the contaminated groundwater and landfill gas plume. The components of the landfill capping remedy consisted of the following:

- Excavate and consolidate the BWA landfill materials onto the SWA landfill;
- Collect and effectively manage leachate and waters collected from runoff and dewatering operations during the excavation of the BWA;
- Construct a multi-layer hazardous waste cap using innovative and cost efficient cover materials, as may be appropriate and as further defined in design, over the extent of the SWA landfill and consolidated BWA materials;
- Inspect and monitor the integrity and performance of the landfill cap over time;
- Assess, control, collect and treat landfill gas emissions by an active internal and perimeter gas collection system and thermal treatment of such gases through the use of an enclosed flare and continue monitoring landfill gas concentrations to assess the need to modify the landfill gas collection treatment system as necessary;
- Implement access restrictions and Institutional Controls (land title restrictions including, but not limited to, easements and restrictive covenants) on land use and the use of, or hydraulic alteration of, groundwater where Preliminary Remediation Goals (PRGs) (based on MCLs, MCLGs) and/or other health based standards are exceeded.
- Install a chain link fence and/or other physical barriers where necessary to prevent Site access, injury, and/or exposure;
- Long-Term monitoring of surface water, groundwater, air and leachate emergence;
- Perform operation and maintenance activities throughout the life of the remedy;
- Conduct statutory five year reviews as required.

Following the ROD and after approximately two years of negotiation, a Consent Decree (CD) effectuating a successful settlement to perform the Remedial Design/Remedial Action (RD/RA) for OU-1 was entered by the District Court in March 2003. The settlement required the potentially responsible parties, the Towns of South Kingstown and Narragansett, RI to pay $4,000,000, plus interest from March 31, 2002, to a Superfund special account in settlement of past costs incurred by the United States and future costs by the United States relating to the OU-1 source control remedy. The CD also provides that the State, with RIDEM as the lead agency, will implement the OU-1 remedy and be responsible for 50% of the cost of construction and 100% of the cost of O&M of the remedy. Under the CD, the Towns are to eventually reimburse the State for 30% of the State's OU1 remedy costs and O&M through a combination of cash payments and in-kind services. The CD also resolves the Towns' liability to the United States for natural resource damages relating to the Site. The Towns will also repair or replace the Indian Run Reservoir Dam and the Asa Pond Dam, both in the Town of South Kingstown, R.I., in settlement of the State's claims for natural resource damages.

Remedy Implementation

The RD/RA was conducted by the State in conformance with the ROD. The selected remedy in the ROD is the first operable unit of a phased approach to remediate the environmental contamination caused by the Site. This first operable unit is a source control remedy which is intended to prevent or minimize the continued release of hazardous substances, pollutants or contaminants to the environment. Upon completion of the source control remedy, site monitoring will furnish data to assess the effectiveness of the remedy and assist the State with TMDL predictions for site-related contaminant concentrations affecting local water bodies.

RD activities began with the development of a Final RD Work Plan (April 2003), prepared by Berger. The Final RD Work Plan described the tasks and investigations to be used to develop a RD. From May 2003 to April 2004, Berger conducted four quarters of groundwater, sediment, surface water, leachate, and landfill gas monitoring and sampling, with results from these activities summarized in the Field Investigation Report (August 2004). The Final Cap Design Report (December 2004) issued by Berger presented the design basis for the selected remedy.

Following review of the Final Cap Design Report by RIDEM, EPA and the Towns of South Kingstown and Narragansett, the decision was made to split the RA work into two phases: Phase I, Waste Consolidation and Landfill Cap Preparation, and Phase II, Landfill Closure. Contract documents (plans and specifications) for Phase I were completed by Berger in January 2005. Following completion of Phase I construction activities, contract documents for Phase II were completed by MACTEC, Inc. in May 2006.

The SSA met minimal State requirements for sewage sludge landfill closure, and did not pose any significant direct contact health threat as originally closed. However, the composted sludge in the SSA held some potential for use as a vegetative support layer for the SWA. The RA included the excavation and removal of buried sewage sludge material from the SSA as part of the project, with clean fill material used to backfill the excavated areas in the SSA. The sludge material was placed on the landfill as an 8-inch thick layer above the 18-inch vegetative support soil layer and topped with 4-inches of plantable soil material. This solution allowed for modest project cost efficiencies while also helping to gain some further environmental and local water quality improvements over time. Additionally, incorporating the SSA material enhanced the OU-1 remedy by serving as a fertile soil amendment to the landfill capping system.

The RA for Phase I, Waste Consolidation and Landfill Cap Preparation consisted of:

- Excavation and consolidation of approximately 167,500 cubic yards (cy) of waste/soil material from the BWA to be transported, placed and compacted at the SWA;

- Excavation and consolidation of approximately 58,500 cy of waste/soil material from the SWA to be placed and compacted within limits of the capped area in the SWA;
- Construction of stormwater management controls, including drainage swales, downchute, diversion benches and constructed wetlands;
- Construction of a culvert crossing at Mitchell Brook;
- Surface restoration of disturbed areas as indicated in grading plans specified in Contract Drawings;
- Utility relocation, fences, security, health and safety, erosion control, odor abatement, sedimentation ponds, dewatering and temporary transfer station access road; and
- Other miscellaneous tasks contained in the Contract Documents.

The RA for Phase II, Landfill Closure consisted of:

- Excavation and consolidation of approximately 41,800 cy of sewage sludge/soil material from the SSA to be transported and placed as part of the multi-layer cap in the SWA and incorporated as part of the plantable soil layer in the restoration and finish grading of the BWA;
- Placement of approximately 8,000 cy of controlled fill as part of the base layer construction within limits of the capped area in the SWA;
- Construct a multi-layer hazardous waste cap over the limits of the SWA and consolidated BWA materials;
- Construction of stormwater management controls, including drainage swales, downchute, diversion benches and constructed wetlands;
- Construction of landfill and BWA access roads;
- Surface restoration of disturbed areas as indicated in grading plans specified in Contract Documents;
- Construction of a landfill gas collection system in the SWA;
- Fence and access gate installation, erosion control, odor abatement, completion of sedimentation ponds, landscape plantings; and
- Other miscellaneous tasks contained in the Contract Documents.

The design for the RA included landfill components such as the landfill cover system, articulating concrete block downchute, landfill access road, riprap and earthen swale encircling the base of the landfill, landfill gas vents and landfill gas collection system. The landfill cover system was composed of base layer fill, low hydraulic conductivity soil or geosynthetic clay liner (GCL) layer, 60 mil textured Low Linear Density Polyethylene (LLDPE) liner, composite drainage net (CDN), vegetative soil layer, sludge layer and topsoil layer. Ancillary components associated with the operation of the landfill include the landfill fence system, including culverts, forebays and two retention ponds.

The landfill cap was designed to the performance standards outlined in the ROD CA and in accordance with the requirements of RCRA Subtitle C, including 40 CFR 264.19, 264.17, 264.310, and 264.111, and the Rhode Island Rules and Regulations for hazardous waste management. The Statement of Work performance standards required that the multi-layer RCRA C cap achieve minimum requirements, which are identified in the Remedial Action Report, Phase II Landfill Closure, January, 2008.

The selected remedy of Alternative 4B – Horizontal Containment (capping) of the SWA, Landfill Mining of the BWA, Leachate Collection and On-Site Treatment During Construction, combined with Gas Collection and Treatment, was revised during the RD/RA phases and an Explanation of Significant Differences (ESD) was issued by the Region in September 2008. Changes were made based upon value engineering opportunities arising from the availability of innovative materials, as well as Site monitoring results. The design for the landfill gas collection and treatment systems was expanded to include a passive landfill gas venting system. The system includes the installation of twenty-nine gas vents on the capped SWA landfill, with each vent directly connected to a landfill gas well and the landfill gas collection system installed under the cap. The vents are located ten (10) feet above the finish grade surface with each vent manually controlled by a butterfly valve. In addition, each vent is connected to an active landfill gas extraction system buried in the cap above the LLDPE liner. A second butterfly valve was installed between each gas vent and the landfill gas extraction system. Landfill gas sampling ports and temperature gauges were installed at each gas vent as well.

The landfill gas extraction system is designated as the active component of the landfill gas system. It is connected to every gas vent and terminates at two locations outside the landfill perimeter. The termination points for the landfill gas extraction system are located outside of the capped limits near the northeast and southeast corners of the SWA. The two piping system termination locations will be utilized, if needed, for installation of a blower system and landfill gas emissions flare. The need for utilizing the active landfill gas system would be assessed during post-closure landfill gas monitoring. By installing both active and passive gas systems, the option to operate either type of system could remain open after completion of the Phase II construction.

The RD/RA determined that the decision to convert the operation of the landfill gas system from passive to active could be made during the post-closure phase and would be based upon results obtained during post-closure landfill gas monitoring and subsequent dispersion modeling.

During post-closure operations, landfill gas was detected at off-site gas monitoring wells and the decision to implement an active blower system was made. The landfill gas flare has been operating successfully since its installation in February 2010. The migration of landfill gas off-site has been virtually eliminated as a result of the switch to an active blower system.

System Operation/Operation and Maintenance

The Post-Closure Operation and Maintenance Plan (O&M Plan) was prepared as a component of the Remedial Action Project Operations Plan (RA POP) in accordance with the Remedial Action Statement of Work (RA SOW) in the May 2004 CA. The overall objective of the O&M Plan is to provide RIDEM and EPA with a written understanding and commitment of how various post-closure aspects such as operations and anticipated use of areas, access, security, contingency procedures, maintenance responsibilities, evaluation and assessment of landfill components, monitoring and inspection programs, record keeping and reporting and well maintenance program are being managed by the Town of South Kingstown and the Supervising Contractor responsible for Environmental Engineering Services to RIDEM.

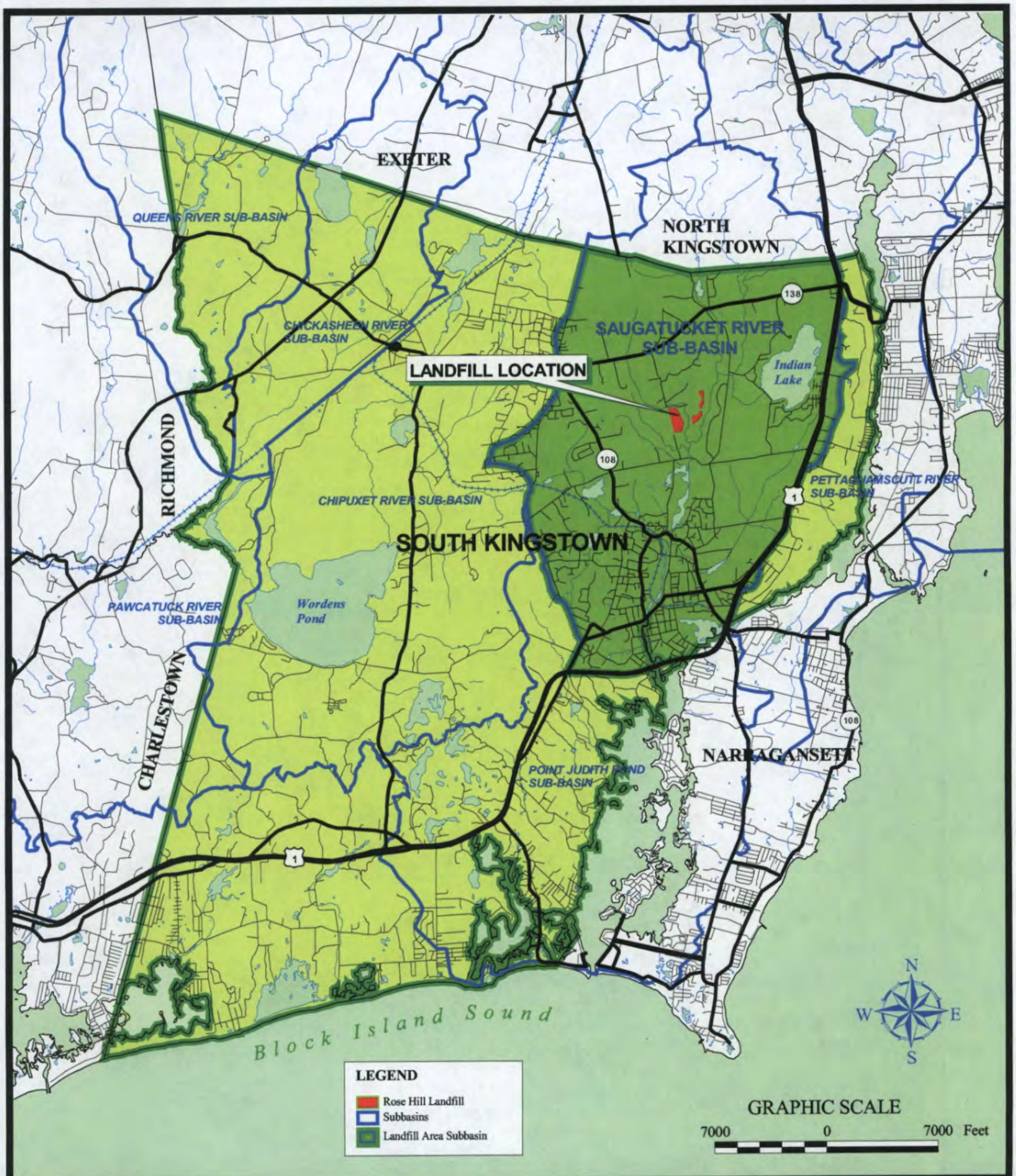
System operations / O & M include:

- Operation of the landfill gas flare
- Quarterly landfill gas monitoring
- Quarterly site inspection
- Twice-yearly groundwater and surface water monitoring
- Annual cutting of vegetation in SWA
- Site repairs, as needed (Fence, gates, roadways, etc.)
- Fallen tree removal
- Occasional maintenance of downchute, swales, culverts, and pond spillway
- maintenance/reporting of methane meters at two homes (on-going)

The initial Site O & M costs, as identified in the 1999 ROD, were estimated at $6,680,000 (net present worth for thirty (30) years). The initial cost estimate for the annual O & M budget for the Site using an active landfill gas system was $466,000 per year (see: Post-Closure Operations and Maintenance Plan, LBG, Inc., February 2008), which included quarterly environmental monitoring and site inspection, quarterly and annual reporting, and operation and amortized purchase of a landfill gas flare system.

Present annual O & M costs for the Site, with the operating active landfill gas system purchased and in place, are approximately $75,000 per year, excluding site monitoring and reporting. After adding quarterly gas and twice-yearly groundwater and surface water environmental monitoring, quarterly and annual reporting, the annual O & M budget for the Site is approximately $210,000.

APPENDIX B
FIGURES



RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 1: SITE LOCATION MAP

Source: RIGIS, RIDEM, M&E | *wp_qapp-s-kingst-lf.apr* | November 2007

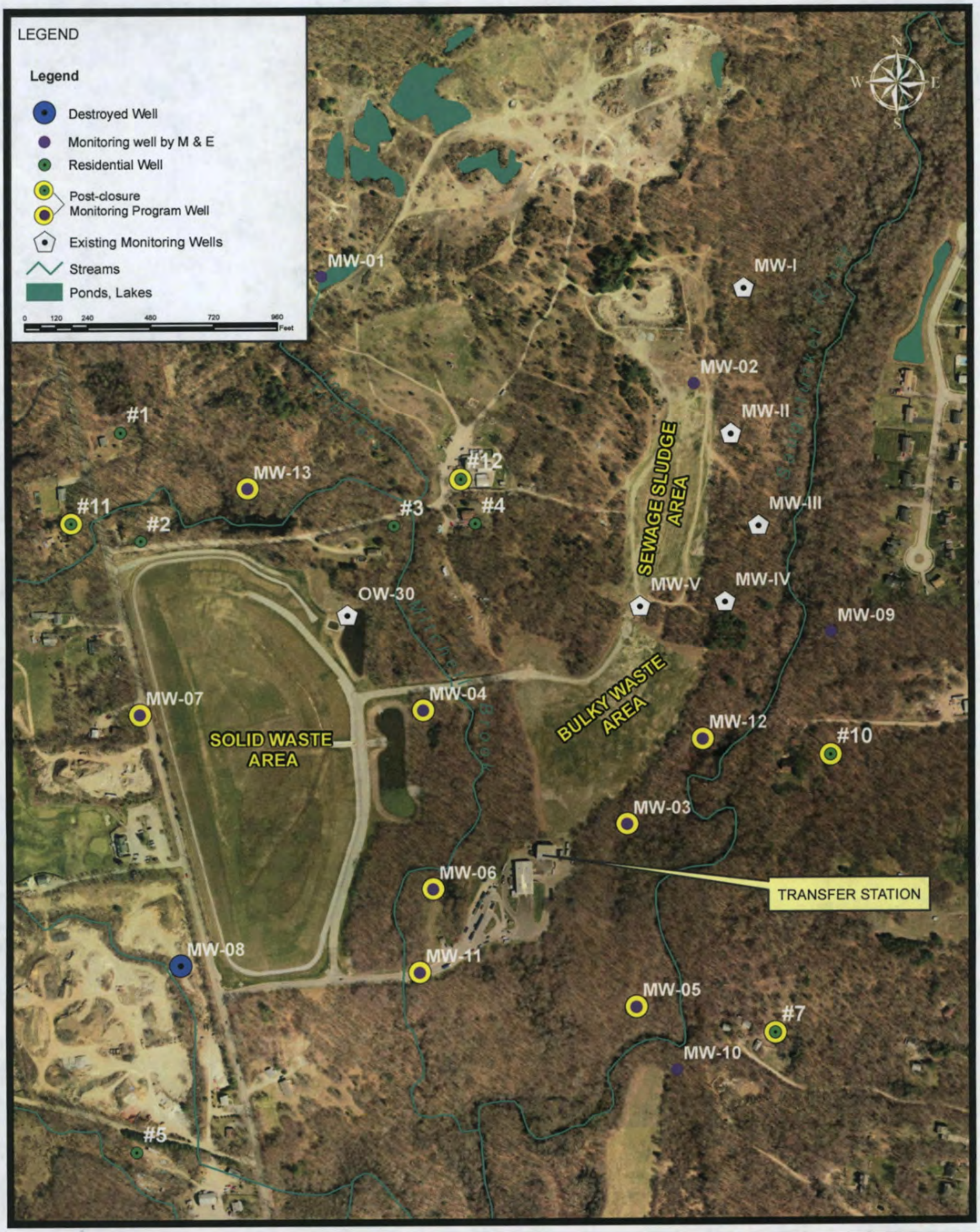
RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 2: SITE AERIAL EXISTING FEATURES MAP

Source: URI, RIDEM, M&E | *Site Aerial* | November 2011



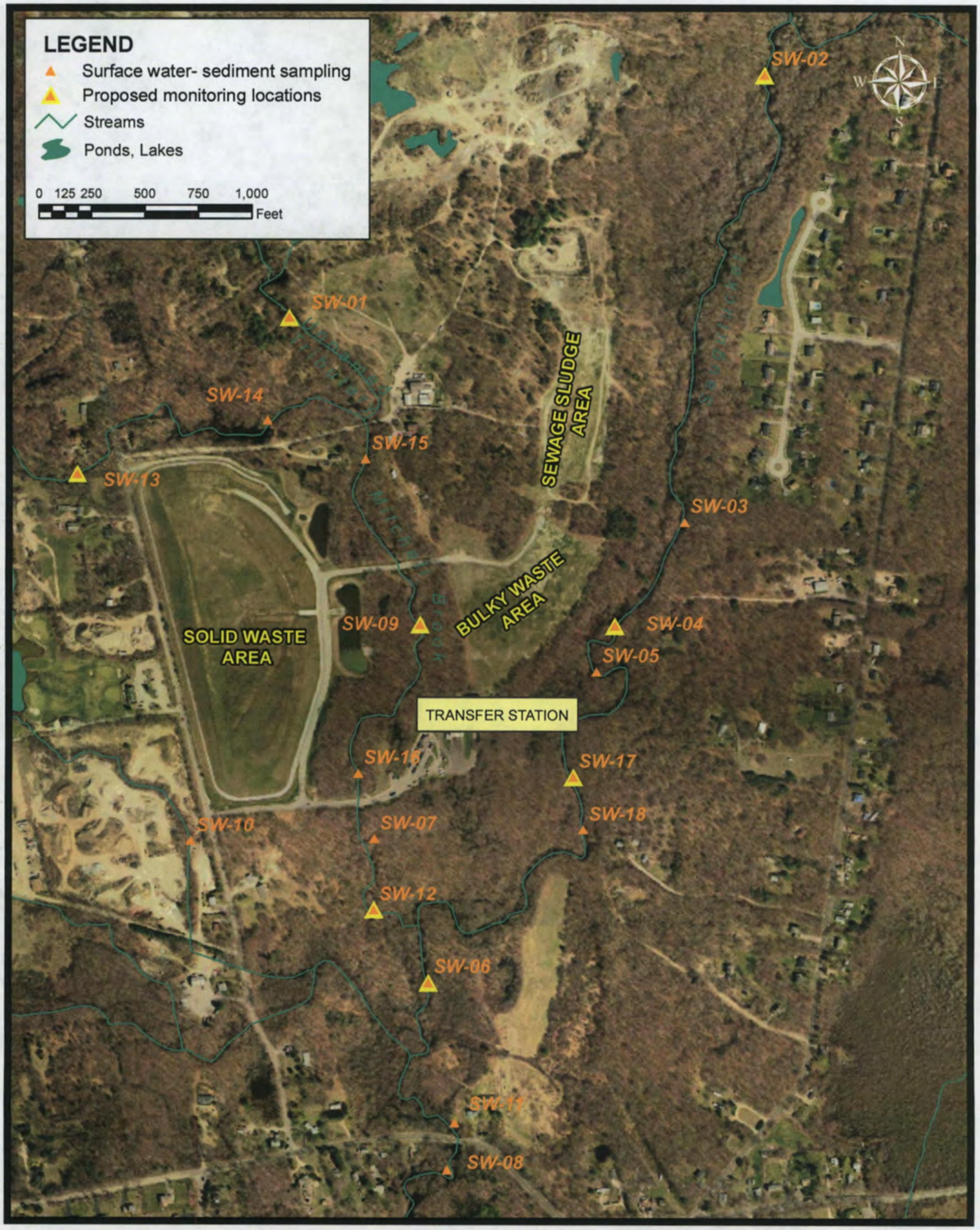
RI Department of Environmental Management

The Louis Berger Group, Inc.

