Second Five-Year Review Report

for

Tibbetts Road Superfund Site

Town of Barrington

Strafford County, New Hampshire

August 2008

PREPARED BY:

The United States Environmental Protection Agency
Region I New England
Boston, Massachusetts

Approved by:

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U.S. EPA, Region I

Date:

August 28, 2008

Five-Year Review Report

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List of Acronyms and Terms

ARAR	Applicable or Relevant and Appropriate Requirement
ARCADIS	ARCADIS, formerly known as Gegarty & Miller, is the contractor working for Ford Motor Company
AROD	Amended Record of Decision
BTEX	The major components of gasoline, Benzene, Toluene, Ethylbenzene, and Xylene.
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cis-1,2-DCE	Cis-1,2-Dichloroethylene
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
EW	Extraction well
Ford	Ford Motor Company, the Potentially Responsible Party for the site.
FS	Feasibility Study
GMZ	Groundwater Management Zone
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
ICL	Interim Cleanup Level
IRIS	Integrated Risk Information System
LTEMP	Long-Term Environmental Monitoring Program
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MW	Monitoring Well
NCP	National Contingency Plan
NHDES	New Hampshire Department of Environmental Services
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCBs	Polychlorinated biphenyls
PRP	Potentially Responsible Party
ppb or µg/L or µg/kg	Parts per billion or micrograms per liter (or kilogram)

ppm or mg/L or mg/kg	Parts per million or milligrams per liter (or kilogram)
RA	Remedial Action
RAO	Remedial Action Objective
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SLVWD or Water District	Swains Lake Village Water District
SDWA	Safe Drinking Water Act
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound
WasteLAN	The most current version of CERCLIS, the database that houses all Superfund site information. Also referred to as "CERCLIS 3."

Executive Summary

The remedy for the Tibbetts Road Superfund site (the "site") in Barrington, New Hampshire, as outlined by decision documents in 1992 and 1998[1,2], and governed by the Consent Decree[3], has included the following:

1. Installing a public water treatment plant to supply drinking and domestic water to residents whose wells were, or may become, contaminated.
2. Establishing institutional controls to prevent the consumption or contact with contaminated ground water.
3. Removing contaminated soil from the site for disposal. Some incineration of dioxin contaminated soil occurred and the treated soil was disposed off-site.
4. Performing soil vacuum extraction to remove volatile organic contaminants from the overburden aquifer. Over 800 pounds of contaminants were removed and destroyed.
5. Performing pump-and-treat in the weathered bedrock removing organic contaminants.
6. Performing phytoremediation and allowing natural attenuation to function at the site to reduce low levels of contamination that remain after the vacuum extraction and pump-and-treat remedies.

The triggering action date for this Five-Year Review is September 26, 2003, the date of the last Five-Year Review. During the conduct of this Five-Year Review EPA made the following findings:

1. The potentially responsible parties constructed the remedy in accordance with the requirements of the 1992 Record of Decision and the 1998 Amended Record of Decision.
2. The construction and operation of the drinking water treatment plant and water supply network is protective of human health. However, the operators of the treatment plant alerted EPA to several issues that may compromise the effectiveness in the future.
3. Institutional controls are effective and operating as intended.
4. The soil removal, vacuum extraction, and the pump-and-treat operation were effective in removing most of the contamination at the site and are protective of human health and the environment in the short-term. However, although concentrations of contaminants are greatly reduced, ground water remains contaminated above cleanup levels.
5. The present ground water remedy, bioremediation, supplemented by phytoremediation, is protective of human health and the environment in the short-term.
6. That neighbors to the site and local officials believe that the site does not pose an immediate threat; however, are respectively concerned with the drinking water supply system and with a proposed large, commercial ground water withdrawal approximately 3 miles from the site that may affect contaminant migration at the site in the future.

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[1] Record of Decision, Tibbetts Road Superfund Site, September 29, 1992 (U.S. Environmental Protection Agency: Region 1, Boston) p. 44 -58.
[2] Amended Record of Decision, Tibbetts Road Superfund Site, September 28, 1998 (U.S. Environmental Protection Agency: Region 1, Boston) p. 23 - 29.
[3] Consent Decree, United States of America and State of New Hampshire, Plaintiffs v. Ford Motor Company, Defendant. Civil Action C-91-120-S, C-91-194-S, Lodged 11/8/1994 and entered 3/20/1995.

Because the remedial actions undertaken at the site are protective in the short-term, the site is protective of human health and the environment in the short-term. However, in order to be protective in the long-term, a number of follow-up actions are recommended. These measures include, but are not limited to: installation of additional monitoring wells, additional geochemical analyses, updated and more accurate ground water and geochemical modeling efforts, and continued implementation of institutional controls (e.g., an approved GMZ, at a minimum).

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Tibbetts Road		
EPA ID *(from WasteLAN)*: NHD989090469		
Region: I	**State:** NH	**City/County:** Town of Barrington/Strafford County
SITE STATUS		
NPL status: ☑ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☑ Operating ☑ Complete		
Multiple OUs?* ☐ YES ☑ NO	**Construction completion date:** 9/29/1998	
Has site been put into reuse? ☐ YES ☑NO		
REVIEW STATUS		
Lead agency: ☑ EPA ☐ State ☐ Tribe ☐ Other Federal Agency ______________________		
Author name: Darryl Luce		
Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA Region I	
Review period:** 12/05/2007 to 7/30/2008		
Date(s) of site inspection: 4/15/2008		
Type of review: ☑ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☑ 2 (second) ☐ 3 (third) ☐ Other (specify) __________		
Triggering action: ☐ Actual RA Onsite Construction at OU #_____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ☑ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date *(from WasteLAN)*: 9/26/2003		
Due date *(five years after triggering action date)*: 9/26/2008		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

1. Cleanup Levels will not be attained by the ROD estimate of 2012: Concentrations of several Contaminants of Concern as identified in the 1992 Record of Decision and 1998 Amended Record of Decision still remain at or above the interim cleanup levels at several locations. Overall there has been a downward trend of ground water contaminant concentrations indicating that the remedy has been successful in controlling migration and expansion of the contaminant plume. However, based on observed trends, arsenic, manganese and some volatile organic contaminants will exceed cleanup levels at the site past 2012.

2. The existing drinking water treatment plant has potential future operational problems: Although these problems do not cause violations of water quality standards presently, future violations may occur.

3. Ground water use pressures in the surrounding area may impact site contaminants: Although there are no ground water uses within the GMZ, future ground water use in a nearby subdivision and a water bottling plant highlight the need for monitoring to confirm that the plume does not migrate beyond areas protected by the alternate water supply and the institutional controls.

4. Vapor Intrusion: In April 2008 EPA received a report evaluating the potential for vapor intrusion to create an inhalation risk for residents that may lie over the site. EPA is still reviewing this report

5. Evaluate bedrock aquifer remedies: In May 2008 EPA received a report evaluating a pilot test to address VOC contaminants in bedrock. EPA is reviewing this report.

Recommendations and Follow-up Actions:

1. Perform additional ground water and geochemical investigations to determine appropriate cleanup times and controls on contaminants.

2. Evaluate potential alternative water supplies for Swains Lake Village Water District.

3. Evaluate potential for additional ground water withdrawals outside of the GMZ to impact bedrock contaminants and methods to monitor any migration.

4. Complete the vapor intrusion pathway evaluation.

5. Evaluate other options to address high concentrations of VOCs in bedrock.

Protectiveness Statement(s):
Because the remedial actions undertaken at the site are protective in the short-term, the site is protective of human health and the environment in the short-term. However, in order to be protective in the long-term, a number of follow-up actions are recommended. These measures include, but are not limited to: installation of additional monitoring wells, additional geochemical analyses, updated and more accurate ground water and geochemical modeling efforts, and continued implementation of institutional controls (e.g., an approved GMZ, at a minimum).