Well Decommissioning - Rose Hill Landfill

Figure 3: POST CLOSURE MONITORING PROGRAM GROUNDWATER

Source: URI, RIDEM, M&E | *Groundwater_loc* | February 2014



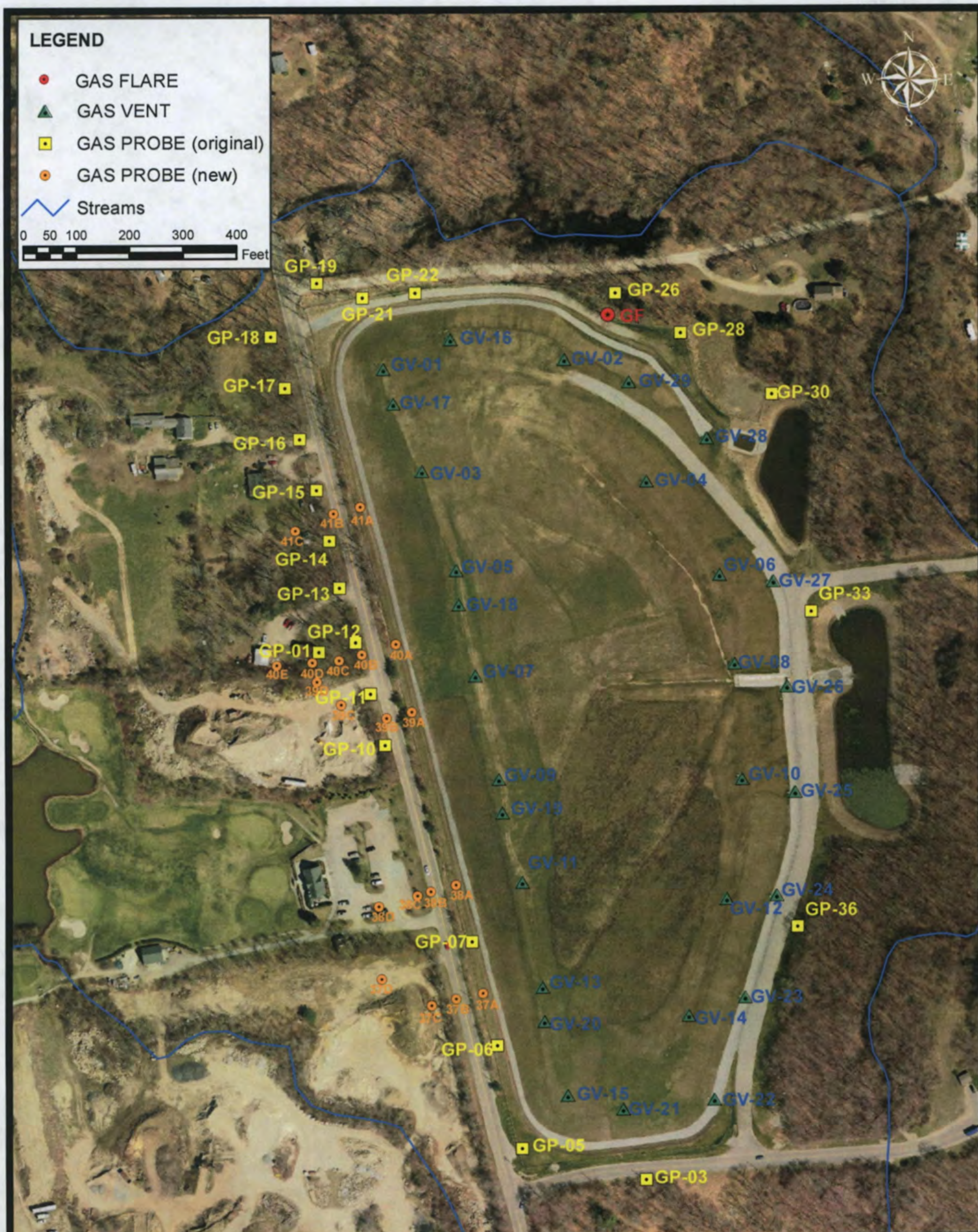
RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 4: POST CLOSURE MONITORING PROGRAM SURFACE WATER

Source: URI, RIDEM, M&E	*Surface Water_loc*	April 2014



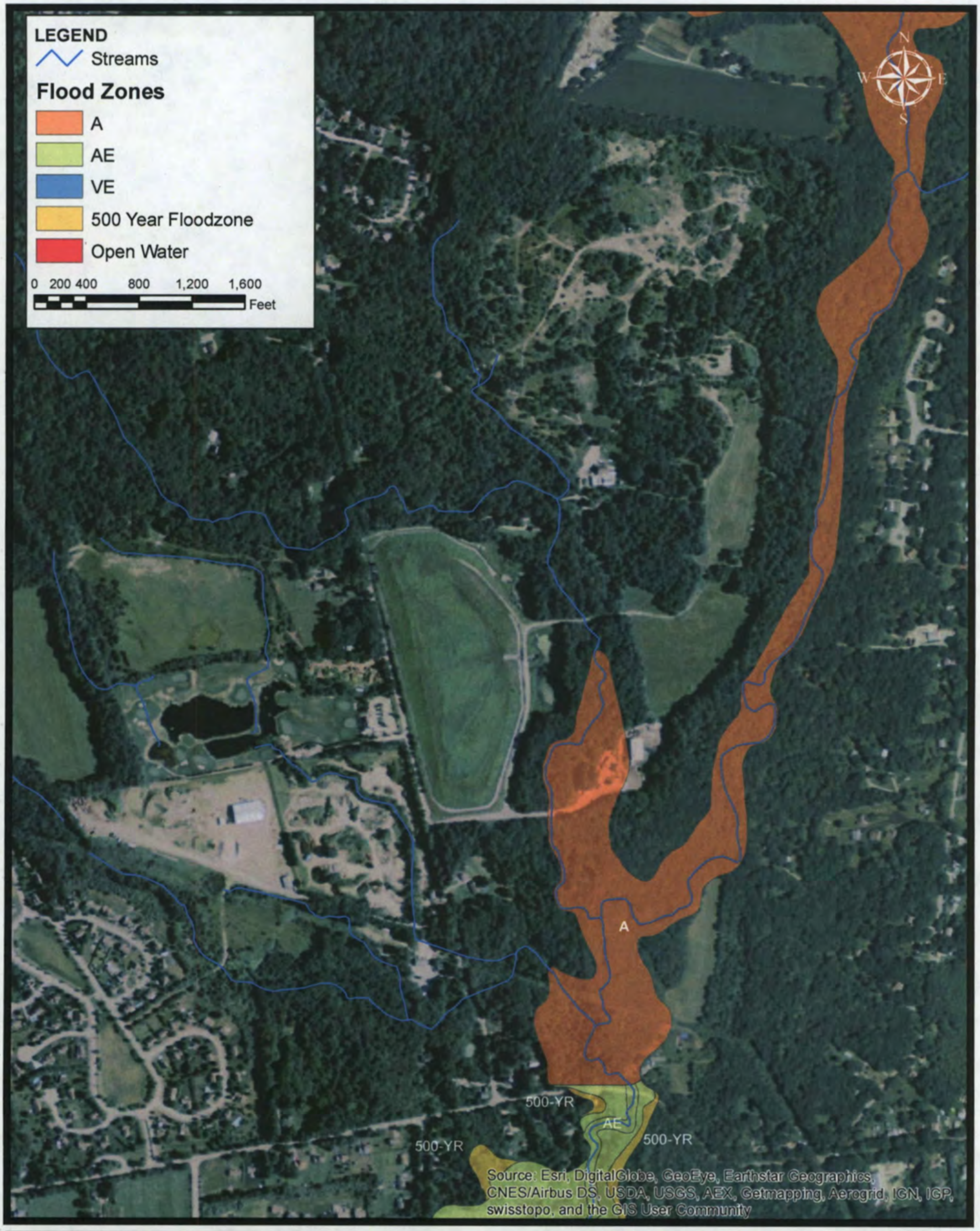
RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 5: POST CLOSURE MONITORING PROGRAM LANDFILL GAS

Source: URI, RIDEM, M&E	*Landfill Gas Map*	February 2012



RI Department of Environmental Management

The Louis Berger Group, Inc.

Remedial Action - Rose Hill Landfill

Figure 6: FEMA Special Flood Hazard Areas

Source: RIDEM, FEMA | *Landfill Gas Map* | August 2015

APPENDIX C

INTERVIEW RECORDS

INTERVIEW RECORD #1

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Meeting	**Date:** April 10, 2015
Location of Visit: Public Services Building Conference Room South Kingstown, RI	

CONTACT MADE BY:

See below.

INDIVIDUAL CONTACTED:

See below.

SUMMARY OF CONVERSATION:

Interview with representatives from the Towns of South Kingstown and Narragansett, RI
April 10, 2015

Attendees:

- Jon Schock, Public Services Director, Town of South Kingstown, RI
- Jeffry Ceasrine, Town Engineer, Town of Narragansett, RI
- Gary Jablonski, Principal Environmental Engineer, RIDEM
- David Newton, EPA Remedial Project Manager
- Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

Notes:

Interview was held at Town of South Kingstown Public Services building conference room.

1. Operations and Maintenance activities

Operation and Maintenance (O & M) activities performed by the Town to date include:

- Annual cutting of vegetation in SWA
- Removal of fallen trees onto property and/or onto property fences
- Repair damage to property fences
- Repair and backfilling of critter burrow holes in top of landfill cap
- Repair and replacement of riprap placed downstream of downchute box culvert at South Pond forebay area

- Access road rut repair
- Maintenance/reporting of methane meters at two homes

Potential future O&M activities over the long term may include:

- Annual cutting of vegetation in SWA
- Fence and Gate repair (as needed)
- Access road rut repair (as needed)
- Fallen tree removal
- Occasional maintenance of downchute, swales, culverts, and pond spillway
- maintenance/reporting of methane meters at two homes (on-going)

The Town of South Kingstown does not see any changes pertaining to this list of activities to be performed except for the methane meters. The Town would like to see the meters removed from the homes in the future, pending results of the flare gas operation. The Town has mowed the SWA each fall. The Town has also cut along the fence line to prevent vegetative growth from damaging the fence.

The Town has not encountered any difficulties or issues conducting current O&M efforts and landfill cap maintenance. Jon Schock said all work has been performed by in-house staff.

2. Municipal concerns with the OU-1 remedy

The Towns were asked if there are any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented, as it affects the Town?

Jon Schock said that the Towns do not have any municipal concerns, observations, or suggestions concerning the OU-1 remedy as presently implemented. The Towns asked if the methane detection systems in the two private residences are still necessary.

3. Municipal concerns with the OU-1 remedy which may affect Town residents

The Towns were asked if there are any municipal concerns with the OU-1 remedy as presently implemented which could affect the residents of the Town (including those who live near the Site and those who do not)? Would the Town have any insight as to the residents' early perceptions pertaining to the construction/operation of the flare?

Jon Schock said the Town hopes that the implementation of active gas collection would eliminate the need for the methane meters which are presently installed in residential homes. Over the course of operating the methane meters, there have been some false alarms. Methane data is digitally recorded and downloaded monthly by Town staff. The downloaded data is provided to a sub-contractor for the Town who is tasked with annual environmental reporting and maintenance of the technical equipment. Jon Schock also indicated that the owner of one of the residences near the landfill continues to express his displeasure with the methane detection system operating in his house. Jon Schock also indicated that a property owner on Pearl's Way has expressed concern regarding the marketability of her property as a result of the landfill gas flare.

4. Potential Future Site Re-use(s)

The Town was asked if any further thought has been given into potential future site re-use(s) within the next five years.

Jon Schock indicated that the Town is interested in the potential installation of photovoltaic solar panels in the SWA and plans to issue a Request for Proposals within the next six months. The Town is reviewing various financing and operational options to determine the best arrangement for the Town if the site is developed for solar energy production. The Town is also developing a municipal Debris Management Plan (DMP) that will identify debris staging areas for catastrophic storm related debris. The BWA will be one site evaluated as a debris staging area during development of the Town DMP.

5. Future Physical or Operational Changes and Improvements to Town Owned Properties

The Town was asked if any physical or operational changes/improvements to Town owned properties (i.e. transfer station improvement/expansion, BWA use and value, SWA, roadways, fencing, etc.) within and/or immediately adjacent to the Site are anticipated.

Jon Schock said that the Town is planning limited capital improvements at the existing transfer station operation such as pavement replacement, second platform scale, new scale house, perimeter litter fence, etc.

6. Changes in the use of the land at or near the Site

The Town was asked if there have been any changes in the use of the land at or near the Site, in terms of the use of groundwater, target populations or potential exposure routes.

Jon Schock said that there are no changes in the groundwater use other than the use of the outside residential well at the Peace Dale Shooting Preserve due to the recent change in ownership. The well was allowed for wash down of the dog kennel only but is no longer in use as it is believed that the dog kennels have been removed by the new owners. The residential well is also used as a sampling point for the Rose Hill Landfill Long Term Monitoring Program. The status of the well is unresolved at this point.

The Town continues to encourage anyone in the vicinity of the Site to use potable water at their residence. No residential developments are presently under review in the vicinity of the Site. No potential exposure routes have resulted based upon changes in the use of the land at or near the Site.

7. Protectiveness of the remedy

The Town indicated that there is not any new information that might call into question the protectiveness of the remedy.

8. Institutional Control

The Towns were asked about the status of Institutional Control (IC) implementation and schedule for the Site. Jon Schock indicated that the Town of South Kingstown has completed ICs for the three Town-owned properties. The ICs were recorded on 9/24/2013.

Jon Schock indicated that the Town held a meeting with Rose Hill IC property owners on 7/10/14, although only two IC property owners attended. Town legal counsel has mailed the most current version of the IC to property owners on 3/9/15. Town legal counsel is actively discussing ICs with two property owners and awaiting response from the balance of the property owners. The Town legal counsel will continue with property owner outreach, including individual meetings with property owner(s) if necessary. The Town states that actual implementation of ICs is predicated on the willingness of the property owners to execute same.

9. Level of outreach and communication provided by RIDEM and EPA

The Town indicated that there is no reason for any complaints or concerns regarding the level of outreach and communication presently provided by RIDEM and EPA. The Town may seek RIDEM or EPA assistance for property owners unwilling to sign an IC.

It was agreed by all that there was no reason at this point to hold a public meeting for the Second Five Year Review. The public announcements regarding the start and conclusion of the review period was viewed to provide sufficient public outreach and communication.

INTERVIEW RECORD #2

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** May 11, 2015
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Myron Duffin – 278 Rose Hill Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on May 11, 2015

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)? Please list any concerns.

   Response: Mr. Duffin does not have any issues with the capped landfill. Again, he stated that he is satisfied with the project and does not have any concerns.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Mr. Duffin has not detected any landfill odors since the cap has been completed. He said that he does occasionally get odors in the summertime from the transfer station when the wind direction turns towards his house.

3. The Town mows the landfill and cuts back woody growth in the SWA each fall and will continue to do this work annually. The Town also repairs any fence sections which are damaged by fallen trees, etc. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Mr. Duffin did not have any O&M suggestions for the Town.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

Response: Mr. Duffin did not have any operational changes that he would suggest to the Town or RIDEM. Again, he suggested that trees should be planted on the west side of the landfill along Rose Hill Road to replace trees that were either removed or have died. He suggested planting pine trees since they would grow faster.

5. Do you have any suggestions for the Town for potential site re-uses?

Response: Mr. Duffin did not mention any suggested potential site re-uses.

6. Have you changed your use of your property in any way?

Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

Response: No alterations to property use.

8. Have you changed your use of the groundwater?

Response: He is on Town water and does not have any wells on his property. He said that he believes that the groundwater table has been significantly lowered in the area.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

Response: Mr. Duffin said that he is aware of monitoring wells on his property and knows the well locations. He does not have any problems with the monitoring program.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

Response: Mr. Duffin has a methane detector in his basement. He suggested that if necessary, the methane detector could be replaced with a portable detector. He stated that he believes that wintertime, when the house is fully enclosed and the ground is frozen, would be the best time to check methane levels. He would not mind if the methane detector was removed from his house.

INTERVIEW RECORD #3

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** May 6, 2015
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Patricia Gagne – 349 Rose Hill Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on May 6, 2015

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)? Please list any concerns.

   Response: Ms. Gagne's view has not changed from the interview five years prior. Again, she stated she has never been in favor of the cap project and is still opposed to it due to its visual impact and its impact to the wildlife. The cap took away the habitat of the wildlife. She stated that the cap is ugly. She does not dislike the fence, but still does not like the look of the landfill site now. She said that there were only seven houses on the perimeter of the landfill and all of those residents were opposed to the Superfund project.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Ms. Gagne has not detected any landfill odors since the cap has been completed. She stated that she noticed them frequently during the project construction.

3. The Town mows the landfill and cuts back woody growth in the SWA each fall and will continue to do this work annually. The Town also repairs any fence sections which are damaged by fallen trees, etc. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Ms. Gagne mentioned that she was very unhappy with the tree cutting performed on Rose Hill Road six years ago. She would like to see trees replanted along the road. She does not have any issues with the Town's O&M actions, such as mowing, fence repairs, etc.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Ms. Gagne again stated that she would like to see more vegetation planted, including trees and plants for the animals to feed from. She did say that the birds have come back to her property after being away for five plus years.

5. Do you have any suggestions for the Town for potential site re-uses?

   Response: Ms. Gagne again suggests that the future area usage should have nothing which involves people. She would want to see open space uses and leave the BWA undisturbed for natural use by wildlife. She would like to see a tree farm planted but would not like to see ballfields or other recreation uses on the site.

6. Have you changed your use of your property in any way?

   Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

   Response: No alterations to property.

8. Have you changed your use of the groundwater?

   Response: There is a groundwater well on the property but the Gagne's utilize town water. They don't use the groundwater, but she says her well was disconnected and that it was always excellent water.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

   Response: Ms. Gagne indicated that she is aware of a monitoring well near the pond and the pet cemetery on her property, but does not believe that anyone uses it for testing or knows about its existence.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

    Response: Ms. Gagne indicated that her methane detector has never gone off and it is not a trouble to them. If it was removed from her house, she would not mind.

INTERVIEW RECORD #4

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** May 12, 2015
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

Cynthia Knight – 75 Pearls Way, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on May 12, 2015

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)? Please list any concerns.

   Response: Ms. Knight stated that she likes the way that the capped landfill looks and that the site does look better now that it is capped. She is happy that there is no longer any litter flying from the old landfill onto her property and getting stuck in trees, etc. Her primary concern is the location of the gas flare in relation to her house and its effect on her property value. She would really like to see some screening trees or plantings placed in the line of view from her house to the gas flare to reduce the visual impact of the flare from her property.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Ms. Knight has not detected any landfill odors since the cap has been completed. She said it smells much better than prior to and during the landfill cap construction.

3. The Town mows the landfill and cuts back woody growth in the SWA each fall and will continue to do this work annually. The Town also repairs any fence sections which are damaged by fallen trees, etc. Are there any other O&M actions which you would suggest

the Town would perform that may help with the current condition of the Site?

Response: Again, Ms. Knight reiterated that her biggest concern was the location of the gas flare. She would like to have screening trees installed between her house and the flare to screen the flare from her view.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

Response: Ms. Knight would like to see the flare screened from her house. She is very concerned about the impact on the value of her house and land with the flare in such close proximity to her house. She feels like it was the primary reason that she could not sell her house when it was previously up for sale.

5. Do you have any suggestions for the Town for potential site re-uses?

Response: Ms. Knight did not mention any suggested potential site re-uses.

6. Have you changed your use of your property in any way?

Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

Response: No alterations to property use, other than adding some dog kennels and kennel fencing.

8. Have you changed your use of the groundwater?

Response: She uses Town water and does not have a groundwater well.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

Response: Ms. Knight did not indicate that she was aware of any monitoring well or probes on her property.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

Response: Ms. Knight does not have a methane detector on her property.

INTERVIEW RECORD #5

Site Name: Rose Hill Landfill Superfund Site South Kingstown, RI	**EPA ID Number:** RID980521025
Type: Telephone call	**Date:** May 12, 2015
Location of Visit: N/A	

CONTACT MADE BY:

Clayton Carlisle, Senior Environmental Engineer, Louis Berger Group, Inc.

INDIVIDUAL CONTACTED:

David Webster – 938 Broad Rock Road, Wakefield, RI

SUMMARY OF CONVERSATION:

Telephone conversation held on May 12, 2015

Notes:

1. Do you have any personal concerns with the OU-1 remedy, as presently implemented, as it affects your residence or those of other residents of the Town (including those who live near the Site and those who do not)? Please list any concerns.

   Response: Mr. Webster does not have any issues with the capped landfill.

2. Do you notice any landfill odors (distinguishable from transfer station operation) coming from the capped landfill site? If so, how frequently and how does this compare to odors you may have noticed prior to the installation of the cap?

   Response: Mr. Webster has not detected any landfill odors. He said that he occasionally gets odors from the transfer station in the summertime.

3. The Town mows the landfill and cuts back woody growth in the SWA each fall and will continue to do this work annually. The Town also repairs any fence sections which are damaged by fallen trees, etc. Are there any other O&M actions which you would suggest the Town would perform that may help with the current condition of the Site?

   Response: Mr. Webster did not have any O&M suggestions for the Town.

4. Do you have any suggestions for the Town, the State or RIDEM regarding the physical or operational changes to the Site?

   Response: Mr. Webster did not have any specific operational changes that he would suggest to the Town or RIDEM, but did say he would be supportive of installation of solar panels if the Town was pursuing that type of use for the site.

5. Do you have any suggestions for the Town for potential site re-uses?

Response: Mr. Webster did not mention any suggested potential site re-uses, but would support a solar project as a site re-use. He said that he was not supportive of using the site for future ballfields.

6. Have you changed your use of your property in any way?

Response: No changes to property use.

7. Have you altered the property (excavation, building construction, etc.)?

Response: No alterations to property use.

8. Have you changed your use of the groundwater?

Response: His water is supplied from a private well located on his property.

9. If you have a monitoring well or landfill gas monitoring probe on your property - are you aware of these and where they are located? Do you have any comments or suggestions concerning these structures? Do you have any comments or suggestions concerning the periodic monitoring?

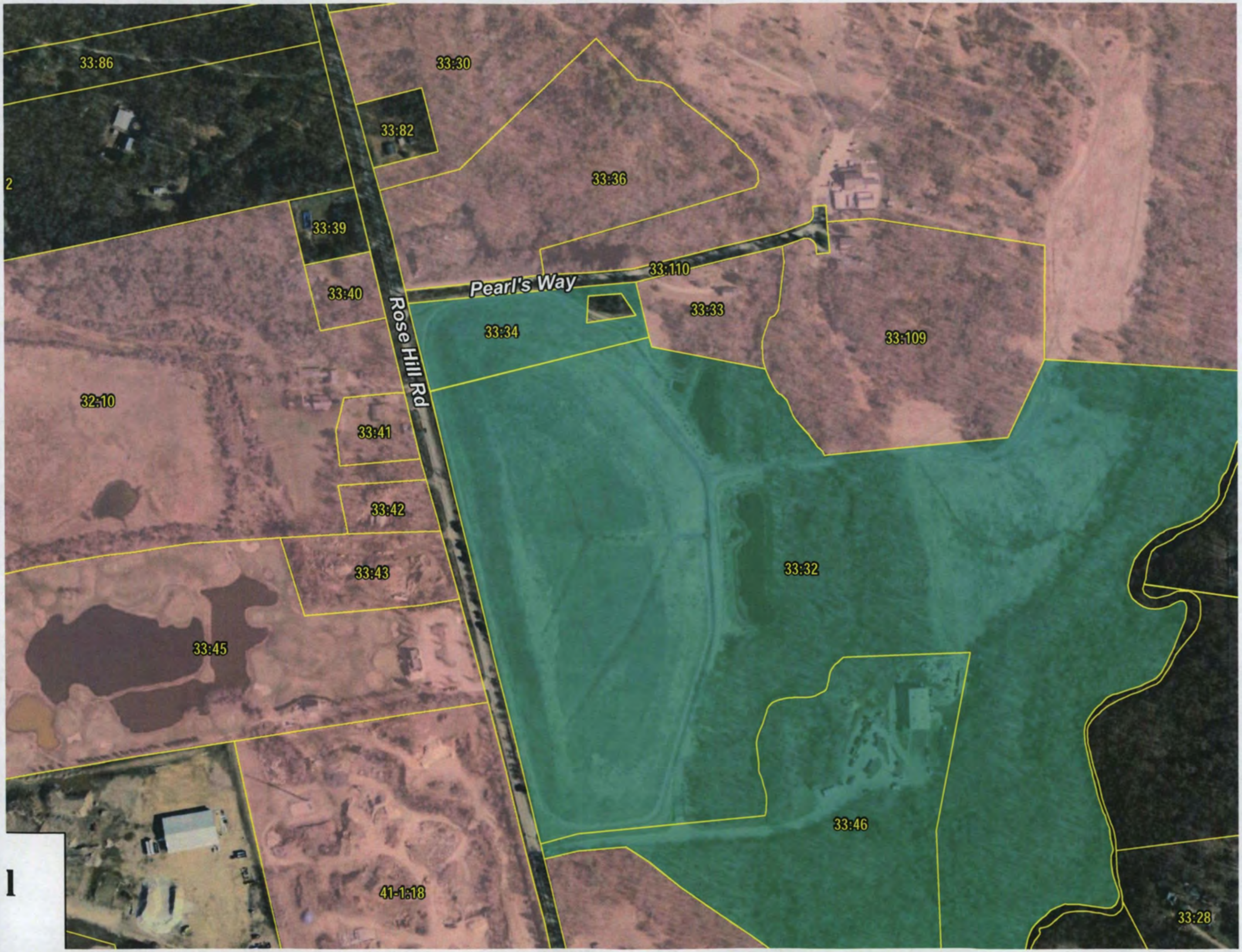
Response: Mr. Webster said that his groundwater well is used as part of the post-closure monitoring. He does not have any problems with the monitoring program.

10. If you have a methane detector on your property - do you have any concerns, questions, comments, recommendations? What would your reaction be if the methane detector system was removed?

Response: Mr. Webster does not have a methane detector on his property.

APPENDIX D

INSTITUTIONAL CONTROLS /PROPERTY ACCESS


33:86
33:30
33:82
2
33:36
33:39
33:110
Pearl's Way
33:40
Rose Hill Rd
33:34
33:33
33:109
32:10
33:41
33:42
33:32
33:43
33:45
33:46
41-1:18
33:28

1

Appendix D
Table D-1: Rose Hill Landfill Property Owner Summary for Town Required ICs

DATE: 3/3/2015

Name	Mailing Address	Property Address	Plat	Lot	Deed Date	Book	Page	Title as of	Comments
Harlin & Henley, LLC	PO Box 306, East Greenwich, RI 02818	121 Rose Hill Road	33	29	10/31/2010	1409	736	Not Done	Property Added to IC by EPA & RIDEM on 1-23-2012
Bernadette Boisclair	3070 South County Trail, West Kingston RI 02892	Rose Hill Road	33	43	8/27/1991	429	345		
Melody H. Carpenter	294 Rose Hill Road, Wakefield, RI 02879	294 Rose Hill Road	33	41	9/11/2003	1090	58		
Alice & Myron Duffin Jr.	278 Rose Hill Road, Wakefield, RI 02879	278 Rose Hill Road	33	42	12/2/1981	156	205		
John D. Frisella (est.)	c/o Cynthia Knight, 75 Pearls Way, Wakefield, RI 02879	129 Pearls Way	33	109	4/22/2002	967	44		
BWJW, LLC	17 Edith Road, Narragansett, RI 02882	130 Pearls Way	33	30	7/26/2000	825	326		Peace Dale Shooting Preserve (Richard Frisella former property owner)
Norman & Patricia Gagne	349 Rose Hill Road, Wakefield, RI 02879	349 Rose Hill Road	33	36	12/3/1993	533	182		
Cynthia F. Knight	75 Pearls Way, Wakefield, RI 02879	75 Pearls Way	33	33	3/22/2002	957	79		
Robert Clark Knowles	320 Rose Hill Road, Wakefield, RI 02879	320 Rose Hill Road	32	10	1/8/1993	489	248		
Associates of Rose Hill LLC	220 Rose Hill Road, Wakefield, RI 02879	220 Rose Hill Road	33	45	7/15/1998	720	166		Rose Hill Golf Course
Eugene P. & Karen A.Seney	340 Rose Hill Road, Wakefield, RI 02879	340 Rose Hill Road	33	40	9/16/1992	473	392		
SBA Towers II LLC, d/b/a SBA Towers II, LLC	94 Rose Hill Road, Wakefield, RI 02879	94 Rose Hill Road	41-1	18	2/29/1980	136	107		
Town of South Kingstown	180 High Street, Wakefield, RI 02879	Rose Hill Road	33	32	11/19/2002	1009	493		Town Landfill - IC Recorded
Town of South Kingstown	180 High Street, Wakefield, RI 02879	163 Rose Hill Road	33	46	9/15/1982	166	150		Town Transfer Station - IC Recorded
Town of South Kingstown	180 High Street, Wakefield, RI 02879	Rose Hill Road	33	34	11/19/2002	1009	493		Town Landfill- IC Recorded

APPENDIX E

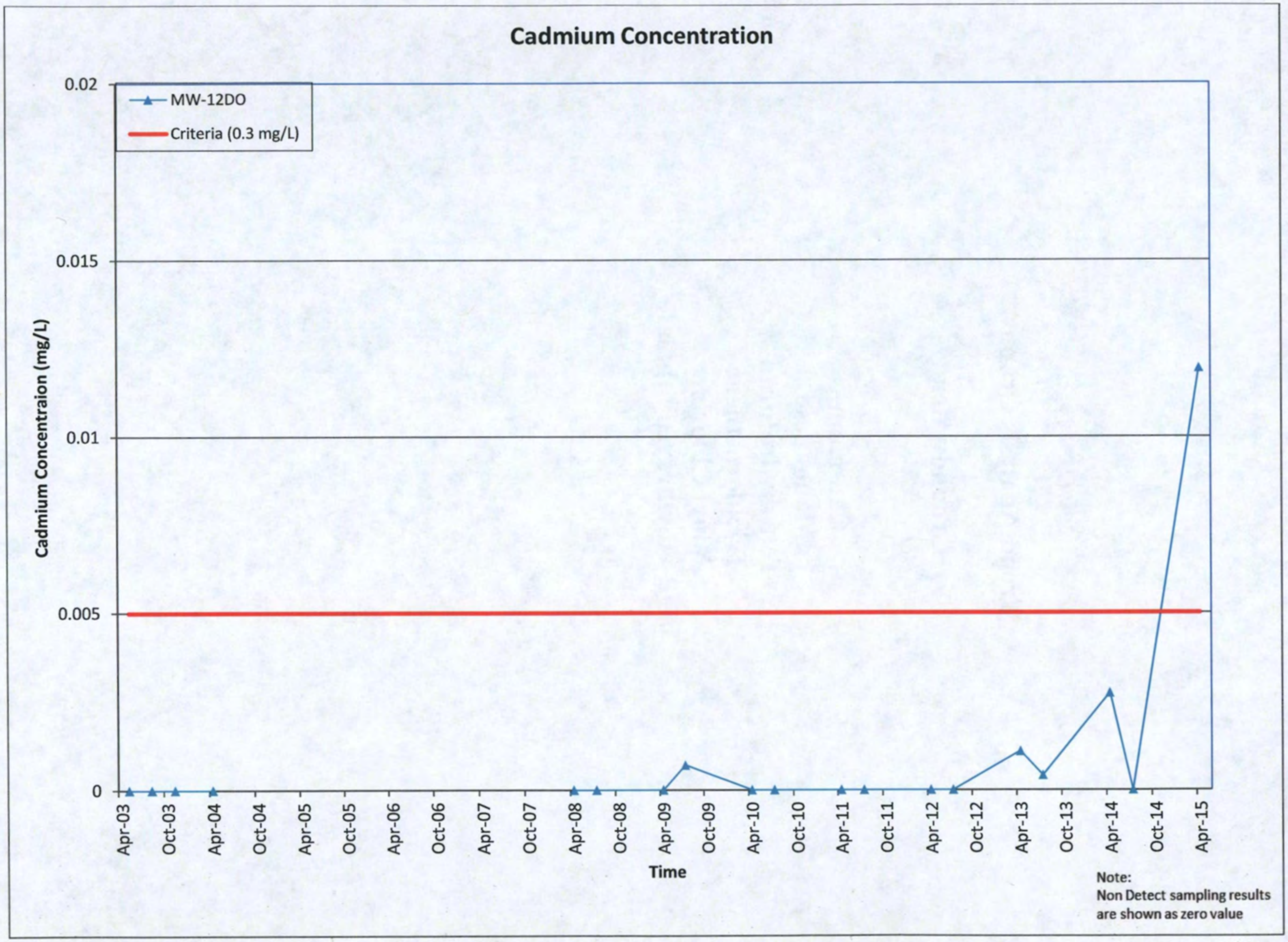
TREND ANALYSIS GRAPHS

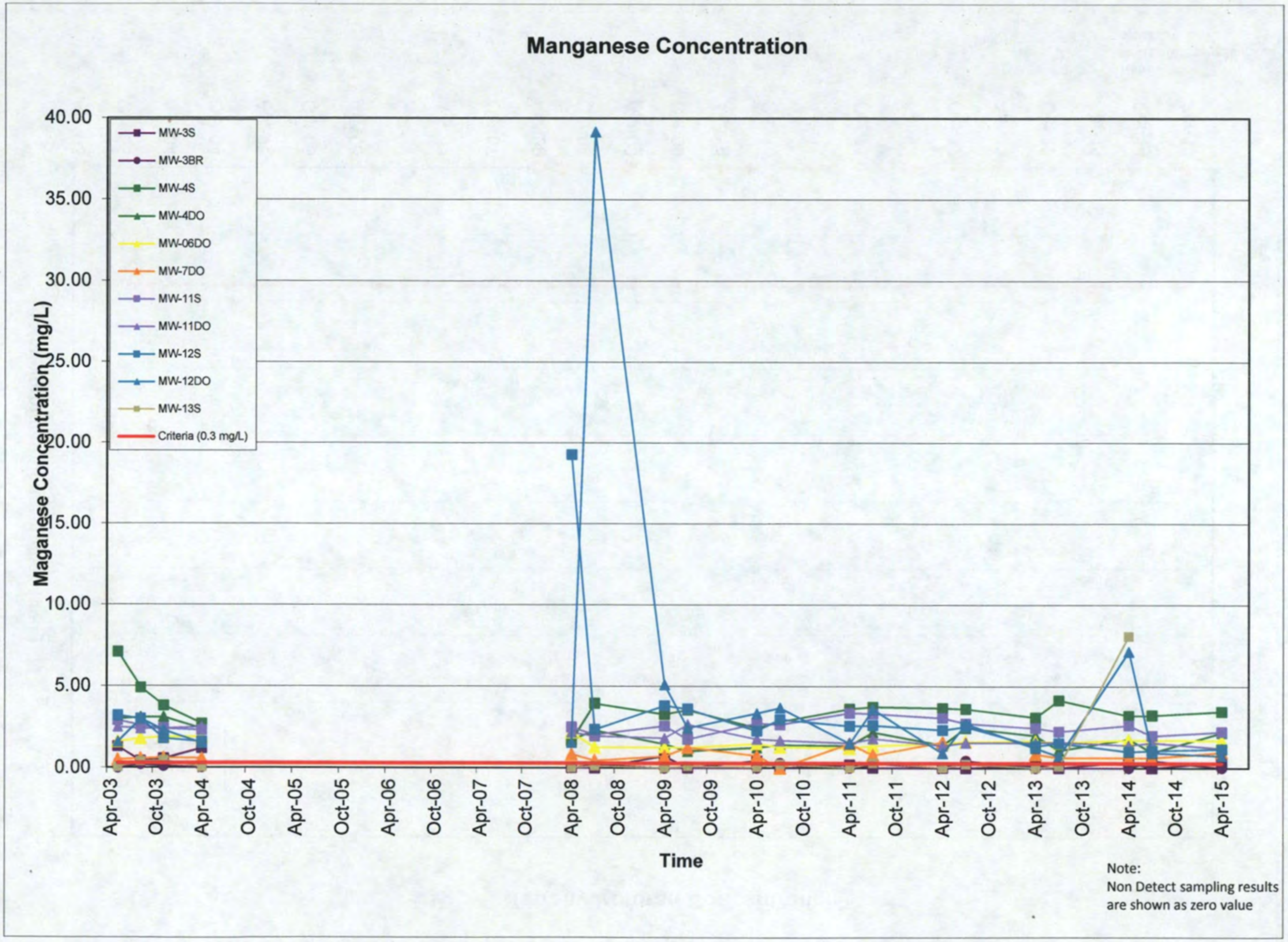
LIST OF TREND ANALYSIS GRAPHS

Trend Analysis Graphs

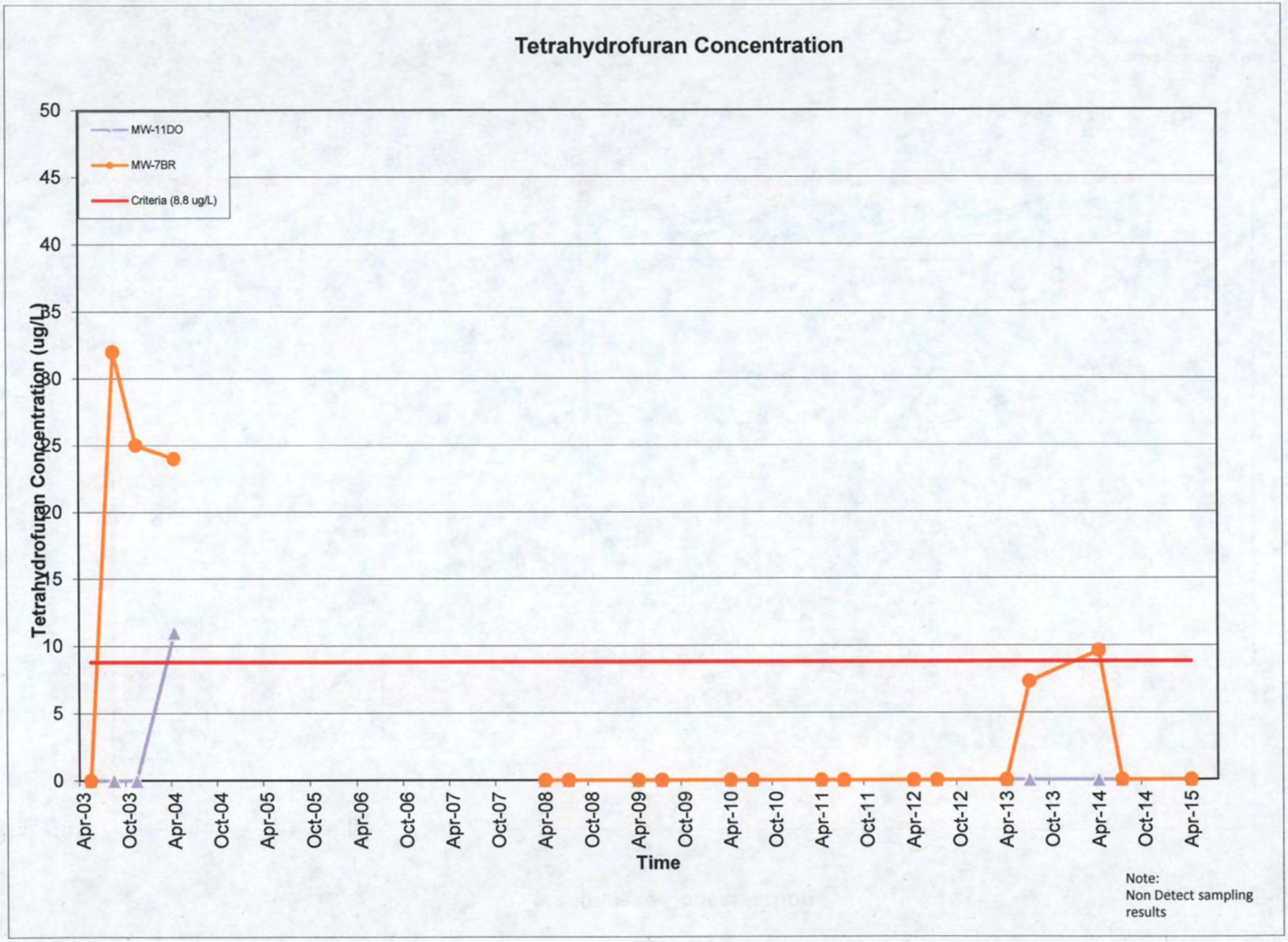
Groundwater

Cadmium
Manganese
Tetrahydrofuran
Trichloroethene
Vinyl Chloride
bis(2-ethylhexyl)Phthalate

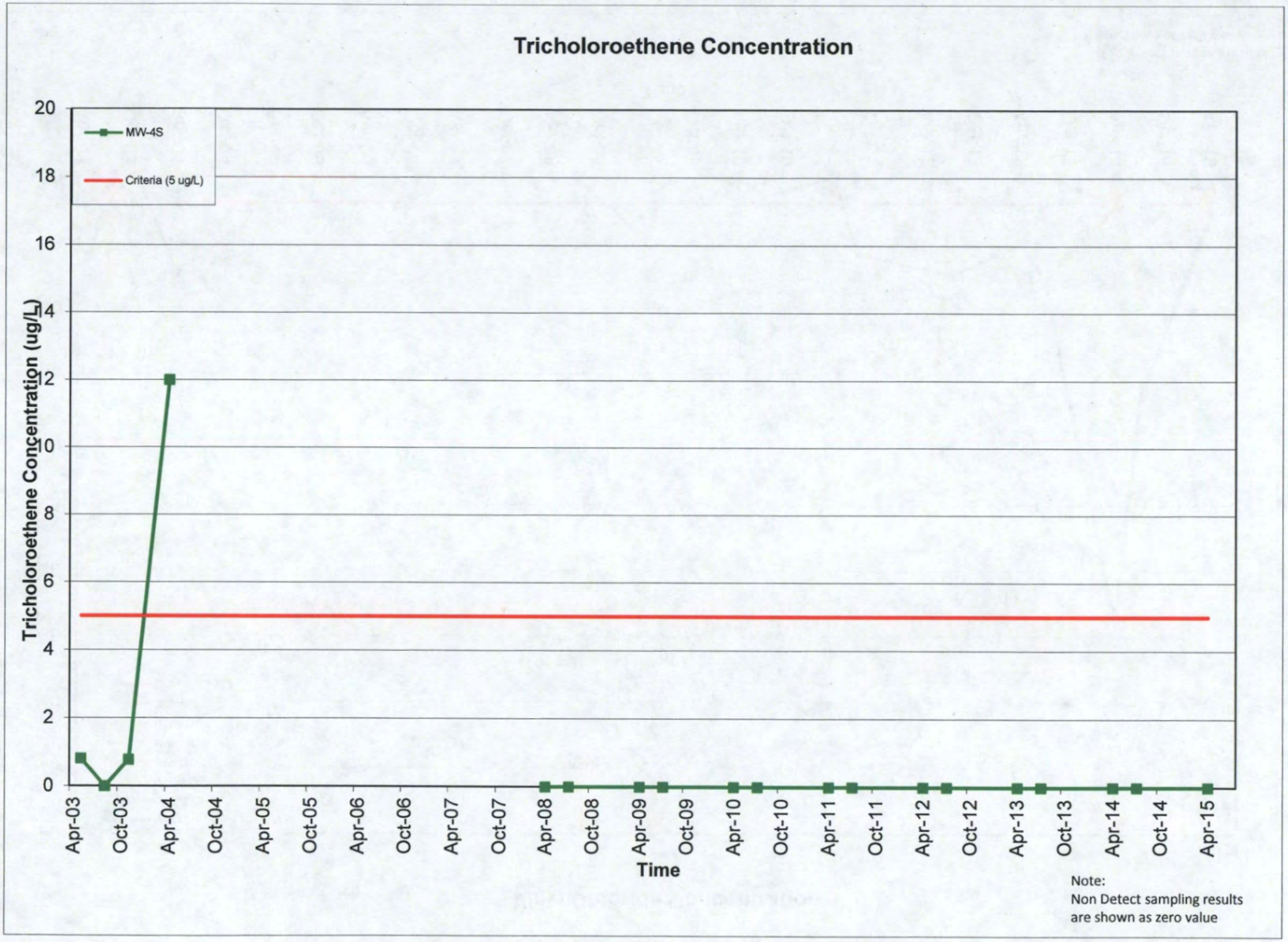

Cadmium Concentration
MW-12DO
Criteria (0.3 mg/L)
Cadmium Concentraion (mg/L)
0.02
0.015
0.01
0.005
0
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