Five-Year Review Report

I. Introduction

The purpose of a Five-Year Review is to determine whether a remedy at a Superfund site is protective of human health and the environment. The methods, findings, and conclusions of a review are documented in a Five-Year Review report. In addition, Five-Year Review reports identify issues, if any, and recommend action(s) necessary to address them.

The U.S. Environmental Protection Agency (EPA), Region I is preparing this Five-Year Review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 121(c) as amended 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.*

The Agency interpreted this requirement further in the National Contingency Plan (NCP); 40 CFR §300.430(f)(4)(ii) 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 action no less often than every five years after the initiation of the selected remedial action.*

The EPA Region I conducted this Five-Year Review of the remedial actions implemented at the Tibbetts Road Superfund site (the "site") in Barrington, Strafford County, New Hampshire (Figures 1 and 2). This review was conducted for the entire site from December 2007 through July 2008. This report documents the results of the review.

This is the second Five-Year Review Report for the Tibbetts Road site. The triggering action for this policy review is the completion date of the first Five-year Review in September 2003. This Five-Year Review 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. Specifically, following implementation and operation of the ground water remedy, ground water remains contaminated.

Figure 1: Site Location Map.
The topographic map shows the location of the site relative to the State and surrounding features. The datum is from 1981 and ARCADIS altered the base of this document to supply the locus map and the scale information. The site is located at 43º 10’ 46” N and 71º 02’ 01” W. The black lines superimposed on the topographic map are spaced at 1 kilometer intervals.

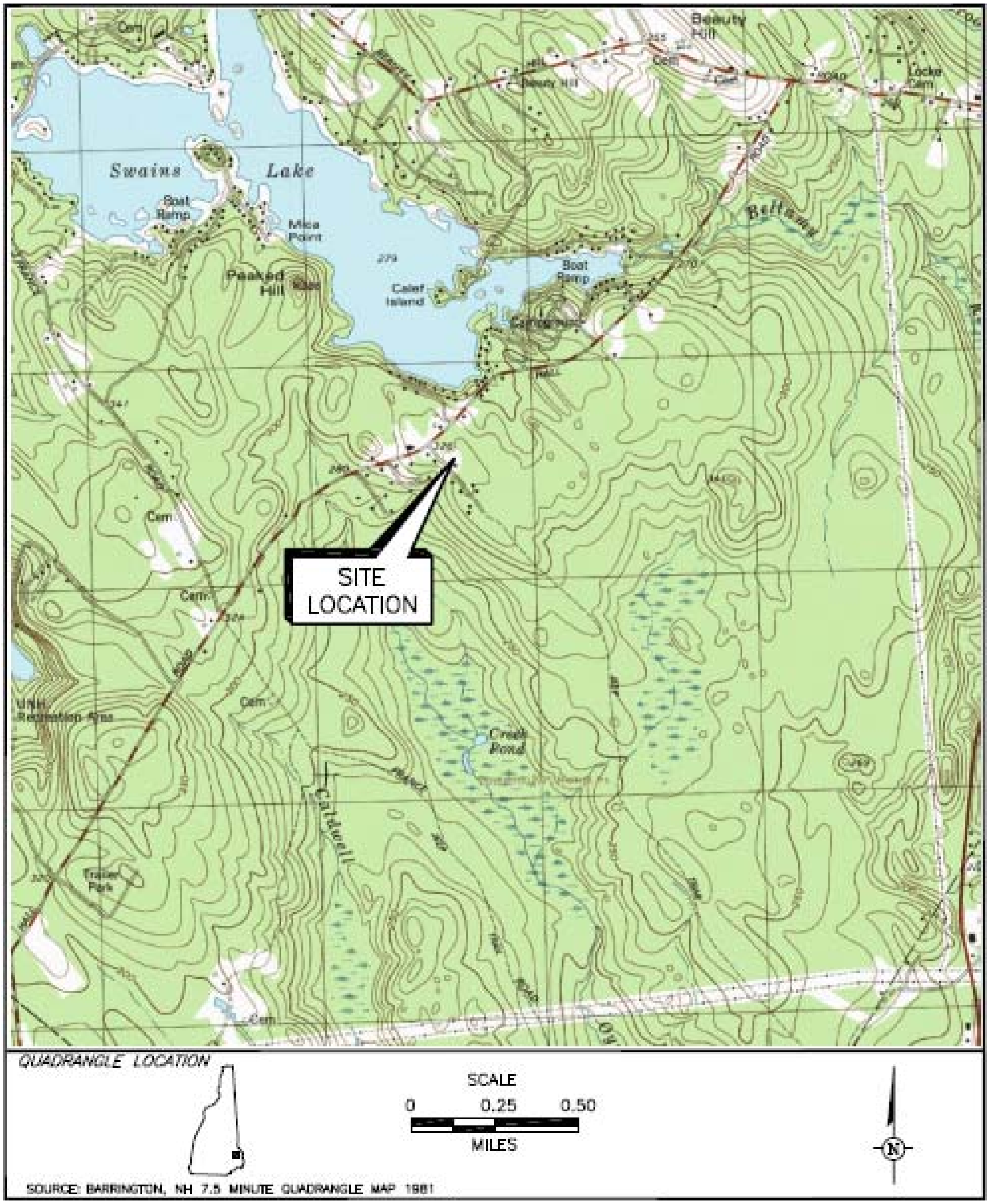
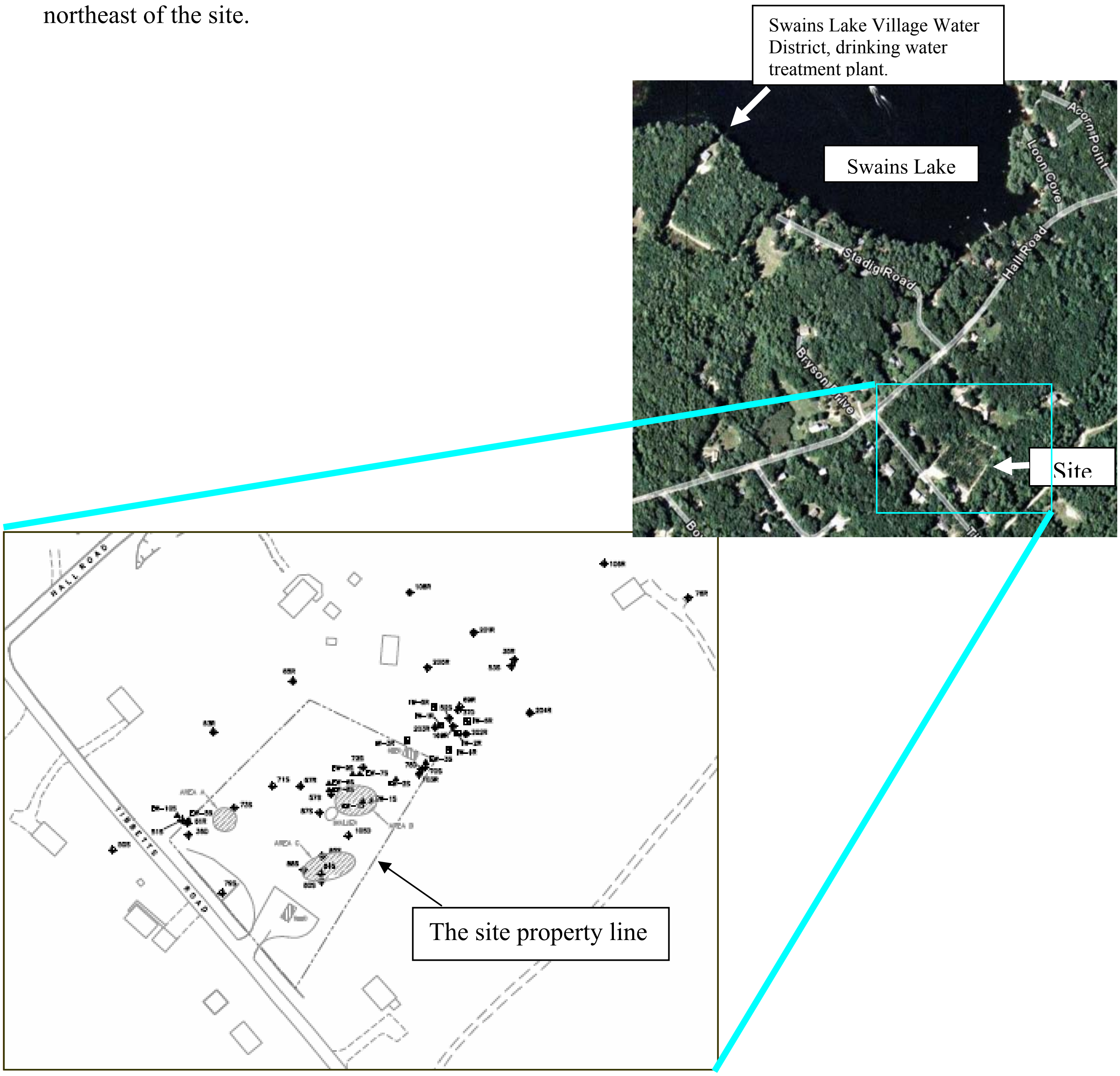