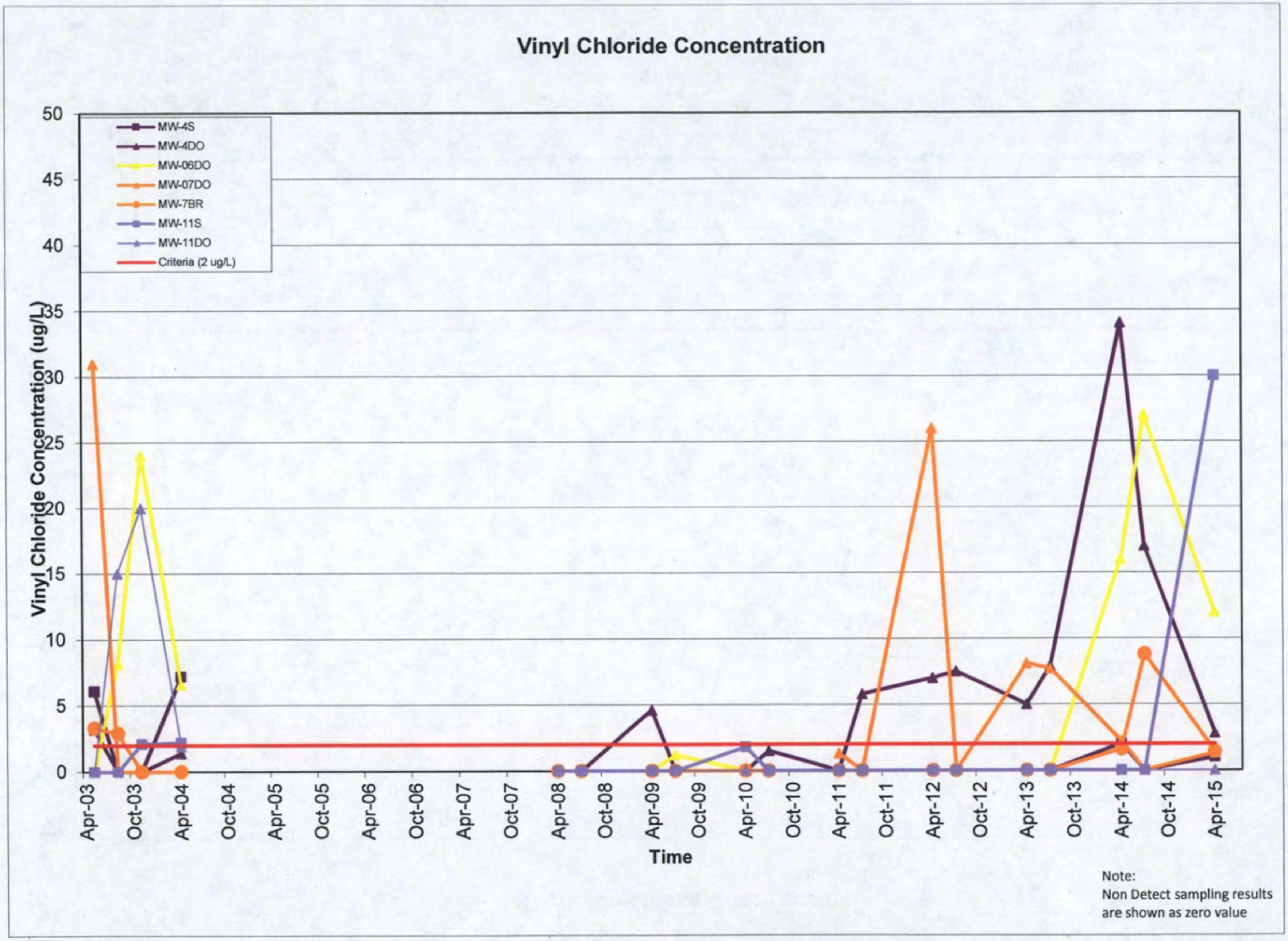
Note:
Non Detect sampling results
are shown as zero value



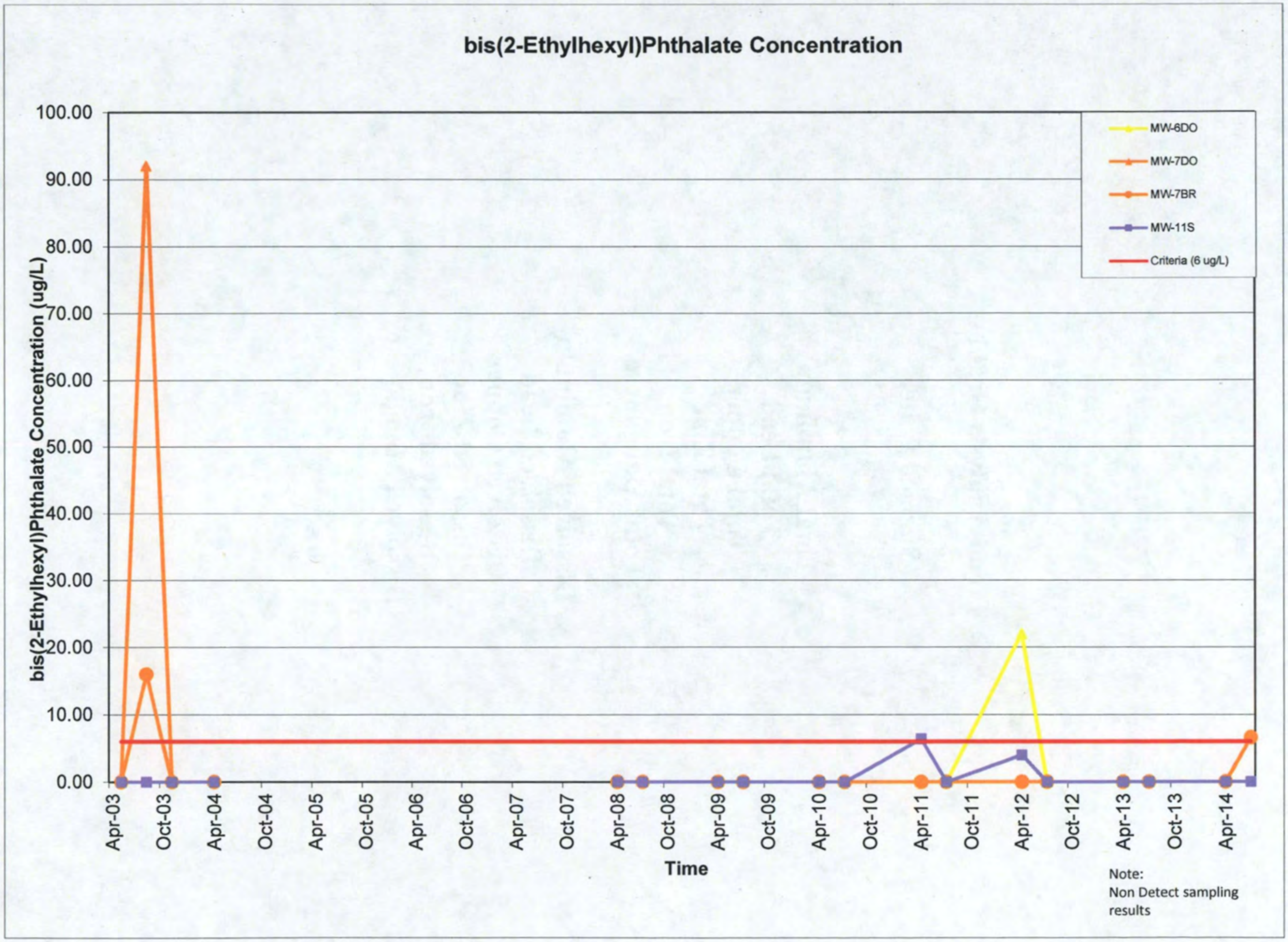
Tetrahydrofuran Concentration
MW-11DO
MW-7BR
Criteria (8.8 ug/L)
Tetrahydrofuran Concentration (ug/L)
50
45
40
35
30
25
20
15
10
5
0
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results



Tricholoroethene Concentration
MW-4S
Criteria (5 ug/L)
20
18
16
14
12
10
8
6
4
2
0
Tricholoroethene Concentration (ug/L)
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



Vinyl Chloride Concentration
MW-4S
MW-4DO
MW-06DO
MW-07DO
MW-7BR
MW-11S
MW-11DO
Criteria (2 ug/L)
Vinyl Chloride Concentration (ug/L)
0
5
10
15
20
25
30
35
40
45
50
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value

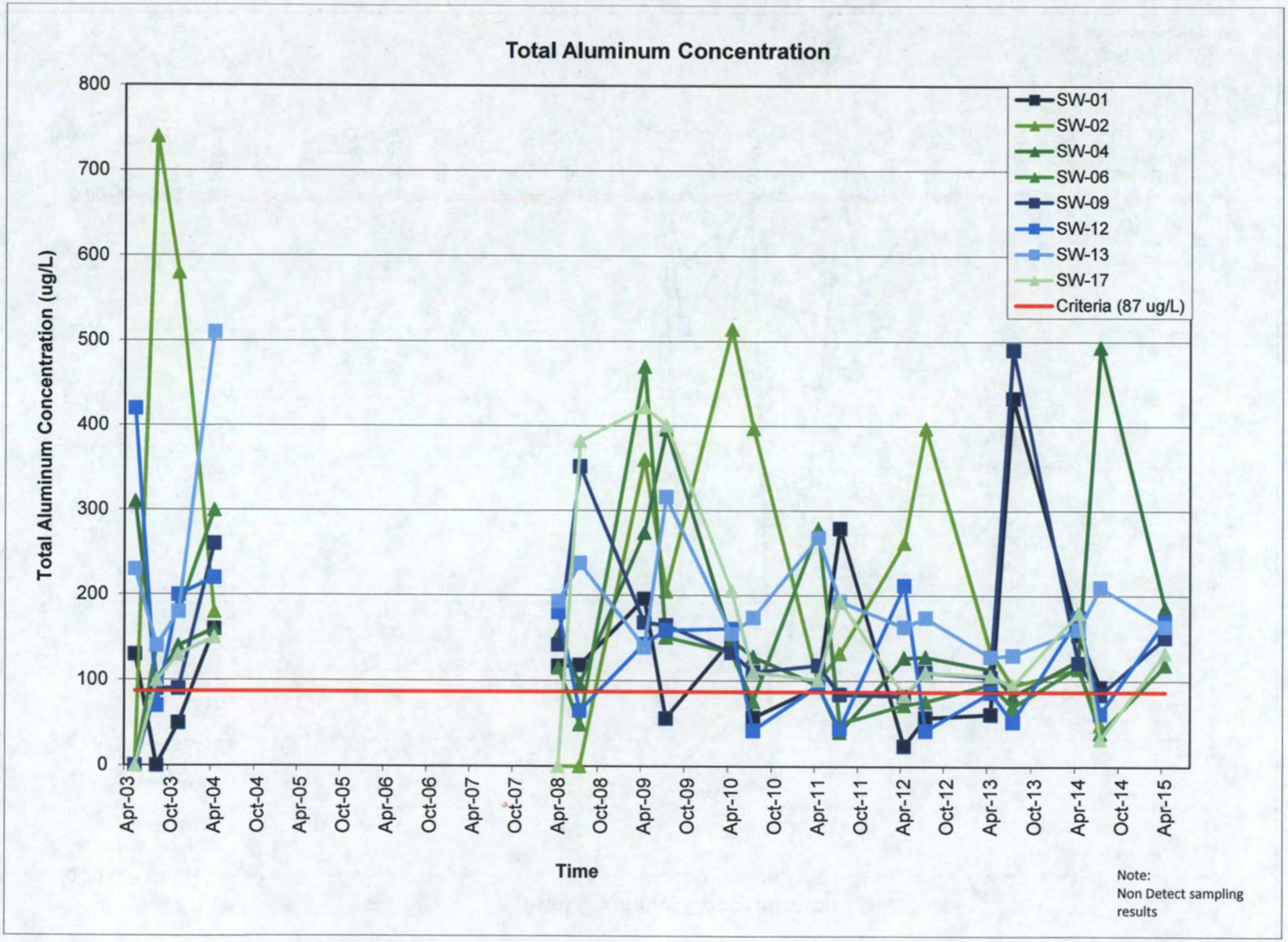

bis(2-Ethylhexyl)Phthalate Concentration
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
bis(2-Ethylhexyl)Phthalate Concentration (ug/L)
MW-6DO
MW-7DO
MW-7BR
MW-11S
Criteria (6 ug/L)
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Time
Note:
Non Detect sampling results

Trend Analysis Graphs

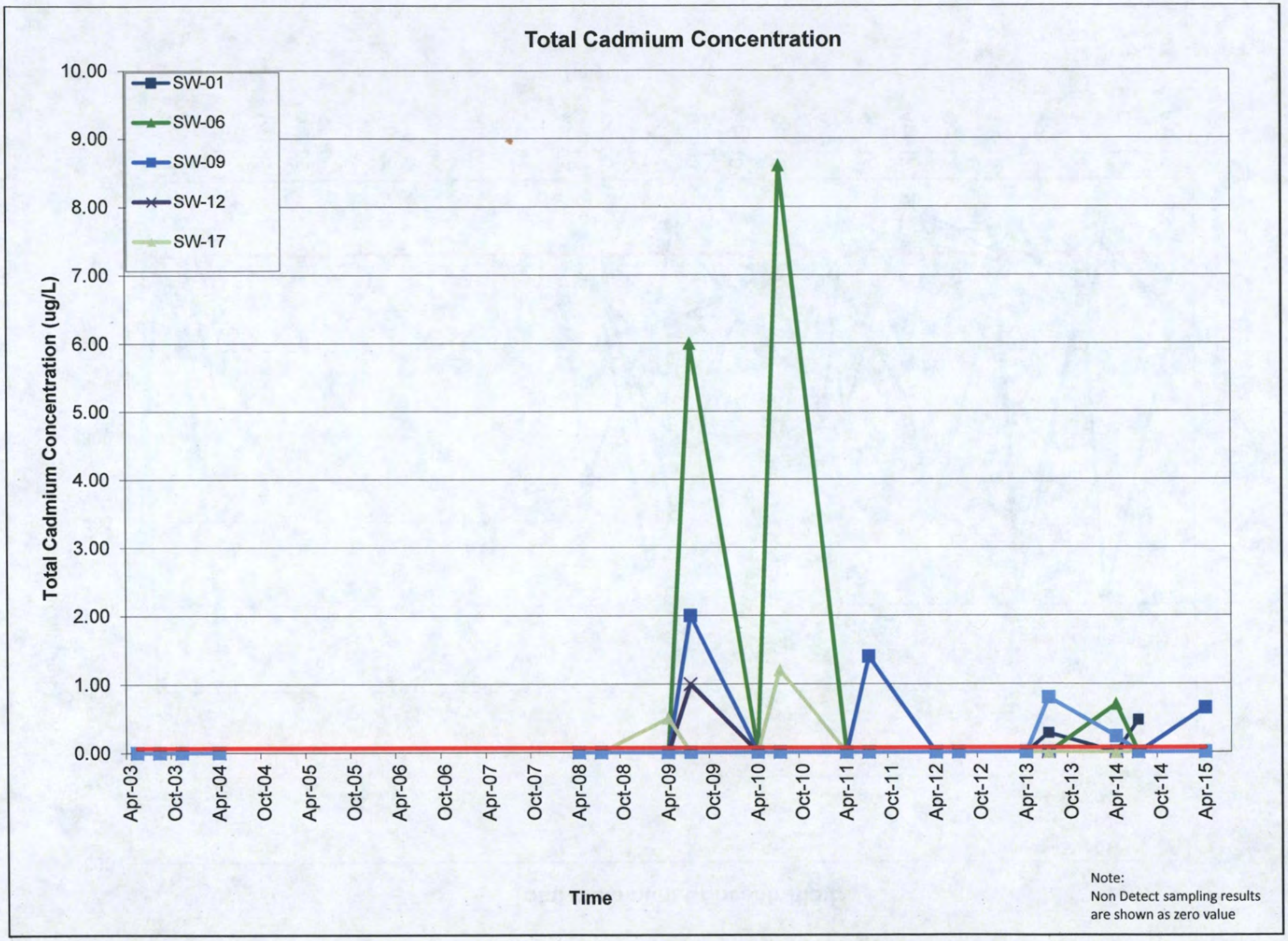
Surface Water

Total Aluminum
Total Lead
Total Copper
Total Zinc
Total Iron
Total Manganese

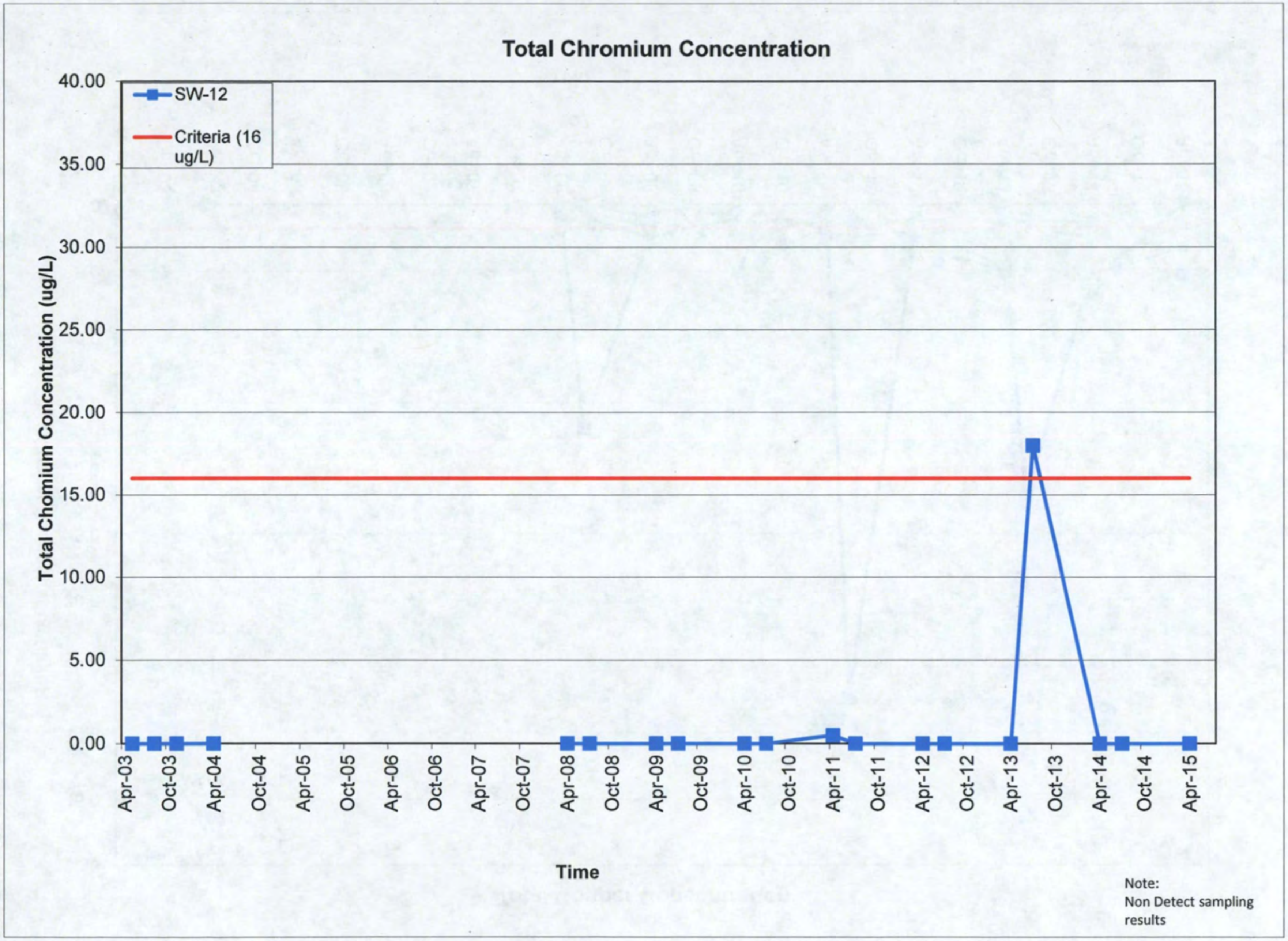
Dissolved Aluminum
Dissolved Lead
Dissolved Copper
Dissolved Zinc
Dissolved Iron
Dissolved Manganese

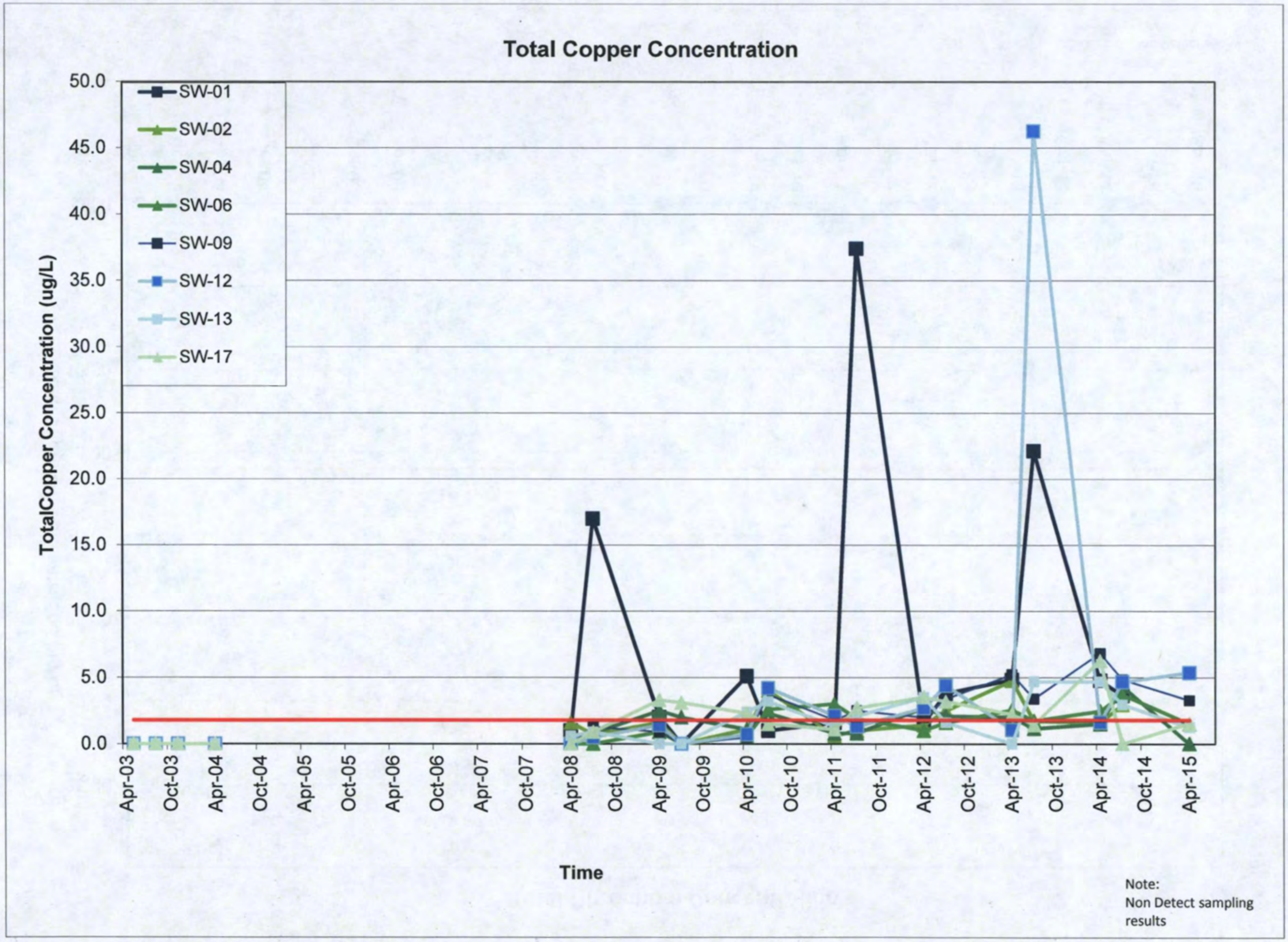


Total Aluminum Concentration
Total Aluminum Concentration (ug/L)
800
700
600
500
400
300
200
100
0
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (87 ug/L)
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results

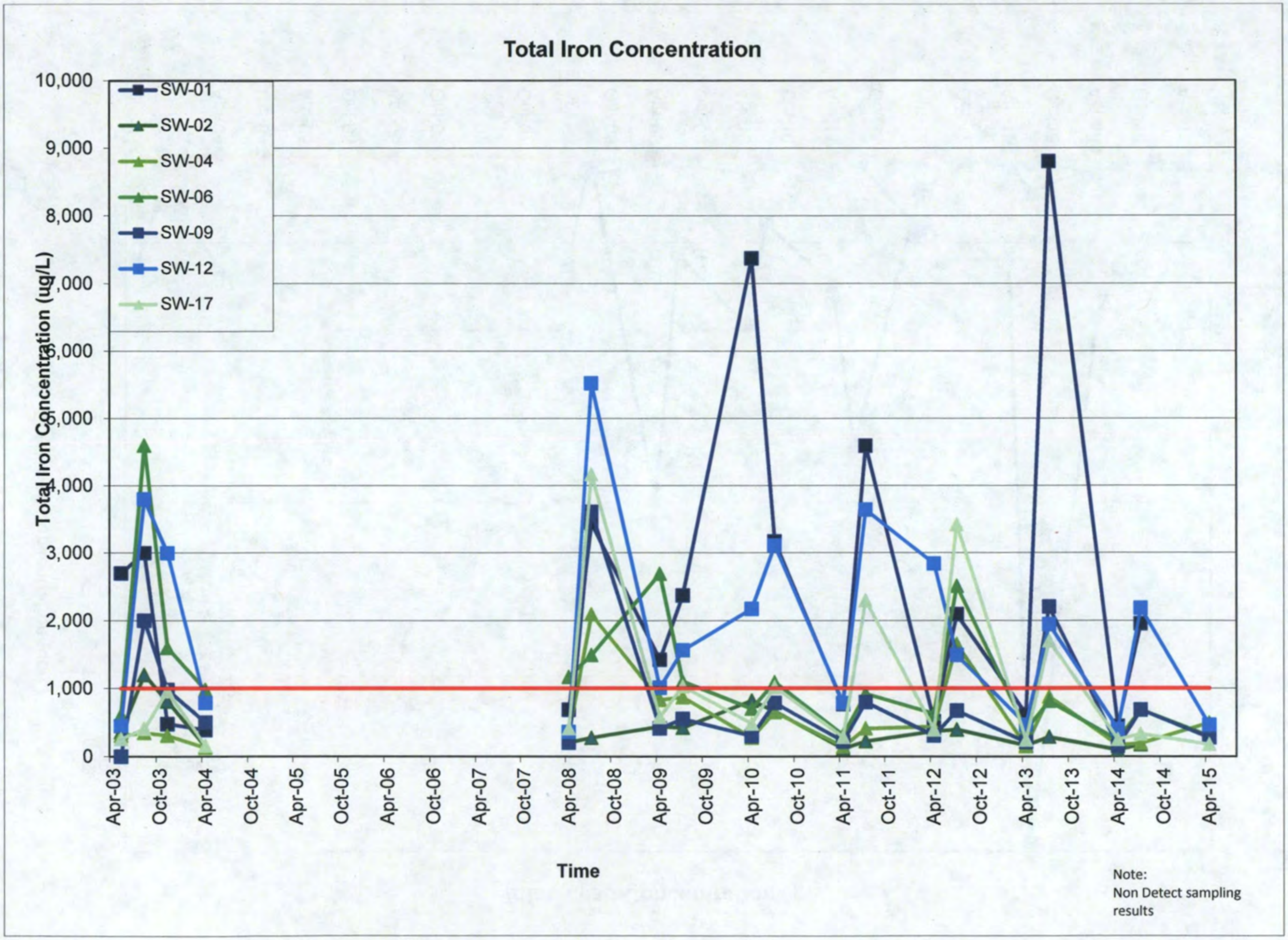


Total Cadmium Concentration
SW-01
SW-06
SW-09
SW-12
SW-17
Total Cadmium Concentration (ug/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value

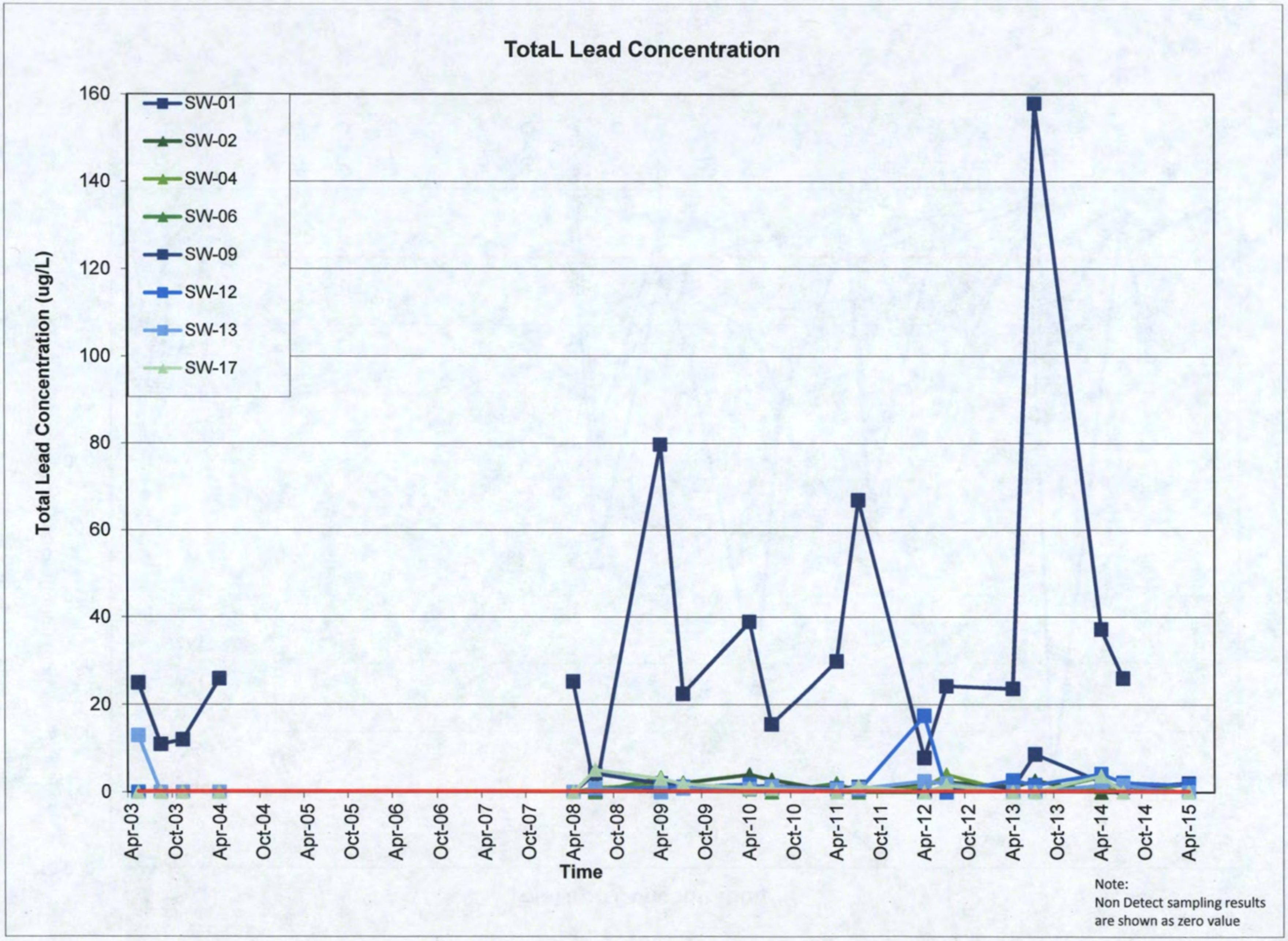

Total Chromium Concentration
SW-12
Criteria (16 ug/L)
Total Chomium Concentration (ug/L)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results

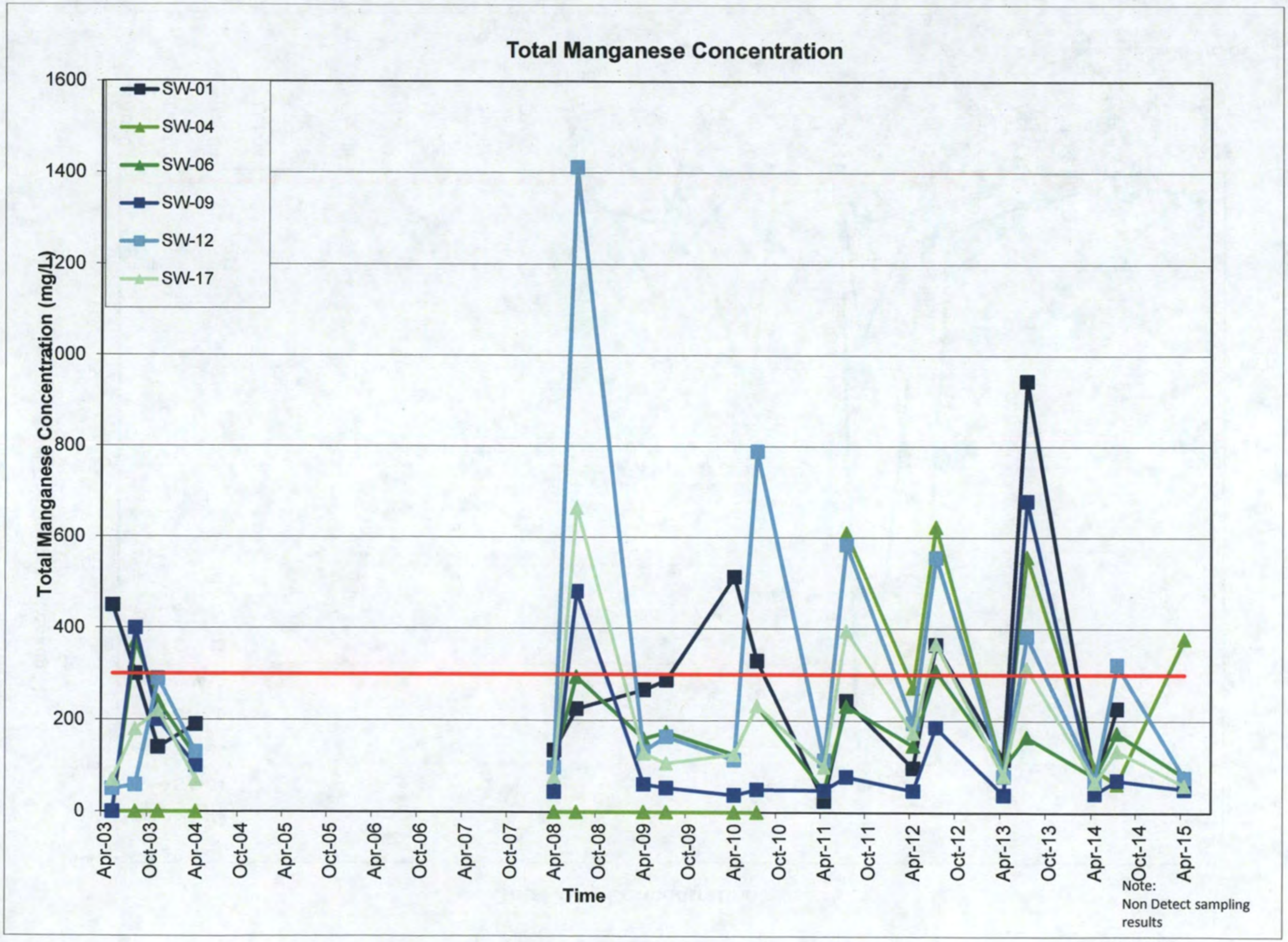


Total Copper Concentration
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
TotalCopper Concentration (ug/L)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results

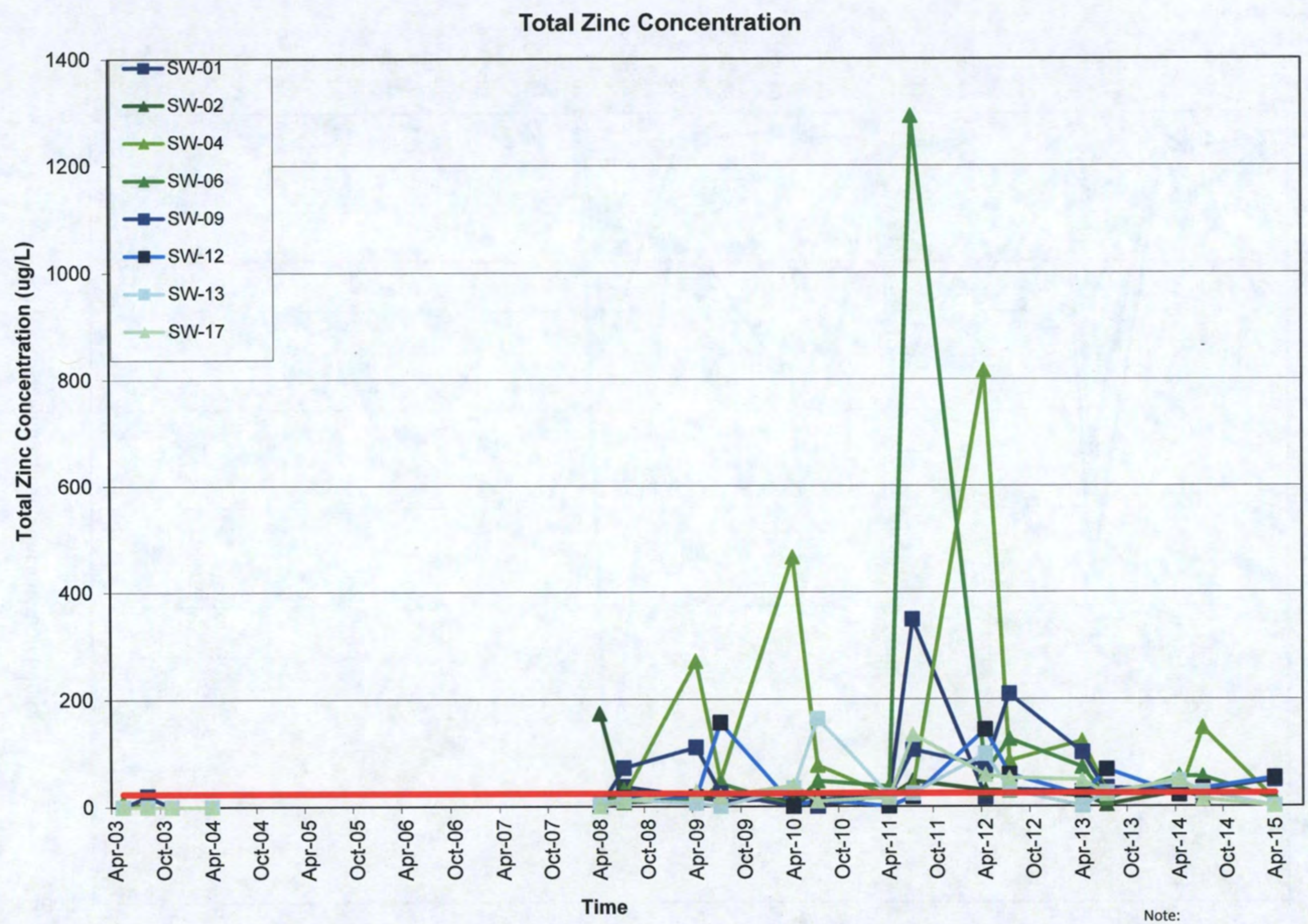


Total Iron Concentration
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-17
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Total Iron Concentration (ug/L)
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results

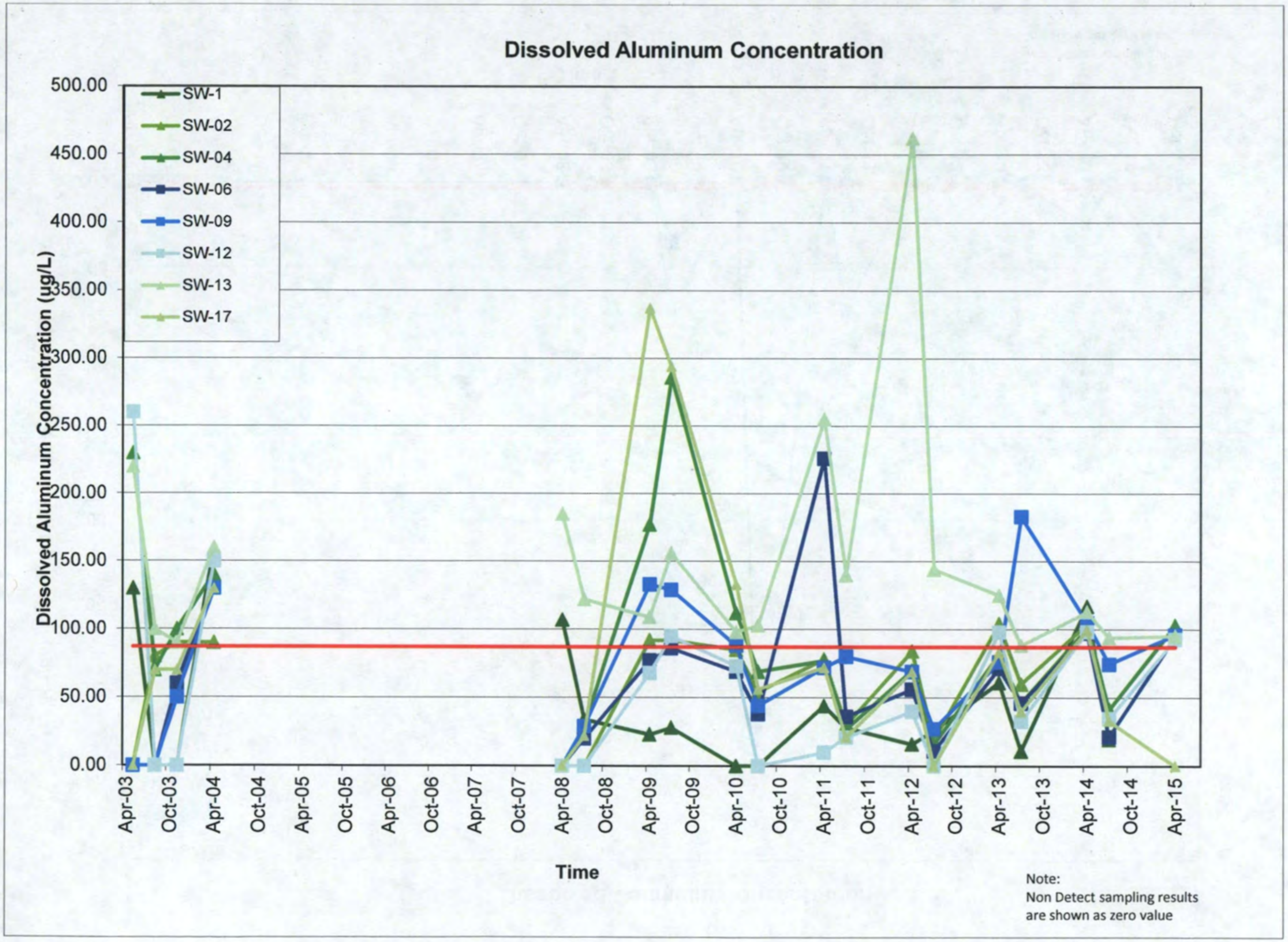

TotaL Lead Concentration
Total Lead Concentration (ug/L)
160
140
120
100
80
60
40
20
0
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