Figure 2: Site Features.

This figure has two maps. The aerial imagery from GoogleEarth Pro, on the upper right, shows the site as it, and the neighborhood, appeared in 2006. Various site features are identified including the location of Swains Lake, the drinking water treatment plant and the road network. In the aerial, the property bounds of the site are evident by the change in vegetation. The line drawing to the lower left, prepared by ARCADIS, is much closer to the site, shows the site and in greater detail, showing the property line, the location of the nearby homes, some of the monitoring well network, and the location of the former drum storage areas (shaded). There are no surface water bodies on the site; however, wetlands lie approximately 200 meters to the northeast of the site.



II. Site Chronology

Table 1 below summarizes the chronology of the events at the site. More detailed chronologies are available in the RI/FS as well as the 1992 Record of Decision and the 1998 Amended Record of Decision.

Table 1: Chronology of Site Events

Date	Event
1945 to 1958	The site serves as the residence of Alexander Johnson and his family. During this period, Mr. Johnson transports drums containing industrial solvents and paint by-products to his home for storage and use.
1982	Acting on complaints from nearby residents, State of New Hampshire officials discover more than 300 drums at Mr. Johnson's residence and evidence of releases to the environment. Subsequent inspections find that the contents of many of the drums were discharged onto the ground or were used to burn cars prior to cutting-up for scrap. These discharges and uses resulted in the contamination of soil with volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenols (PCBs), and dioxin. Some of these compounds migrate to ground water resulting in ground water contamination with VOCs, acetone, and gasoline components including benzene, toluene, ethylbenzene and xylene (BTEX).
1984	The State of New Hampshire requests EPA's assistance in removing drums and contaminated soils at the site. EPA removes 337 drums containing solvents, PCBs, and other hazardous materials. EPA also identifies risk due to contaminated ground water found in nearby residential drinking water wells.
1984 to 1985	The State of New Hampshire and EPA conduct investigations into the extent of soil and ground water contamination.
1986	EPA and the State excavate and remove over 405 cubic yards of soil contaminated by solvents and PCBs from the site. EPA incinerates four cubic yards of soil contaminated with dioxin at the site. The site is finalized for inclusion on the National Priorities List (NPL) on June 10, 1986.
1987 to 1988	EPA and the State construct a drinking water treatment plant and water distribution network to serve approximately 45 homes whose wells are contaminated or threatened by ground water contamination from the site. Drinking water is supplied using treated water from nearby Swains Lake. A group of residents surrounding the site form the Swains Lake Village Water District to assume responsibility for the operation and maintenance of the water supply system.
1992	EPA holds a public informational meeting on June 24, 1992 to discuss the results of the Remedial Investigation and Feasibility Study (RI/FS) and to present the EPA's proposed cleanup plan for the site. After soliciting comments from the public, the cleanup plan for the site is finalized in the Record of Decision signed by EPA on September 29, 1992.

Table 1: Chronology of Site Events

Date	Event
1993	EPA extends the distribution of the Swains Lake Village Water District supply system to include several nearby residences and a seasonal campground.
1994 to 1995	EPA, the State, and the Swains Lake Village Water District negotiate a Consent Decree with Ford Motor Company (Ford), the Potentially Responsible Party (PRP). Ford agrees to help improve and fund the drinking water supply system operated by the Swains Lake Village Water District and to conduct the remedial action at the site.
1995	Ford's consultant, ARCADIS, begins the supervised remedial action at the site. The original Johnson residence, damaged by fire and more than ten-years of abandonment, is demolished. ARCADIS clears the site, grades and paves approximately 2 acres overlying contaminated ground water, and begins operation of a vacuum-enhanced ground water recovery (VER) system.
1995 to 1997	ARCADIS operates the VER system in the overburden aquifer over the entire site. The VER system removes more than 800 pounds of VOC contaminants over the 3 years of operation.
1998	After attaining the remediation goals established in the 1992 Record of Decision, the VER system is shut down and the asphalt cap over much of the site is removed. The remedy is described in the ROD as amended on September 28, 1998, to reflect that ground water treatment will consist of bioremediation and phytoremediation with some potential "hot-spot" remediation using the existing VER system. Approximately 1,600 hybrid poplar trees were planted at the site in May of 1998 as part of the phytoremediation component of the Amended ROD. The Preliminary Close-Out Report is signed by the EPA on September 29, 1998, signifying the completion of the construction activities at the site.
1998 to present	Ground water monitoring shows concentrations of site contaminants remain above cleanup levels in a limited area of the overburden aquifer and the bedrock aquifer. Concentrations in the bedrock area remain high.
2003	First Five-Year Review is issued by the EPA.
2003 to present	ARCADIS maintains equipment on the site to perform hotspot remediation in the bedrock aquifer, near the northern property line, on a periodic basis.
2003 to 2006	ARCADIS performs a series of sodium permanganate injections into the bedrock aquifer near the northern property line.
August 2008	EPA issued this second Five-Year Review.

III. Background

The Tibbetts Road Superfund site (the "site") is located in the Town of Barrington, Strafford County, southeastern New Hampshire, 43º 10' 46" N and 71º 02' 01" W. The 1.9-acre site is owned by the estate of Alexander Johnson, and is bordered by Tibbetts Road to the southwest, and by residences on the remaining three sides. See Figures 1 and 2.

A. Physical Characteristics

Physical Setting

The site is in an area of light, rural residential development. The area was formerly logged and farmed for a number of years prior to residential development that began in the late 1970's. Except for the pockets surrounding each residence, the area consists of oak-maple-white pine forest. At the southern end of Tibbetts Road is the entry to the 1400-acre Tamposi property. The Tamposi property consists of wetlands and mixed hardwood and conifer forest, and is protected from future development. The area is set aside for passive recreation and the primary use is to protect the watershed of the Bellamy Reservoir. Swains Lake lies 300 meters north of the site.

Site Conditions

Currently, the 1.9 acre Johnson property, the origin of the contamination, exists as a vacant lot and has a driveway, a small garage, a large sugar maple at the front of the lot, and a large number of poplar trees that nearly cover the entire 1.9 acres. The poplar trees are part of the phytoremediation remedy. ARCADIS maintains the property, caring for the grounds. Photos of the site and surrounding neighborhood are attached in Appendix C.

Surrounding Properties, Condition and Use

The area surrounding the site is zoned for residential use and the area may be characterized as rural/residential. There is an auto paint shop attached to a home approximately 100 meters southeast of the site at the end of Tibbetts Road. During the period of site characterization and active remediation no new homes were built within ½ kilometer of the site. Since 2003 one home was built within 100 meters of the site and a new residential subdivision consisting of 18 homes has begun construction at the end of Tibbetts Road, 200 meters south of the site.