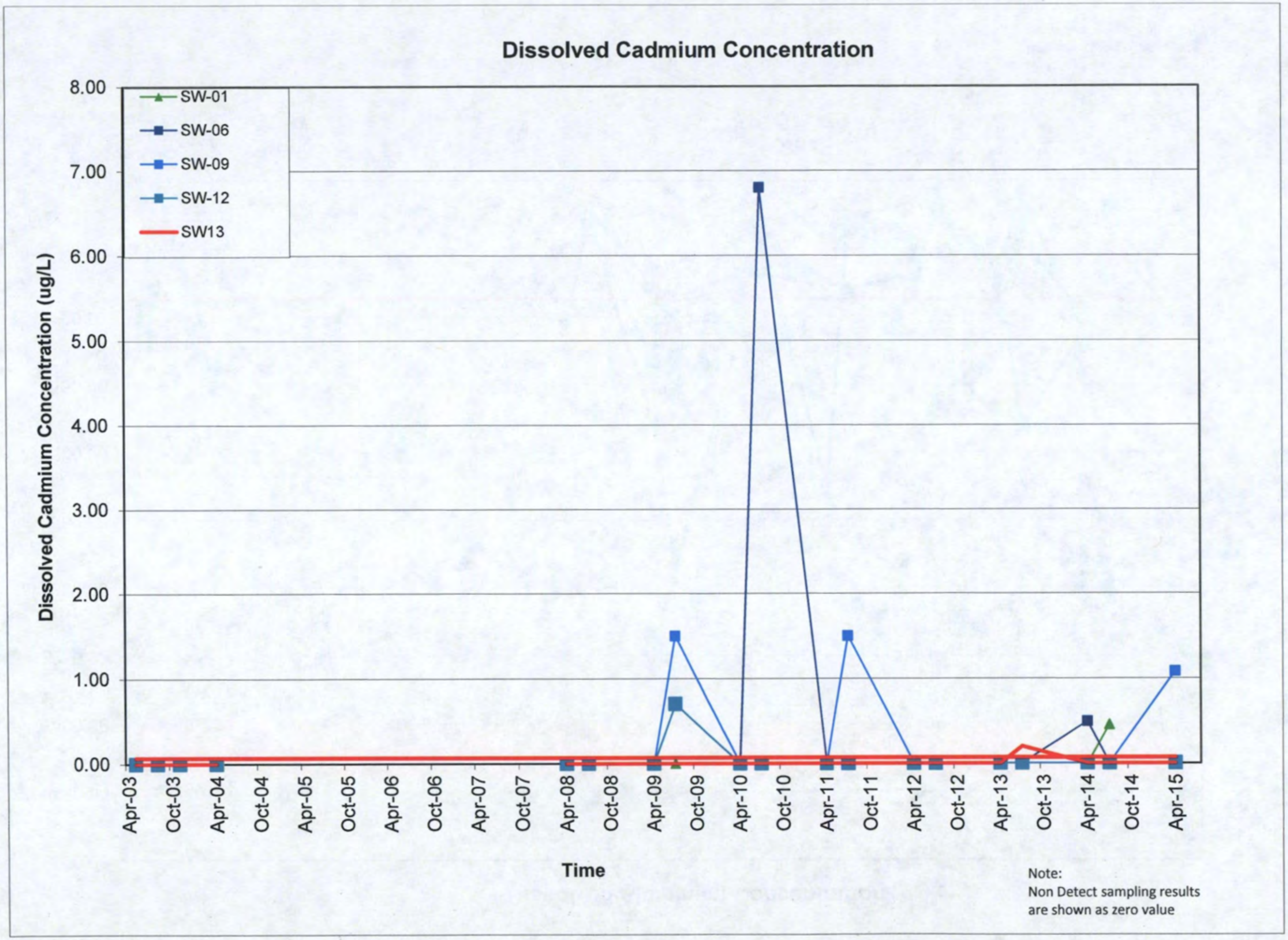
Total Manganese Concentration
SW-01
SW-04
SW-06
SW-09
SW-12
SW-17
Total Manganese Concentration (mg/L)
1600
1400
1200
1000
800
600
400
200
0
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results



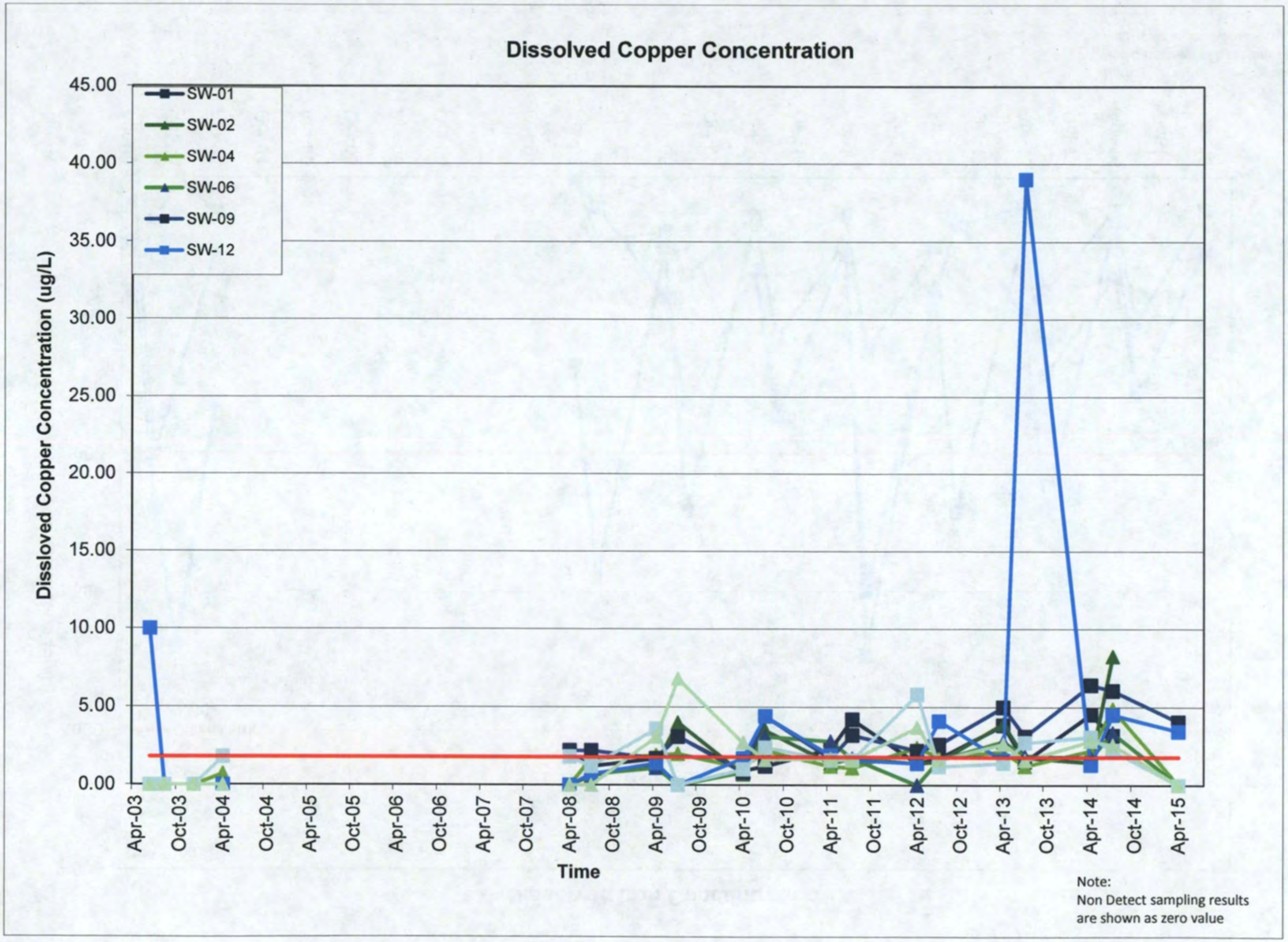
Note:
Non Detect sampling results
are shown as zero value



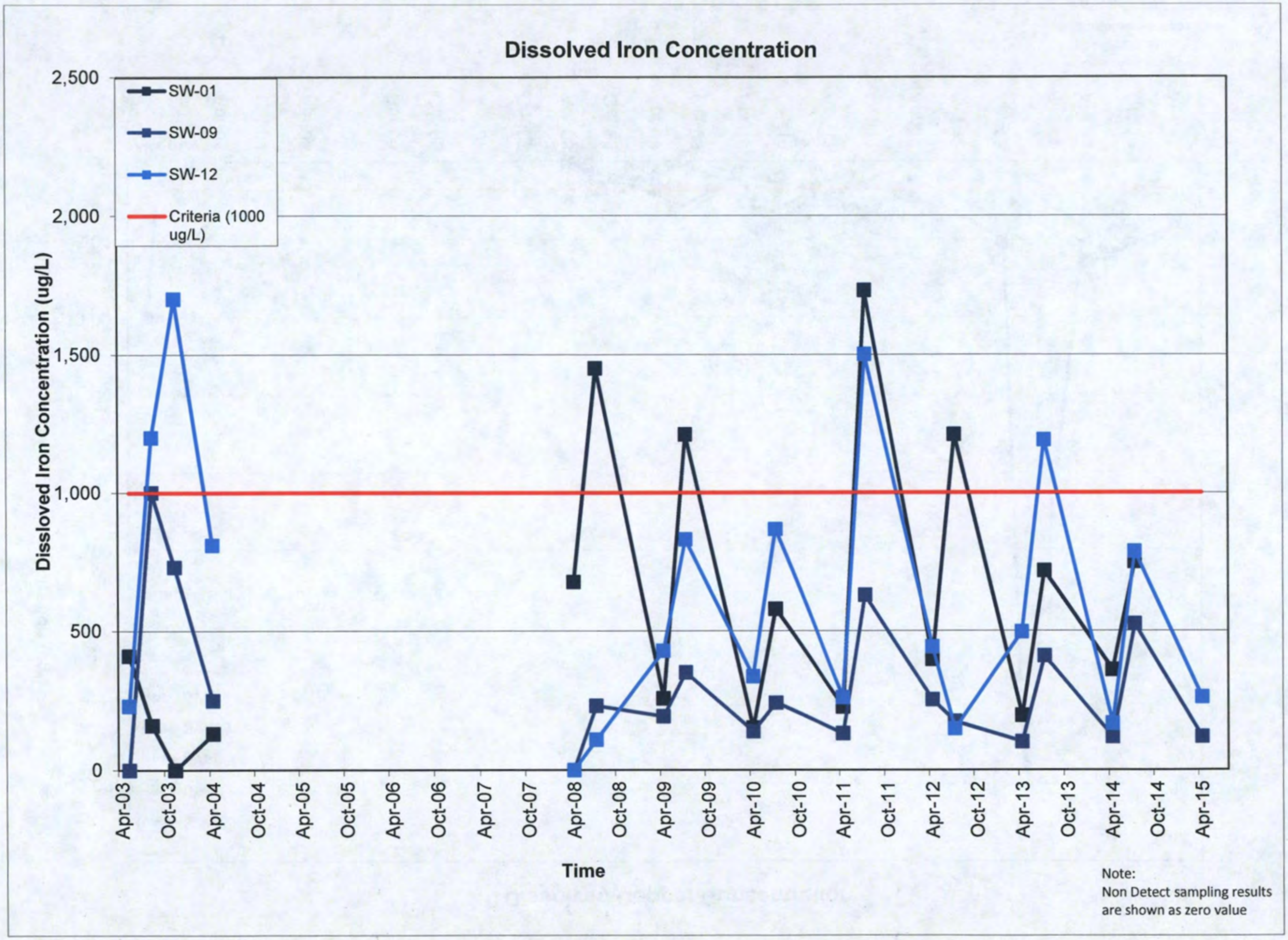
Dissolved Aluminum Concentration
SW-1
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Dissolved Aluminum Concentration (ug/L)
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



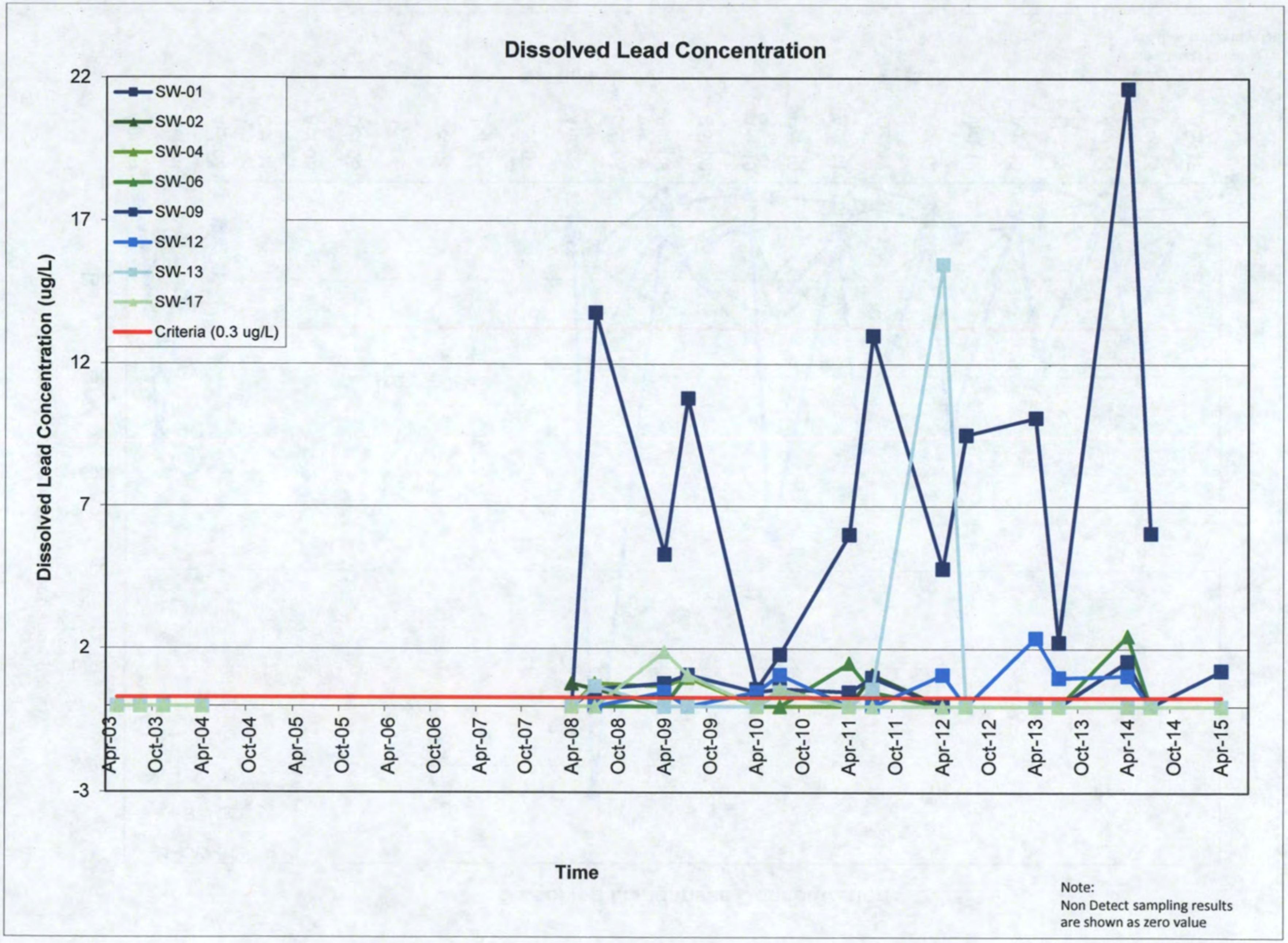
Dissolved Cadmium Concentration
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Dissolved Cadmium Concentration (ug/L)
SW-01
SW-06
SW-09
SW-12
SW13
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



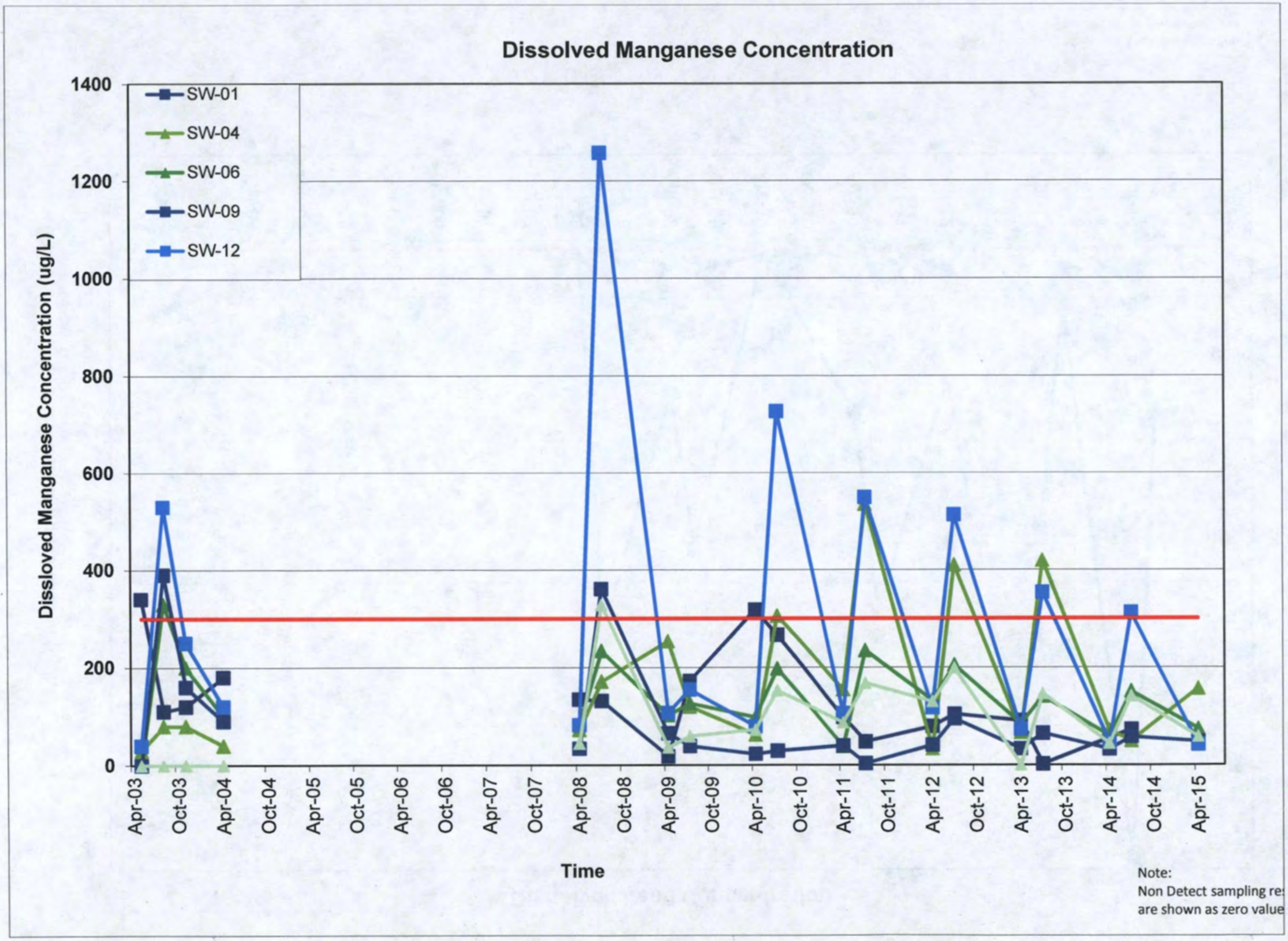
Dissolved Copper Concentration
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
Dissloved Copper Concentration (ug/L)
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



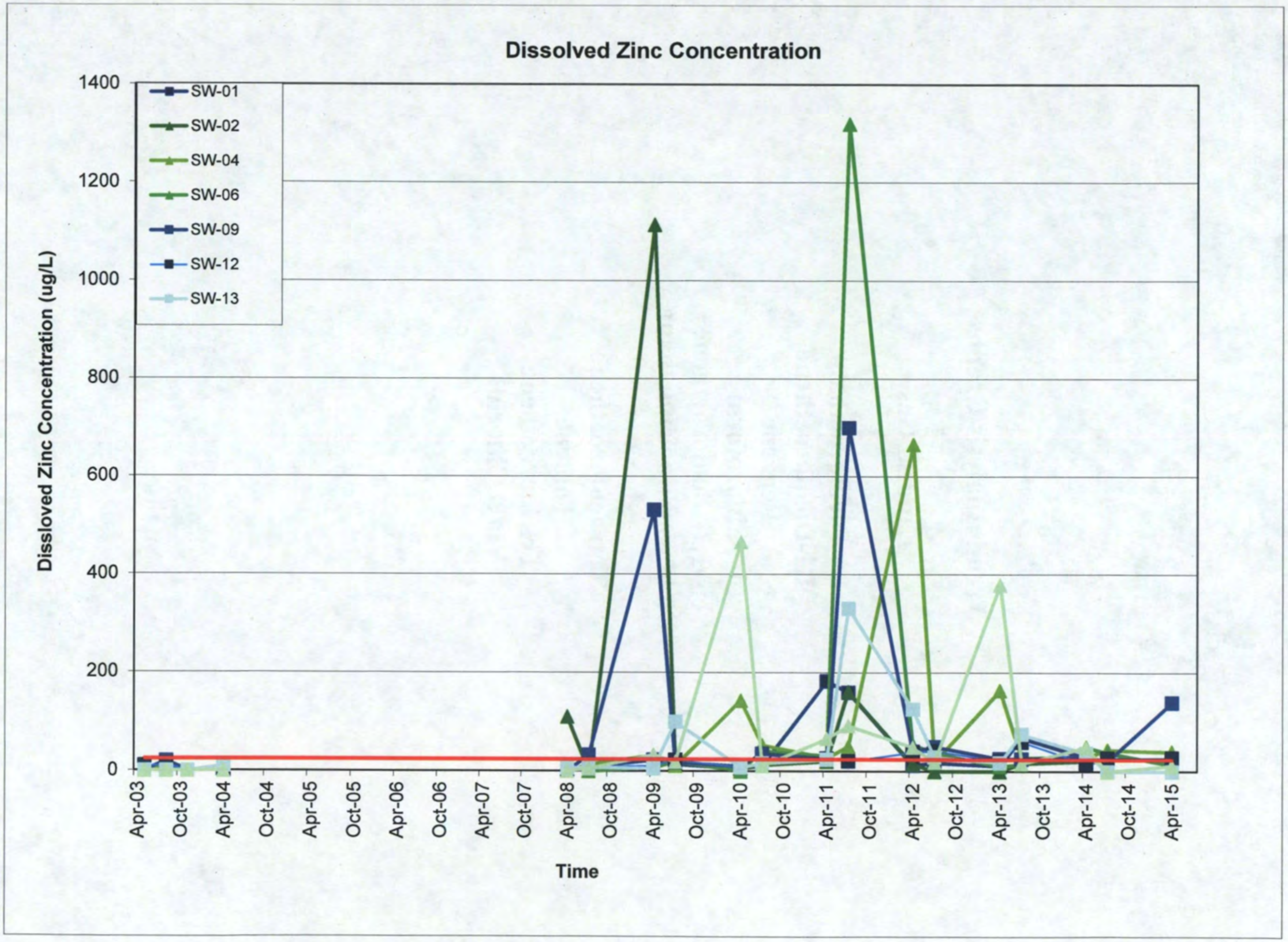
Dissolved Iron Concentration
SW-01
SW-09
SW-12
Criteria (1000 ug/L)
Dissolved Iron Concentration (ug/L)
2,500
2,000
1,500
1,000
500
0
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results are shown as zero value