Surface Water Hydrology

The site straddles a ridge that runs northwest towards Swains Lake. The ridge serves as a drainage divide between the Oyster River to the south and the Bellamy River to the north. Most of the site lies in the northern, Bellamy River, portion of the watershed. Approximately ¼ of the site lies in the southern Oyster River watershed. Surface water runoff from the site is through sheet flow to the north and south, depending on the portion of the site. Figure 1 displays the terrain and water features surrounding the site. The primary water bodies include Swains Lake 300 meters to the north and an extensive wetland to the south. However, there is a small wetland that is not shown on Figure 1 that lies approximately 200 meters north of the site and drains westward to Swain's Lake. Swains Lake is the result of an impoundment and overall is a very shallow lake despite its large lateral extent.

Geology

Geology at the site consists of a layer of glacial till approximately 5 to 9 meters thick that rests on top of a lens of compacted clay known as a "lodgment till." The lodgment till is approximately 18 meters thick beneath the site, but pinches out just off the northern and southern site bounds. Beneath the lodgment till lies a fractured quartz-monzonite granite bedrock.[4] The bedrock fractures consist of many sub-horizontal release fractures in the upper sections, connected to steeply dipping fractures that are oriented roughly northeast-southwest and northwest-southeast.[5] Figure 3 offers a representation of the geology beneath the site.

Hydrogeology

Ground water flow at the site occurs in the glacial till, or overburden, and the bedrock aquifers. Ground water flow in the overburden aquifer is governed by the topography and an aquitard, the lodgement till described in the preceding section. As described above, the site lies at the top of a ridge that trends roughly east-west. In the overburden aquifer ground water flow mirrors the surface water flow, in the northern half of the site ground water flows to the north and in the southern half of the site flows south. On the site ground water does not infiltrate to the bedrock, but instead flows downward towards the lodgment till and then flows horizontally off-site to where the lodgment till pinches out.[6] Ground water then enters the weathered bedrock via the sub-horizontal release fractures before being intercepted by the steeply dipping fractures. The fracture flow extends over considerable distances and can be significant in volume.[7] Figure 3 generalizes ground water flow at the site.

B. Resource Use

Water is the primary resource in the area surrounding the site. Surface water and ground water constitute important resources to the community. Ground water, in the form of private wells, is the primary drinking water source for most residents in Barrington. In the area impacted by the Tibbetts Road site, surface water treated and supplied by the Swains Lake Village Water District is the primary source of drinking water. The many lakes, ponds and streams are also important recreational resources in Barrington.

Swains Lake is a key surface water resource for recreation and drinking water. Swains Lake is classified as a class "B" waterway by the State of New Hampshire and is used for recreational swimming, boating and fishing. A seasonal campground, approximately 1 kilometer north of the site, lies on the eastern shore of Swains Lake. Swains Lake is also ringed by many large homes that were recently converted from seasonal cottages. However, the more important use of Swains Lake is as a direct drinking water source for the residents affected by ground water contamination at the site. The surface water drinking supply system will be discussed in detail in Section D. Swains Lake is also a tributary to the Bellamy River which eventually forms the Bellamy Reservoir, a primary drinking water resource for the city of Portsmouth, New Hampshire.

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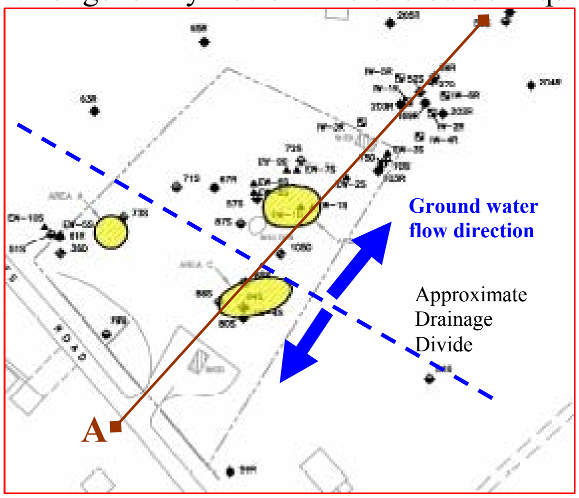
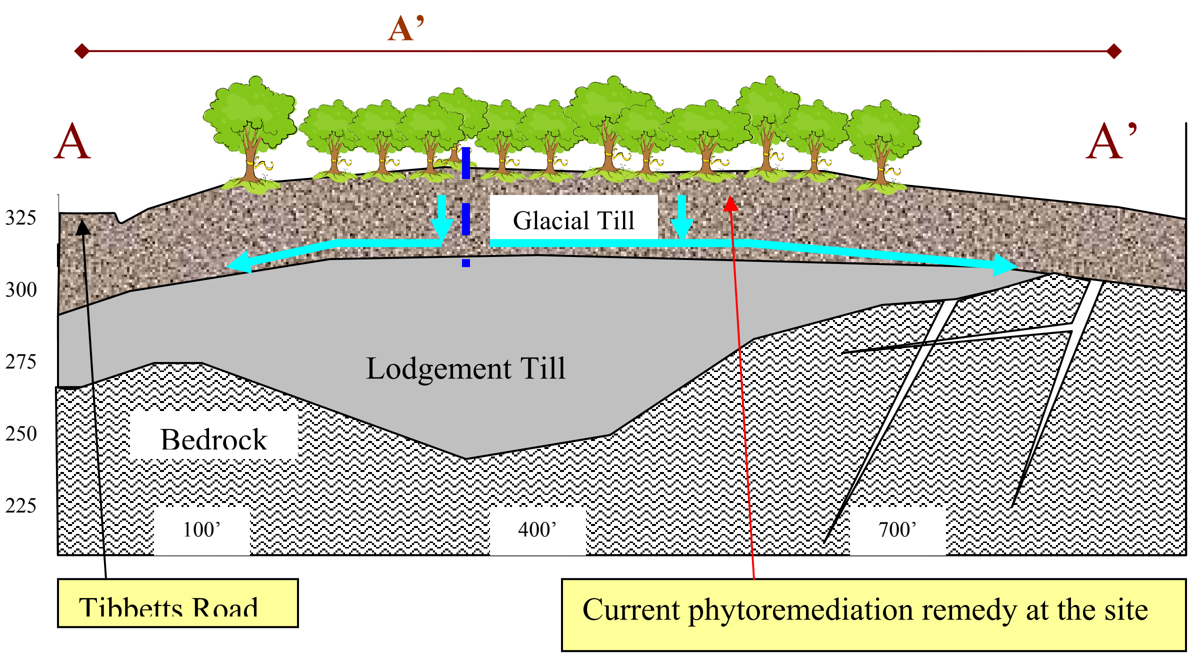
[4] Remedial Investigation Report Tibbetts Road Superfund Site, Volume I, June 1992 (CDM Federal Programs Corporation, Boston, MA) p. 3-1 to 3-2.
[5] Remedial Investigation, Volume I, p. 3-7 to 3-11.
[6] Remedial Investigation, Volume I, p. 3-5 to 3-6.
[7] Remedial Investigation, Volume I, p. 3-10 to 3-23.

Figure 3: Site Geology and Ground Water Flow

Site geology consists of three primary units depicted in the cross-section below. The first diagram shows the location of the drainage divide (dashed blue line), the cross-section (solid brown line with labels A at the southwest end and A’ at the northeast end), and where ground water generally flows in the overburden aquifer (thick blue arrows).





Cross Section A-A’ showing generalized topography, geology, and ground water flow. Elevation on the left is above mean sea level. The fractures depicted in the bedrock are schematic

C. History of Contamination

Originally, the property and surrounding area contained a single family residence belonging to Mr. Alexander "Bud" Johnson. It is reported that from 1945 until 1958 Mr. Johnson transported many drums containing wastes from industrial processes, primarily automobile production and painting, to his property for storage and use.

Mr. Johnson sold several house lots from his property in the 1970s. Many of these new neighbors noticed the large stockpile of drums and notified the State of New Hampshire. During an initial investigation of the site by the State of New Hampshire personnel in 1982, it became apparent that the drums contained hazardous materials and had leaked onto the ground. Subsequent testing of the drums showed the presence of Volatile Organic Compounds (VOCs) such as acetone, toluene, benzene, xylene, trichloroethylene (TCE), tetrachloroethylene (PCE), 4-methyl-2-pentanone (also known as methyl isobutyl ketone or MIBK), and polychlorinated biphenyls (PCBs).

D. Initial Responses

Drum Removal

In 1984 acting at the request of the State of New Hampshire, the EPA temporarily relocated the surrounding residents and removed the drums from the property. EPA removed 337 drums containing solvents, PCBs and other hazardous materials. During the removal EPA determined that the underlying soil was contaminated and that contamination of the ground water was likely. Figure 4 shows the location of the drum storage Areas A, B and C.

Soil Removal

Following an investigation into the extent of soil and ground water contamination in 1986, EPA and the State excavated over 405 yards of soil contaminated with solvents, PCBs, and other organic compounds from soils in drum storage Areas B and C to a depth of approximately 5 to 6 feet. The soil was removed from the site and disposed at a secure landfill. An additional 3.5 cubic yards of soil contaminated with 2,3,7,8 TCDD, dioxin, was retained at the site and destroyed in a mobile incinerator. The 3.5 cubic yards of soil were placed into twelve 55-gallon drums following on-site treatment and later disposed in a secure landfill. The areas of the soil removal were filled with clean fill.[8] Former drum storage Area A did not have concentrations of soil contaminants that required removal.

Drinking Water Treatment Plant and Distribution System

At the time of EPA's initial response, all residents obtained drinking water through bedrock wells. Ground water sampling indicated that site contaminants were entering the residential wells and contaminating them to concentrations not protective of human health.[9] In response to this contamination, EPA began construction of a drinking water treatment plant. EPA finished building the treatment plant and distribution system in 1988. The plant initially served 45 homes that were affected by the contamination. After one year of shake-down EPA turned the treatment plant over to the State, who then promptly turned it over to the residents. A group of residents

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[8] Remedial Investigation, Vol. I, p. 4-3 to 4-4.
[9] Remedial Investigation, Volume II – Tables, Table 4-15.

whose homes directly abutted the site formed the Swains Lake Village Water District (the "SLVWD") to operate the drinking water treatment plant. The SLVWD is funded, in part, through user fees and the potentially responsible party. The SLVWD was a part of the Consent Decree negotiations and agreed to serve homes within the Groundwater Management Zone (GMZ). The location of the treatment plant, the distribution system, and the GMZ are shown on Figure 5.

Swains Lake, although not classified as a class "A" reservoir, is used for drinking water. The drinking water treatment plant takes surface water from Swains Lake and treats it through sand filtration, chlorination, and carbon filtration before it is distributed in a piped network. Annually, the system supplies 3.5 million gallons of drinking water per year to 70 homes and a seasonal campground. The average daily demand is approximately 6,000 gallons per day for the residences and the balance of the usage is by the campground. The seasonal campground is approximately 1 kilometer north of the site. The maximum daily demand is approximately 15,000 gallons. Operational issues of the SLVWD are discussed further in the O&M Section.