Dissolved Lead Concentration
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
SW-17
Criteria (0.3 ug/L)
Dissolved Lead Concentration (ug/L)
22
17
12
7
2
-3
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



Dissolved Manganese Concentration
1400
1200
1000
800
600
400
200
0
Dissloved Manganese Concentration (ug/L)
SW-01
SW-04
SW-06
SW-09
SW-12
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time
Note:
Non Detect sampling re
are shown as zero value

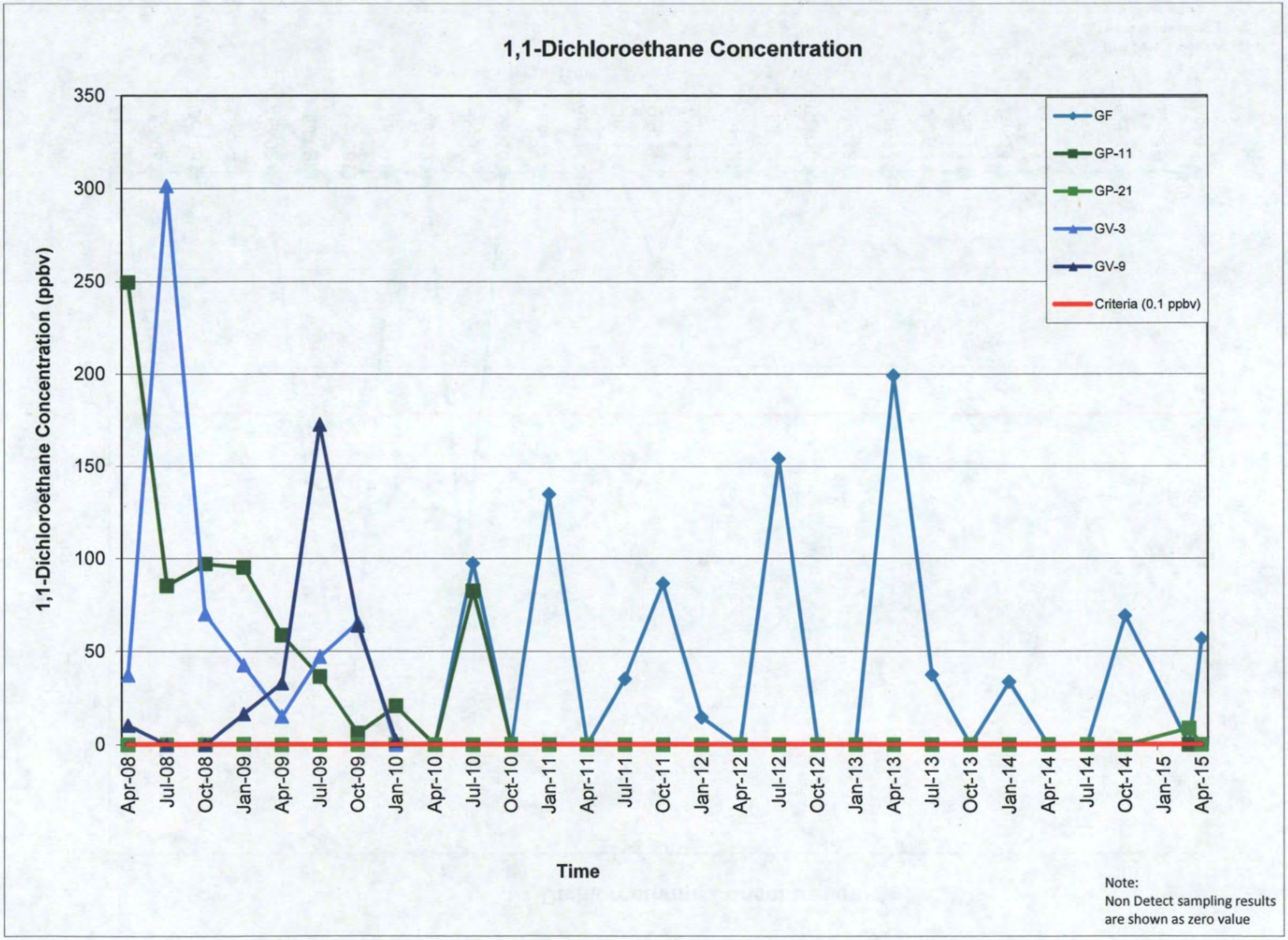


Dissolved Zinc Concentration
1400
1200
1000
800
600
400
200
0
Dissloved Zinc Concentration (ug/L)
SW-01
SW-02
SW-04
SW-06
SW-09
SW-12
SW-13
Apr-03
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
Oct-14
Apr-15
Time

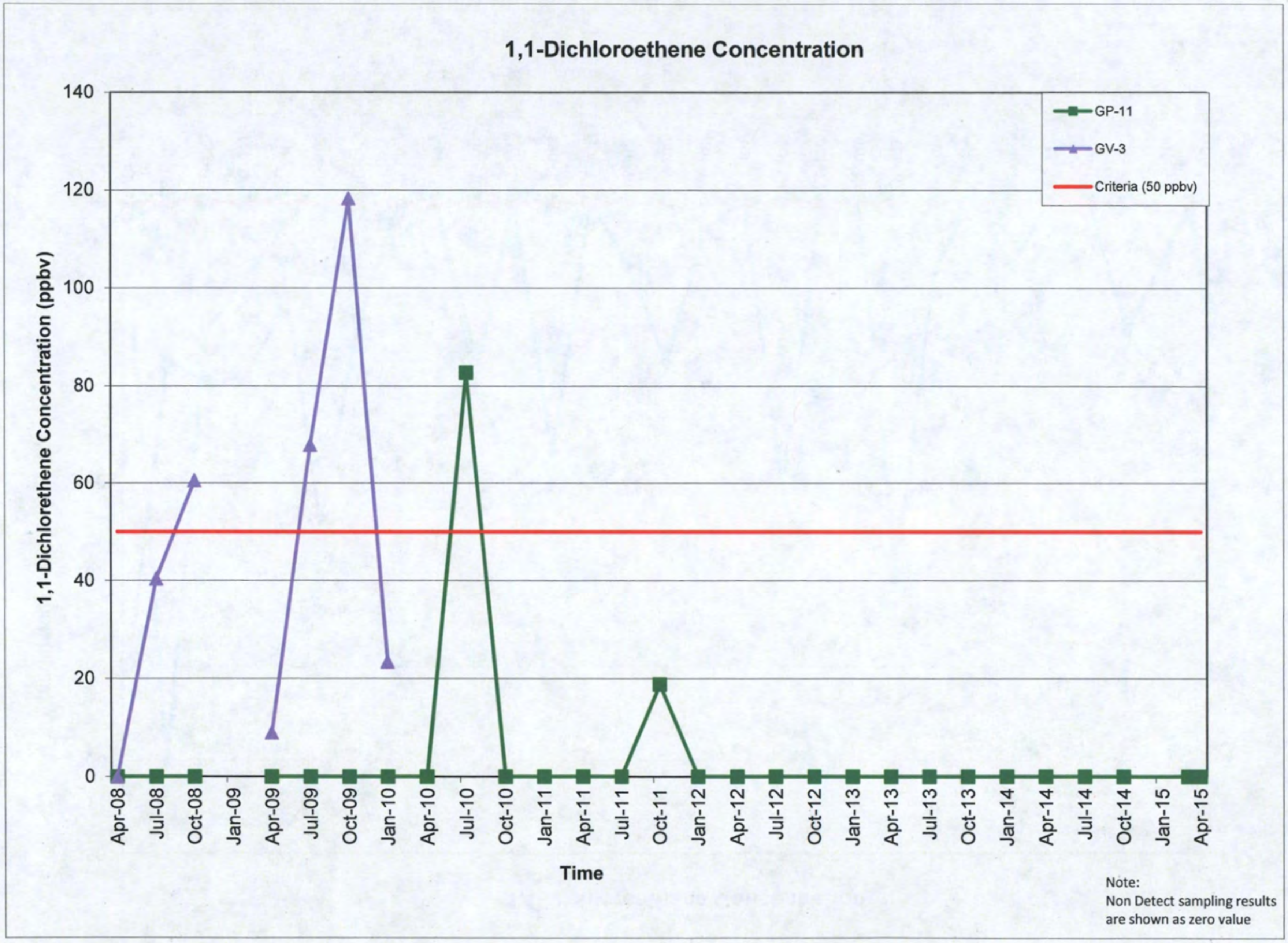
Trend Analysis Graphs

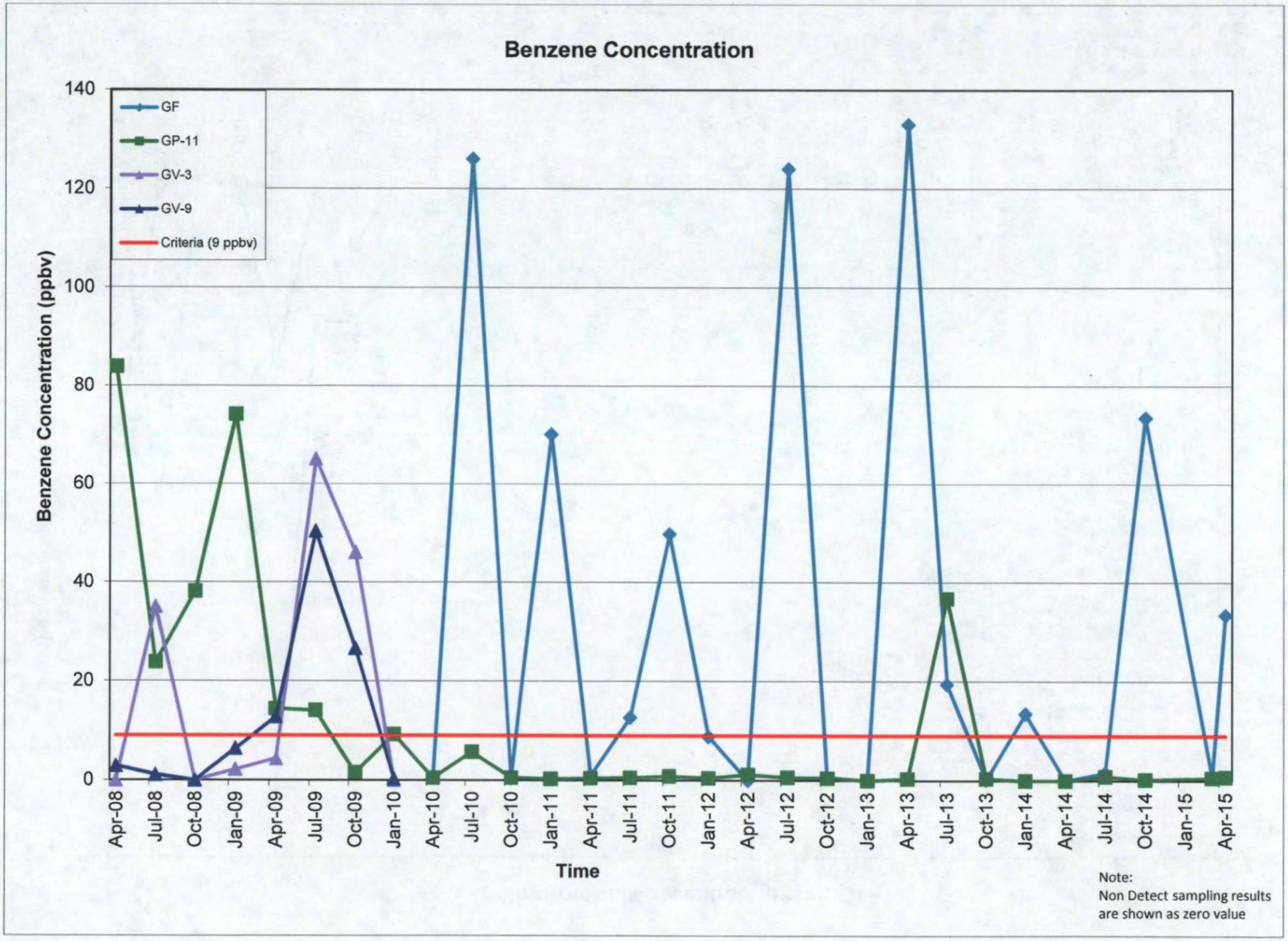
Landfill Gas

1,1-Dichloroethane
1,1-Dichloroethene
Benzene
Chloroform
cis-1,2-Dichloroethene
Dichlorodifluoromethane
n-hexane
Tetrachloroethene
Toluene
Trichloroethene
Vinyl Chloride

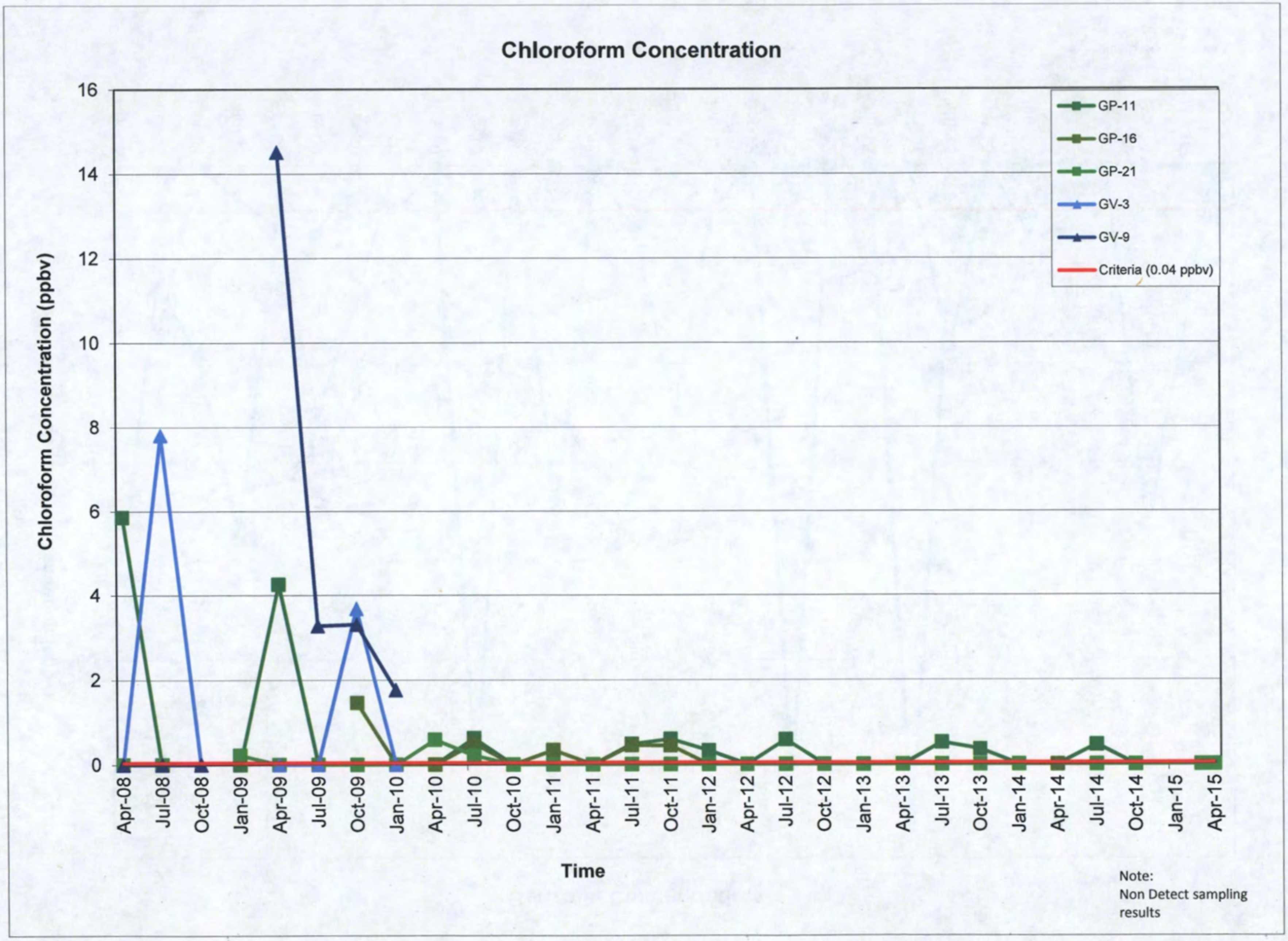


1,1-Dichloroethane Concentration
1,1-Dichloroethane Concentration (ppbv)
350
300
250
200
150
100
50
0
GF
GP-11
GP-21
GV-3
GV-9
Criteria (0.1 ppbv)
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value

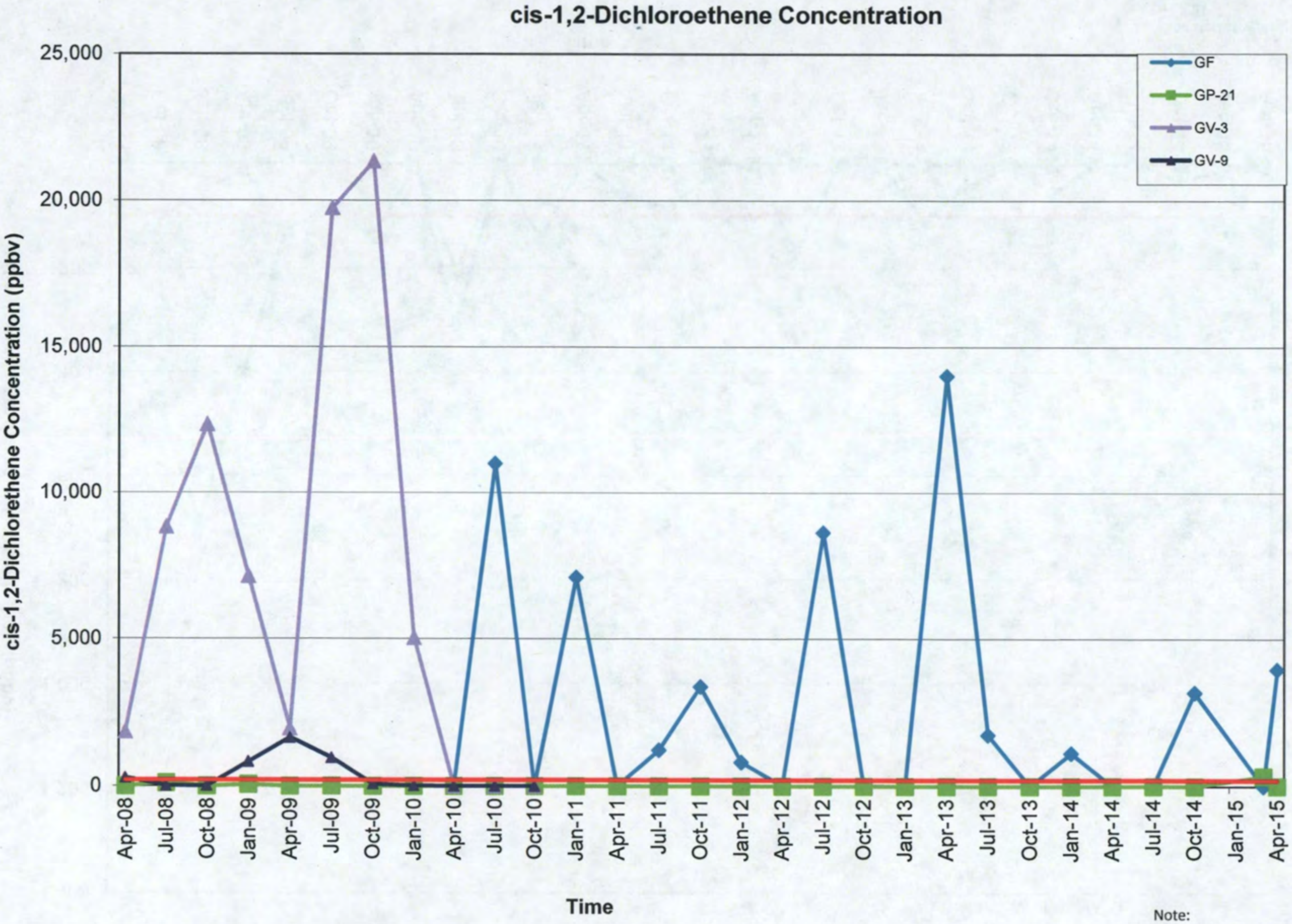

1,1-Dichloroethene Concentration
GP-11
GV-3
Criteria (50 ppbv)
1,1-Dichlorethene Concentration (ppbv)
0
20
40
60
80
100
120
140
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



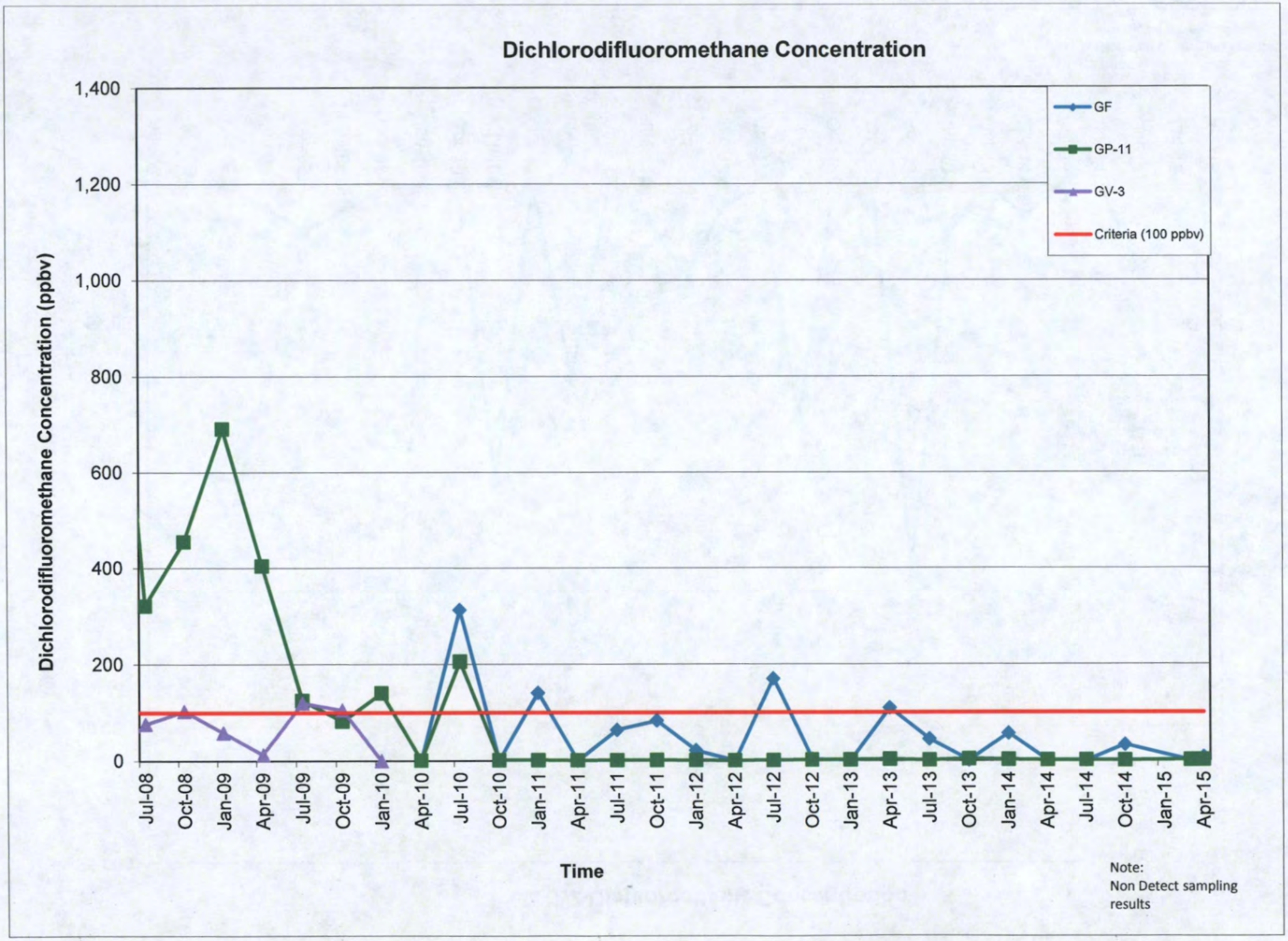
Benzene Concentration
GF
GP-11
GV-3
GV-9
Criteria (9 ppbv)
Benzene Concentration (ppbv)
140
120
100
80
60
40
20
0
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