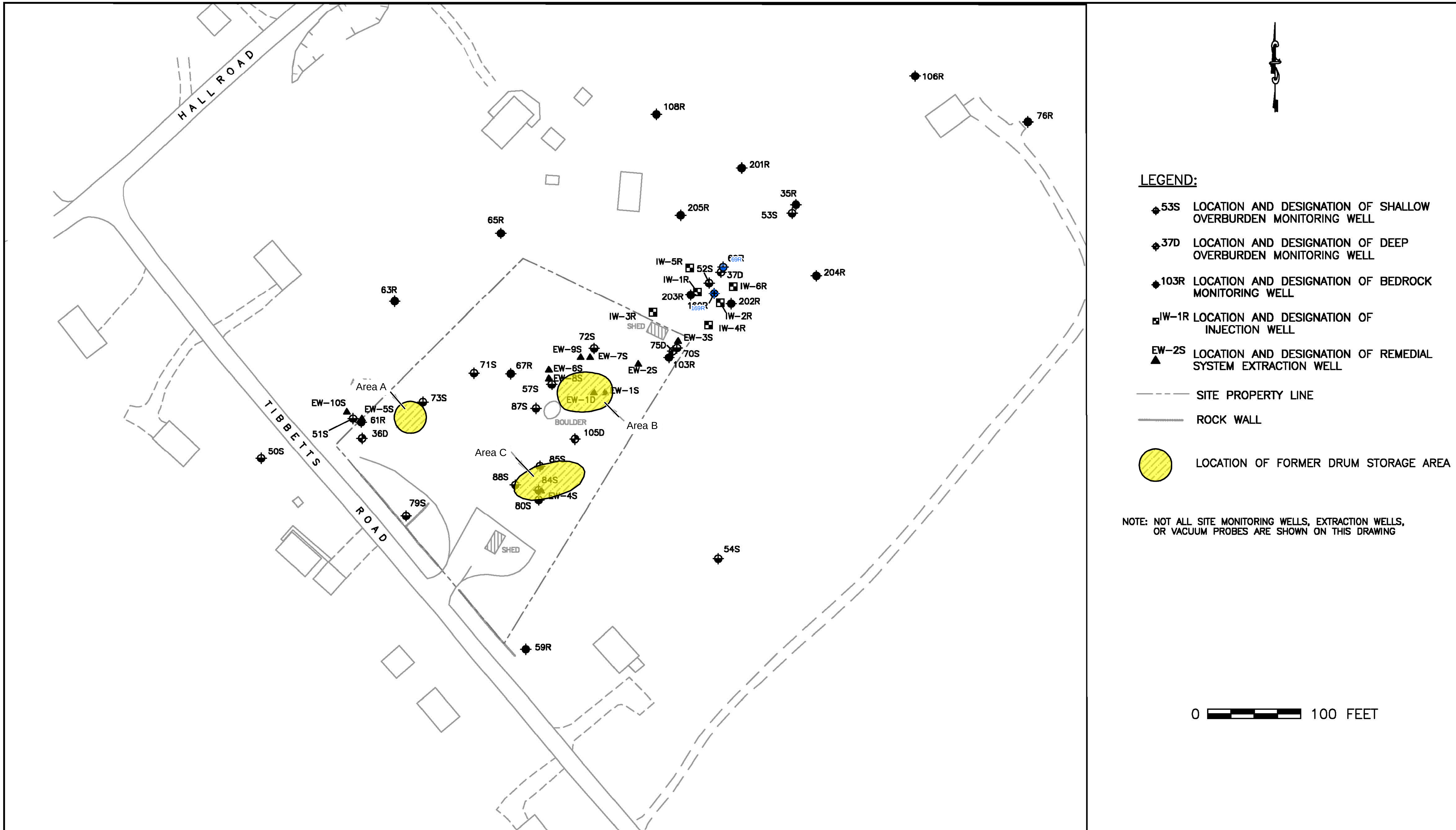


Figure 4: Location of Barrel Storage Areas

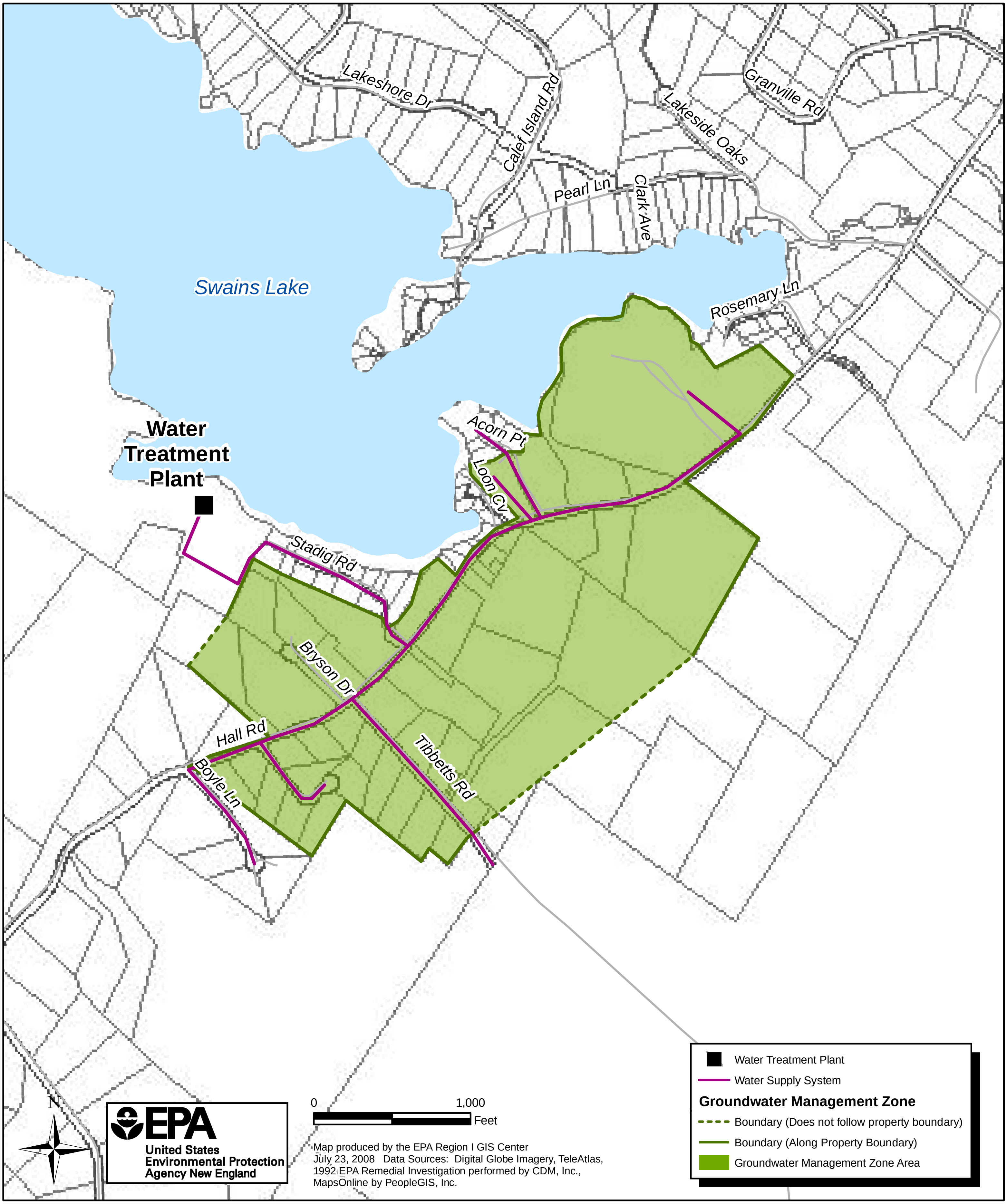
TIBBETTS ROAD SITE
BARRINGTON, NEW HAMPSHIRE

Area Manager	R. GAN
Project Director	D. STAKE
Task Manager	J. SANTANIELLO
Technical Review	D. STAKE

ARCADIS
SUITE 400
175 CABOT STREET
LOWELL, MASSACHUSETTS 01854
Tel: 978-937-9999 Fax: 978-937-7555
www.arcadis-us.com

Project Number: MA000725.0002
Drawing Date: 07 NOV 2007
Figure: 4

Figure 5: Location of Water Treatment Plant, Distribution System and Groundwater Management Zone



E. Summary of Basis for Taking Action

Initial investigations conducted at the site found contaminants that included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) poly-chlorinated biphenyls (PCBs) and dioxins in drums and soils. Those investigations also found VOCs as well as metal contaminants such as lead, arsenic and manganese in ground water.

In 1989 EPA began a Remedial Investigation and Feasibility Study (RI/FS) to determine the extent of contamination that remained at the site, if the contamination posed a risk, and what remedies would be effective at reducing or eliminating that risk. EPA finished the RI/FS in 1992 and held a public meeting discussing the findings.

The RI/FS found that due to the presence of VOCs and metals in ground water at the site, a risk existed for anyone who may use ground water for domestic purposes in the future. No other exposure pathways to site contaminants were found to generate an excess risk.[10] Moreover, the concentration of contaminants and conditions in ground water made it likely that the ground water contaminant plume would continue to migrate and contaminate other drinking water wells in the area. Therefore, in 1992 the EPA published a Record of Decision (ROD) documenting the risk and establishing Interim Clean-up Levels (ICLs) for ground water. These cleanup levels were proposed as "interim" to account for potential regulatory changes that may occur over the period of the remedy at the site, in concentrations that are deemed to pose a risk. For instance, in the case of arsenic at the time of the ROD the cleanup level, established using the Safe Drinking Water Act (SDWA) Maximum Concentration Limit (MCL), was 50 parts per billion (ppb). Since that time, the SDWA MCL was lowered to 10 ppb and thus the cleanup level as well. Prior to declaring the site to be cleaned up, EPA will evaluate the Interim Cleanup Levels, determine if the concentrations present in the ground water are protective of human health and the environment, and if so, the Interim Cleanup Levels will become the Final Cleanup Levels. Table 2 lists the present Interim Cleanup Levels, their basis, and what the maximum concentration was in the ground water contaminant plume prior to remediation.

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[10] Remedial Investigation, Vol. I, p. 7-8 – 7-9.

Table 2: Ground Water Interim Cleanup Levels and Maximum Concentration in Ground Water prior to Remediation (1996)				
Contaminant of Concern	**Cleanup Level (parts per billion)**	**Basis of Interim Cleanup Level**	**Maximum Concentration in ground water in 1996 (parts per billion)[a]**	
			Overburden	**Bedrock**
Inorganic compounds				
Arsenic	10[b]	MCL	446	80
Chromium	100	MCLG	353	221
Manganese	3,650[c]	Risk	44,500	11,400
Nickel	100	MCLG	252	80
Vanadium	256	Risk	290	90
Volatile Organic Compounds				
1,1,1 Trichloroethane	200	MCL	28	220
Trans-1,2 dichloroethene	100	MCLG	18,000	100
Cis-1,2 dichloroethene	70	MCLG	18,000	100
Bis(2-ethylhexyl)phthalate	4	MCL	8	240
Trichloroethene	5	MCL	27,000	3,000
Tetrachloroethene	5	MCL	3,200	11
Benzene	5	MCL	4,100	4,800
Toluene	1,000	MCL	140,000	9,000
Ethylbenzene	700	MCL	4,700	1,500
Xylene	10,000	MCLG	29,000	5,000
4-Methyl-2-pentanone	1,825	Risk	96,000	51,000
Naphthalene	1,460	Risk	440	145
Styrene	100	MCL	330	0

Notes:
[a] This represents the maximum concentration found at the site during that time period.
[b] MCL of 10 became effective as of 22 February 2002 replacing the former value of 50 ppb.
[c] The cleanup level for manganese will require adjustment prior to any remedy completion efforts at the site. Typical risk assessments are assigning cleanup levels of 300 parts per billion for manganese currently.

IV. Remedial Actions

A. Remedy Selection

During the summer of 1992 EPA held an informational meeting to discuss the results of the Remedial Investigation (RI) and the cleanup alternatives presented in the Feasibility Study (FS). At this time EPA also identified the Agency's Proposed Plan for the cleanup of the site and held a public comment period on the plan to solicit comments from interested members of the community. Since many of the earlier Removal Actions had dealt with the mitigation of the source areas at the site, the main focus of the Proposed Plan was for the recovery and treatment of contaminated ground water at the site. After receiving and responding to comments from the public, the cleanup approach for the site was finalized and documented in the September 29, 1992 Record of Decision (ROD) for this site. The remedial action objectives (RAOs) identified for the site in the ROD included:

- Eliminate or minimize the threat posed to human health by preventing the ingestion of contaminated ground water.
- Prevent further migration of ground water contamination to uncontaminated portions of the overburden and bedrock aquifers.
- Restore contaminated ground water in the overburden and bedrock aquifers to Federal and State applicable or relevant and appropriate requirements (ARARs), including drinking water standards, such that consumption of ground water is protective of human health.
- Prevent the dermal contact, ingestion, or inhalation of contents of 12 drums of incinerator ash and three VOC-contaminated barrels used for water filtration.

To meet these RAOs the ROD remedy included the following components:

- Upgrade and improve the existing drinking water distribution system.
- Dewater and treat, *in-situ*, contaminated aquifer matrix using a vacuum extraction system.
- Capture contaminated ground water in the overburden and bedrock aquifers through the use of trenches and wells.
- Treat and remove inorganic and organic contaminants through flocculation and ultra-violet catalyzed oxidation.
- Discharge treated ground water into the overburden and bedrock aquifers to enhance containment and recovery of contaminants.

B. Remedy Implementation

Drinking Water and Institutional Controls

Following EPA's issuance of the 1992 ROD, cleanup actions to protect public health began. In response to low-levels of contamination found in a drinking water supply well to a seasonal, public campground, EPA extended a water line northward to several additional residences and the campground in spring 1993.

During 1994 and 1995 EPA negotiated a Consent Decree (CD) with the State of New Hampshire, the Swain's Lake Village Water District, and Ford Motor Company, the potentially responsible party. Under the CD, which was entered by the District Court on March 20, 1995, Ford agreed to, among other items, to conduct the cleanup of the site as specified in the ROD and to subsidize the Swain's Lake Village Water District for a portion of their operating costs. Also under the CD, the Water District agreed to operate and maintain an alternate water supply for affected residences and to restrict the use of the ground water in the impacted area.

To provide the ground water Institutional Controls called for in the CD, the Water District enacted a local ordinance to prevent the use of ground water at the site as well as within the impacted area surrounding the site. The enactment of the ordinance by the Water District also complied with the statutory requirements then identified under the State of New Hampshire's Ground Water Management Zone Regulations (Env-Ws 410) and present Env-Or 602.13.

Site Cleanup

In 1995 Ford Motor Company, through their contractor, ARCADIS, initiated cleanup activities at the site. Among the first actions was removing twelve drums stored at the site that contained incinerator ash and three VOC-contaminated barrels used for water filtration. The twelve drums of soil and three VOC barrels were transported off-site for disposal at a RCRA Subtitle C landfill in Model City, New York. The original, heavily fire-damaged, Johnson residence at the site was demolished and the debris disposed of at a RCRA Subtitle D landfill in Rochester, New Hampshire.

Ground Water Remediation

The 1992 ROD selected vacuum extraction in the overburden aquifer and ground water extraction and treatment in the bedrock aquifer to address ground water contamination at the site. Ford began performing the vacuum extraction component of the ROD remedy in the summer of 1995. The remedy was expanded to full-scale and operated through 1997. The vacuum extraction wells were positioned within the overburden aquifer primarily in and around the three source areas at the site identified in Figure 4 as drums storage Areas A, B, and C. In addition, the site was paved within the fenced area to reduce infiltration of ground water and enhance the effectiveness of the VER system.

Over its operational lifetime, the VER system removed approximately 800 pounds of hydrocarbons from the ground water that were captured and treated. During its peak operation, the VER system removed as much as 3.5 pounds of contaminants per day. Shortly before the system was shut down in 1997, the system was removing less than one ounce of contaminants per day.[11] The recovery of contaminants met the criteria in the Consent Decree to discontinue the VER. The recovery system was optimized to ensure that areas of high concentration in the overburden aquifer were addressed.[12] The VER system attained the Interim Cleanup Levels (ICLs) for VOCs as identified in the ROD and Table 2 of this Five-Year Review beneath drum

[11] Although higher estimates were provided in subsequent documents, these figures were calculated at the time of the Construction Completion Report in 1998 and are believed to be the last, accurate estimates.
[12] Findings of Subsurface Investigation, Tibbetts Road Site, July 1997 (Geraghty & Miller, Inc (ARCADIS): Andover, MA).`

storage Area C.[13] In addition, VOC concentrations in the overburden aquifer beneath drum storage Area A were significantly reduced and were approaching cleanup levels at the time the VER system was shut down.[14] The remaining known source area undergoing treatment at the site, drum storage Area B, showed more limited progress in achieving the cleanup levels identified in the ROD. Following shutdown of the VER system it was evident that although the system had, for the most part, achieved the operational goals, some residual pockets of contamination in this area would continue to require further treatment in order to achieve the ICLs.

However, because the VER system had met the contaminant recovery standards set forth in the Consent Decree Scope of Work,[15] and the recovery efficiency of the VER system declined to less than one ounce per day, EPA considered other cleanup alternatives for the site including pulsed hot-spot treatments using VER, bioremediation, and phytoremediation. After evaluating the alternatives, it was agreed by EPA, NHDES and Ford to implement all three alternatives as the situation dictated.

Bioremediation was shown, through microcosm work of Dr. John Wilson of EPA's Ada laboratory, to be a significant contributor to contaminant reduction at the site before remedial efforts began at the site.[16] Bioremediation's importance was the initial consideration in selecting the phytoremediation remedy. Bioremediation requires slower ground water travel times to effectively degrade contaminants. The phytoremediation remedy was installed primarily to lower the water table and thus decrease infiltration and thereby slow the ground water flow.

As a result of the above analysis, the ROD was amended on September 28, 1998 to change the overburden aquifer remedy to bioremediation and phytoremediation with limited "hot spot" remediation using the existing VER system. Approximately 1,600 poplar trees (one-year old *Deltoides x Nigra* hybrid) were planted on the 1.9-acre site in May 1998 after the removal of the asphalt cap. The trees, which were three to five feet tall "whips" at the time of planting, were planted in rows which are ten feet apart and at intervals of one tree every three feet. With the planting of the poplar trees, all construction activities associated with phytoremediation at the site were completed; however, operation and maintenance of the trees would be required. No additional activities were required to implement the bioremediation component of the Amended ROD since it is a natural process which was already occurring at the site. The Preliminary Close-Out Report was signed by EPA on September 29, 1998, signifying the completion of construction activities at the site.

With respect to the bedrock ground water remedy, during the design and construction of the overburden VER system, it became apparent that the removal of ground water from the weathered bedrock aquifer may create downward ground water gradients. It was believed that this would increase the introduction of the more highly contaminated ground water from the overburden aquifer and exacerbate the contamination problem in the weathered bedrock aquifer.

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13 Tibbetts Road Superfund Site Amended Record of Decision , September 28, 1998 (USEPA, Region I, Boston) p. 12.
14 Amended Record of Decision, p. 11.
15 Consent Decree, Appendix B, Section VII. B., p. 39 – 46.
16 Amended Record of Decision, p. 5, 6, and 10 – 14, and Appendix D.