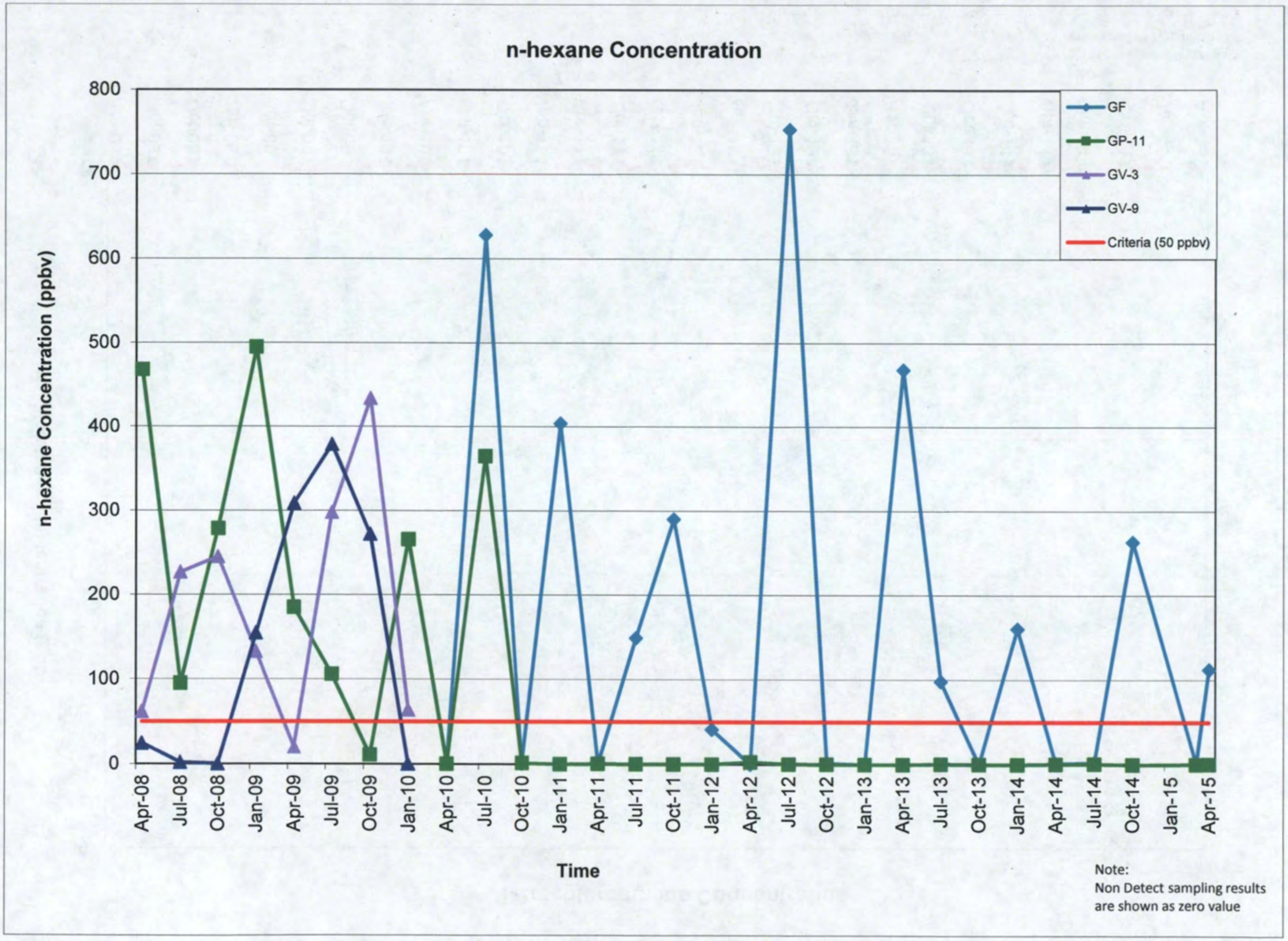
Chloroform Concentration
Chloroform Concentration (ppbv)
16
14
12
10
8
6
4
2
0
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
GP-11
GP-16
GP-21
GV-3
GV-9
Criteria (0.04 ppbv)
Note:
Non Detect sampling results

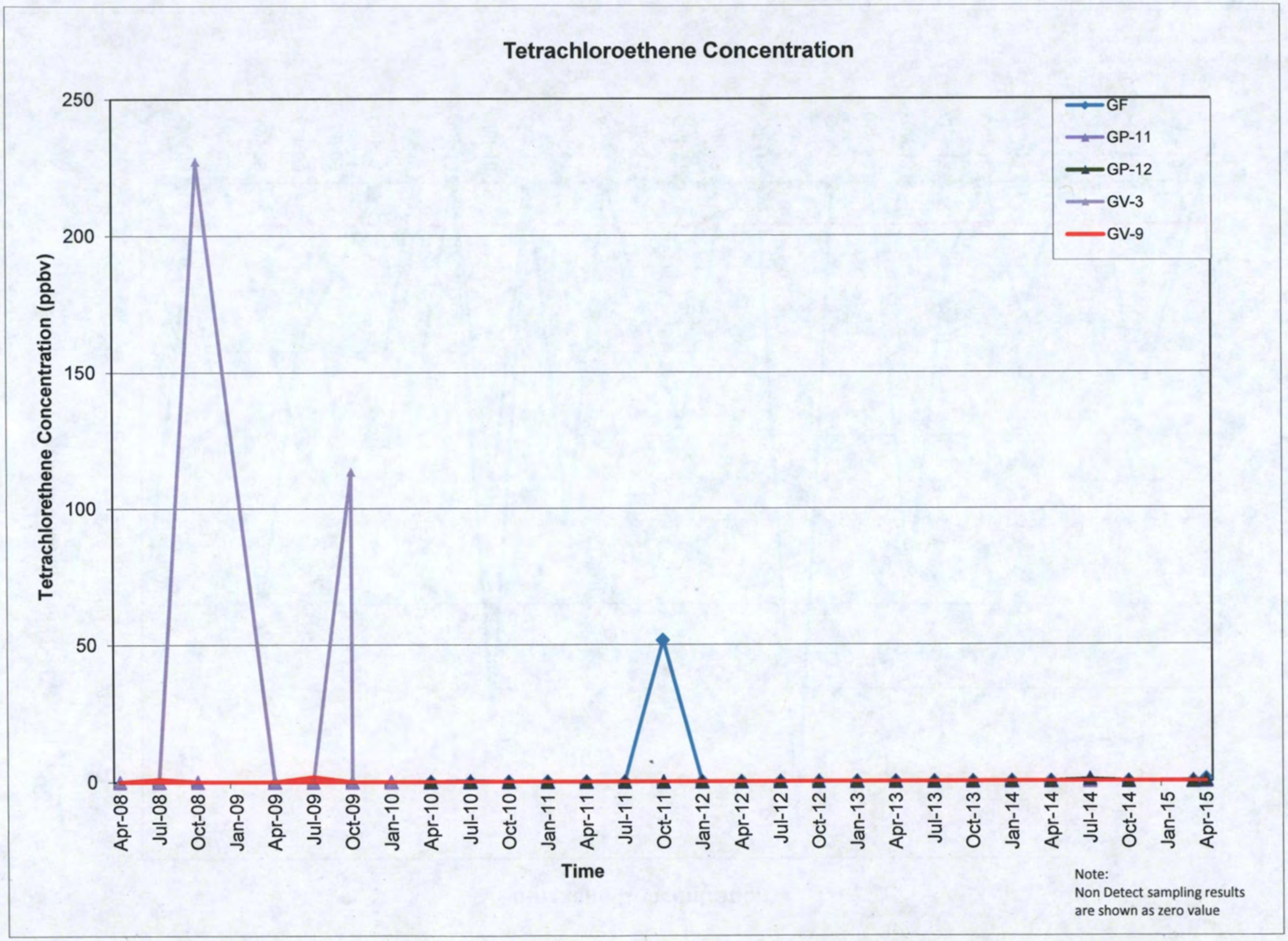


Note:
Non Detect sampling results are shown as zero value

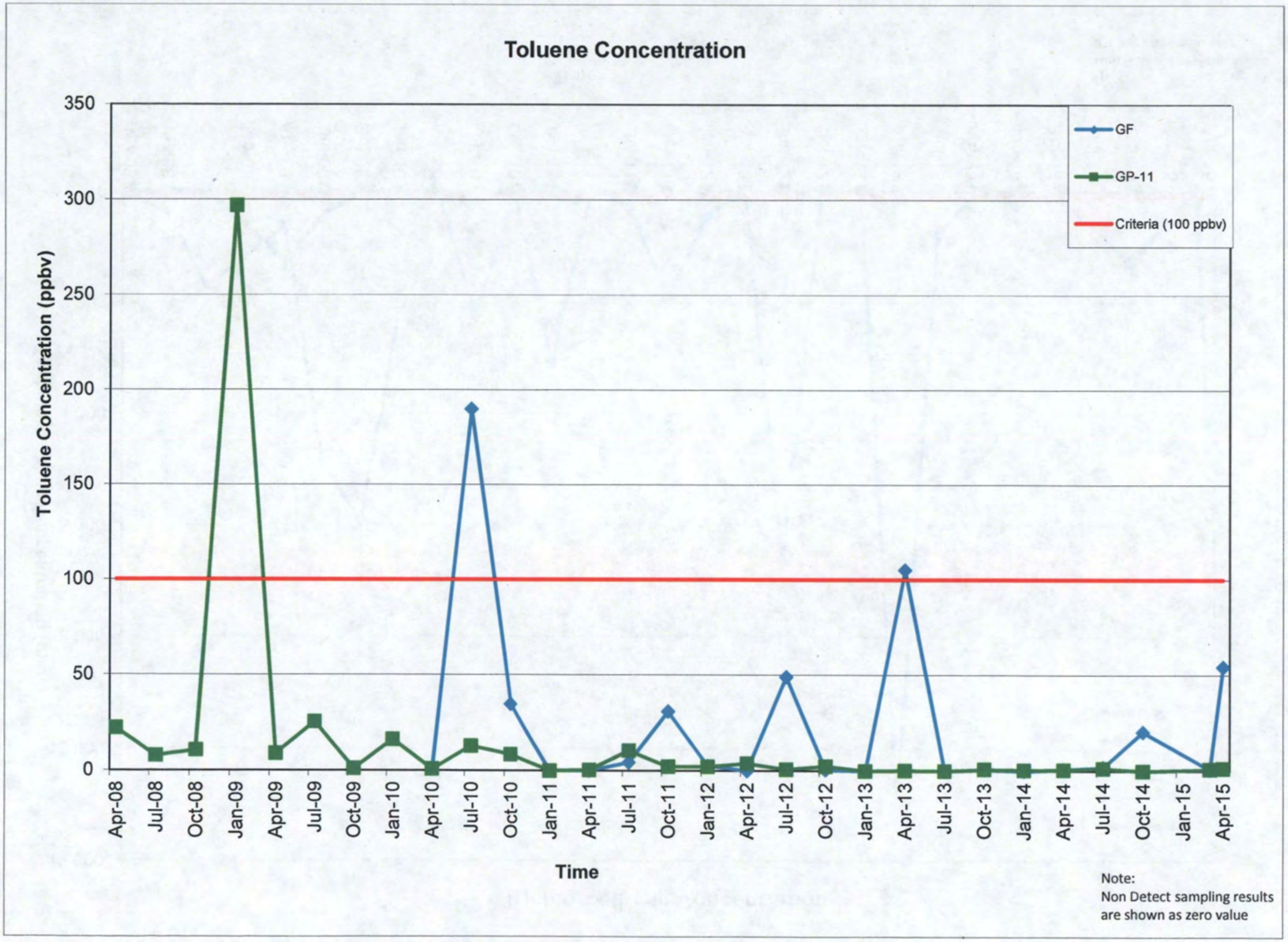


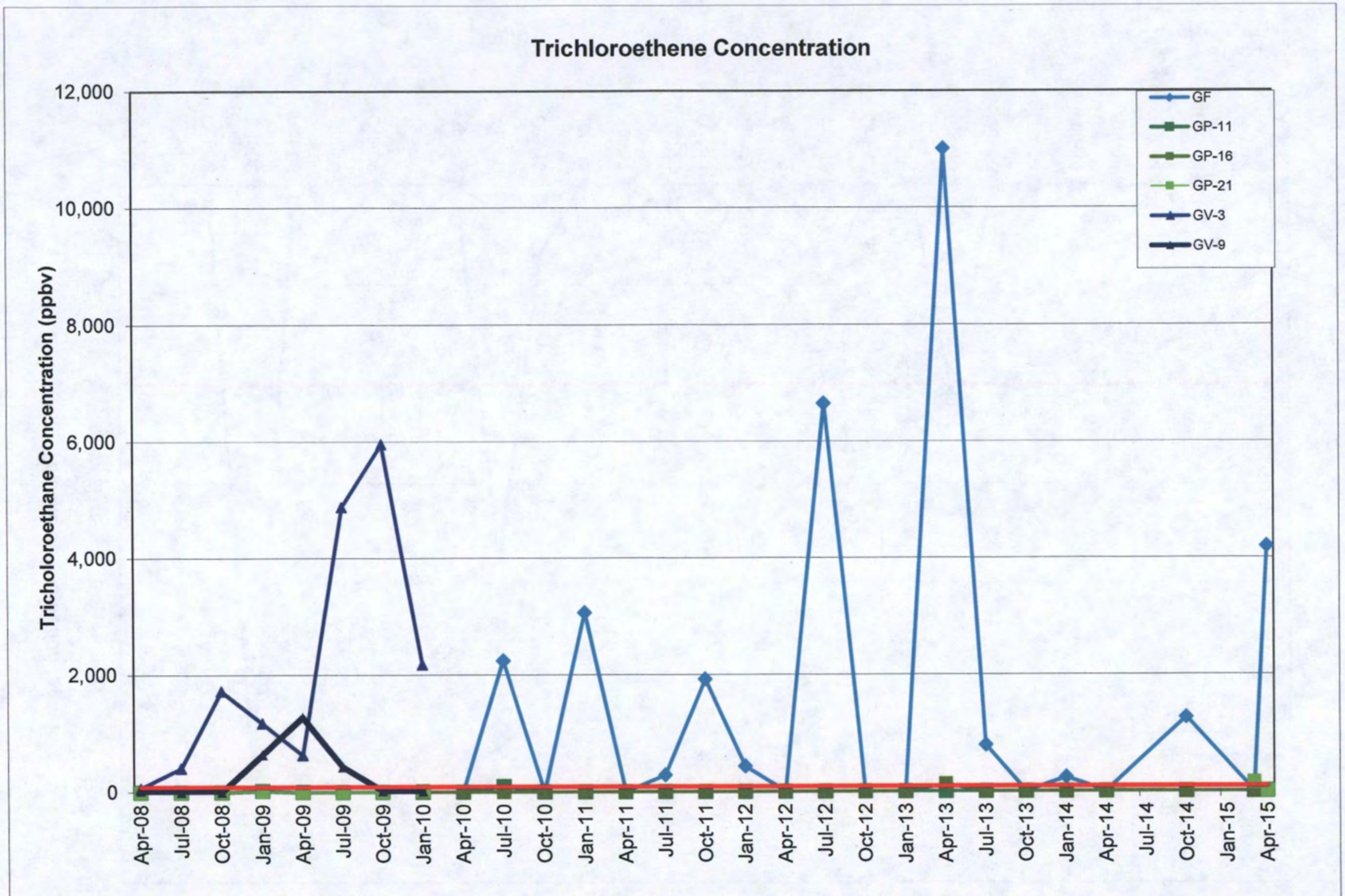
Dichlorodifluoromethane Concentration
1,400
1,200
1,000
800
600
400
200
0
Dichlorodifluoromethane Concentration (ppbv)
GF
GP-11
GV-3
Criteria (100 ppbv)
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results


n-hexane Concentration
n-hexane Concentration (ppbv)
800
700
600
500
400
300
200
100
0
GF
GP-11
GV-3
GV-9
Criteria (50 ppbv)
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value

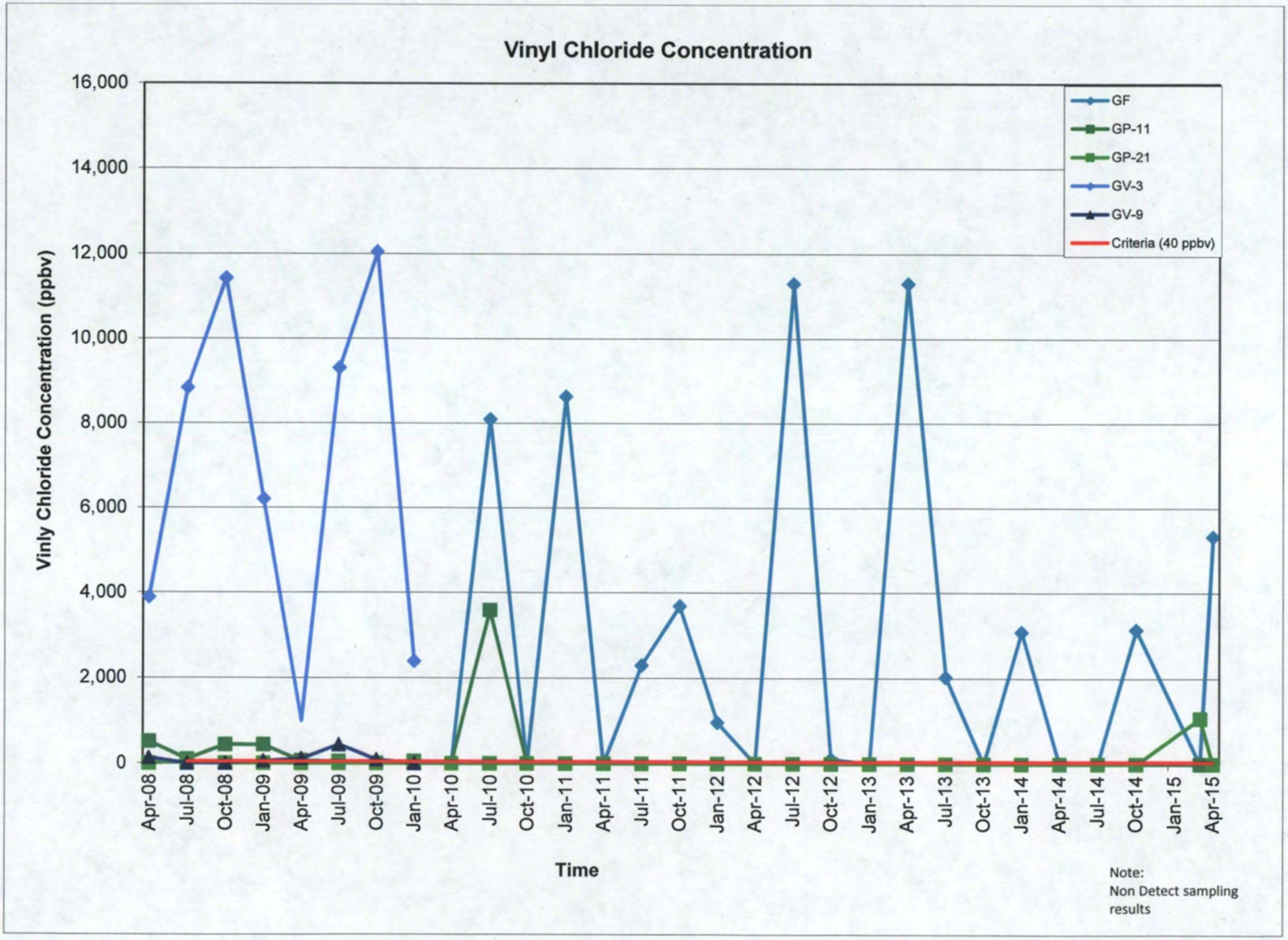


Tetrachloroethene Concentration
Tetrachlorethene Concentration (ppbv)
250
200
150
100
50
0
GF
GP-11
GP-12
GV-3
GV-9
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value


Toluene Concentration
Toluene Concentration (ppbv)
350
300
250
200
150
100
50
0
GF
GP-11
Criteria (100 ppbv)
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results
are shown as zero value



Note:
Non Detect sampling results are shown as zero value



Vinyl Chloride Concentration
Vinly Chloride Concentration (ppbv)
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
GF
GP-11
GP-21
GV-3
GV-9
Criteria (40 ppbv)
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Apr-13
Jul-13
Oct-13
Jan-14
Apr-14
Jul-14
Oct-14
Jan-15
Apr-15
Time
Note:
Non Detect sampling results