Therefore, it was determined that recovery of bedrock contaminants would be coordinated to not interfere with the recovery of contamination in Area B. The 1998 Amended ROD also amended the proposed pump-and-treat remedy in the weathered bedrock to a bioremediation remedy that would be examined in the future to determine whether other measures are necessary.[17]

In 2001, despite significant reductions in contaminants in the overburden aquifer at the site, concentrations in the weathered bedrock, particularly well 69R, remained very high with concentrations of benzene at 3 parts per million and other contaminants much greater than their cleanup limit. Because concentrations in drum storage Area B were low and based on monitoring it appeared that the mass of the plume was small, it was believed that low-scale pump-and-treat would be effective in reducing the concentrations quickly. A submersible pump operated in well 169R from August 21, 2002 to November 4, 2002 removing and treating contaminants. Based on the results of pumping it was believed that an in-situ chemical oxidizing agent (ISCO) may be a better alternative to reduce concentrations.

An ISCO pilot injection program began on November 2, 2003 with the injection of approximately 100 gallons of sodium permanganate solution into wells positioned in the weathered bedrock just north of the site property line and drum storage area B. An additional injection of approximately 55 gallons of sodium permanganate was made on December 30, 2003. The conclusion and recommendations of the initial pilot treatment was, among other items, that the sodium permanganate was successful in reducing both chlorinated and non-chlorinated VOCs and that future applications may be useful but will require longer reaction times, respectively.[18]

ARCADIS performed a second phase of ISCO pilot injections in June and November of 2006. Whereas the 2003 ISCO operation had used only limited pumping of perimeter wells to help distribute the sodium permanganate, the 2006 application sealed the perimeter wells and injected the oxidizer under pressure into the wells screened across the overburden and bedrock and then utilized a recirculation system extracting and re-injecting ground water to increase the hydraulic gradient as well as aid and control the distribution of the sodium permanganate. Although EPA has just received this data and is in the process of assessing the overall pilot performance, the results cited in the report are that ISCO successfully reduced the concentrations of many of the target compounds. However, the report did find that benzene was not reduced in concentration to a significant amount and that additional applications of sodium permanganate would not be applied.[19]

The 1992 ROD estimated that it would take approximately twenty years to attain the interim cleanup levels in both the overburden and bedrock aquifers.[20, 21] The 1998 Amended ROD

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[17] Amended Record of Decision, p. 28.
[18] In-Situ Chemical Oxidation Pilot Test Interim Report and Supplemental Work Plan, May 2005 (ARCADIS: Lowell, MA) p. 20 – 22.
[19] In-Situ Chemical Oxidation Pilot Testing, Tibbetts Road Site…, May6, 2008 (ARCADIS: Lowell, MA) p. 7 & 8.
[20] Tibbetts Road Site Feasibility Study Report, Volume I: Text, June 1992 (CDM Federal Programs Corporation, Boston, MA) p. 3-23.
[21] Tibbetts Road Site Feasibility Study Report Appendices, Appendix B, June 1992 (CDM Federal Programs Corporation, Boston, MA).

estimated that the interim cleanup levels would be attained in 14 years (2012).[22]

C. Operations and Maintenance

The operation and maintenance (O&M) activities required for the remedy as described in the 1998 Amended ROD consist of:

- Maintaining the trees for the phytoremediation remedy.
- Maintaining the VER system for "hot spot" applications.
- Performing the required environmental monitoring.
- Operating and maintaining the drinking water treatment plant.

During the first few years after planting in 1998, the trees were irrigated, fertilized, pruned, and protected from pests. As the trees have matured, the level of O&M needed to maintain them has diminished. At the time of the writing of this Five-Year Review, many of the trees at the site are over 30 feet tall and have well-established root systems. Accordingly, the need for irrigation has been eliminated and the effort required to fertilize and control pests has been reduced significantly. Over the next several years, pruning will be the major O&M activity required for the trees as they continue to grow and form a canopy over the site.[23]

The configuration of the VER system during the initial remedial action and for "hot spot" treatments includes liquid-ring pumps, a 150 gallon knockout tank, a centrifugal type transfer pump, a cartridge type particulate bag filter, a pair of 100-pound liquid-phase granular activated carbon drums in series, and a pair of 100-pound vapor-phase granular activated carbon drums in series. The liquid-ring pumps recover both ground water and soil gas from the extraction wells. The extracted air/water mixture flows into the knockout tank where the vapors are passed through the two vapor-phase carbon drums prior to being discharged to the atmosphere. Ground water in the knockout tank is then pumped through a particulate filter bag and then through two liquid-phase carbon drums. The clean water is discharged onto the ground surface at the site at a rate of one to four gallons per minute through a drip irrigation system. The discharge is low volume and, therefore, no puddles or standing water is ever evident. Typically, the VER system was operated during non-freezing times of the year, April to early December and then shutoff during the winter months from December to March.[24]

During 2002 the VER system, which operated from April 25, 2002 through November 4, 2002, recovered liquid and vapors from extraction wells EW5S and EW10S located in former drum storage Area A. In addition, a new bedrock extraction well 169R was installed northeast of the site in an area down-gradient of former drum storage Area B where VOC concentrations were above ICLs. Well 169R was installed in addition to an existing well in that area (69R) to expedite the treatment of VOCs. Ground water which was recovered from well 169R using a submersible pump was combined in the liquid knockout tank with water obtained from wells EW5S and EW10S. Approximately 92,873 gallons of ground water was treated by the system in

[22] Amended Record of Decision, p. 26.
[23] Phytoremediation Installation Report, Tibbetts Road Site, December 1998 (ARCADIS: Lowell, MA).
[24] Final Remedial Action Construction Report for Overburden Remedial System, Tibbetts Road…, June 1997 (ARCADIS, Geraghty & Miller, Inc., Andover, MA) p. 8-1.

2002 at an average flow rate of 0.61 gallons per minute. A majority of the extracted ground water came from well 169R. Since the Amended ROD, the configuration of the VER extraction system has been modified slightly to reflect changes noted in VOC concentrations in the ground water at the site. These changes have included the elimination of some older extraction wells (e.g., 69R and 103R) as well as the addition of a new extraction well (169R).

Ground water samples collected from the effluent of the VER system during the 2002 reporting period did not show the presence of any VOCs above their respective ICLs. No off-gas effluent vapor samples were submitted for analysis in 2002 due to the fact that most if not all of the air produced by the treatment system during this time consisted of ambient air which was metered into the system for temperature control. O&M for the VER system consists mainly of replacing the particulate filter bag cartridges fouled by the oxidation of inorganic minerals found in the ground water, winterizing of the system when it is shutdown each year, and ground water monitoring for the contaminants of concern on a semi-annual basis. The annual O&M costs for the site have averaged approximately $150,000 to $350,000 per year since the Amended ROD.

In 2003, the VER system was not operated because the levels of VOCs found in EW5S and EW10S were at or below ICLs. In addition, ground water was not extracted from monitoring well (MW) 169R during 2003 because it was determined that it would be more beneficial to focus on the performance of a pilot scale test using in-situ oxidation in the vicinity of MW169R. Maintaining a static state in MW169R (e.g., by not pumping the well) was necessary for the performance of the pilot test.

With respect to the operation and maintenance of the drinking water treatment plant, the operators of the Swains Lake Village Water District maintain and monitor the treatment facility, service the distribution lines, and ensure compliance with the GMZ provisions. To supply drinking water to residents within the GMZ, surface water is withdrawn directly from Swains Lake, infiltrated through sand filters at the treatment plant, treated to remove pathogens with ultraviolet light, chlorinated, passed through granular activated carbon filters, and chlorinated once again before entering distribution lines. Although the SLVWD meets all requirements, the Water District Commissioners have cited the following concerns:

- Swain's Lake is not a reservoir and is a class "B" waterbody with many recreational uses. MTBE, pollen, tannins and turbidity affect the finished water in the treatment plant.
- EPA and the State periodically tighten drinking water restrictions both on surface water supplies and disinfection by-products in treated water.
- Many items within the treatment plant are improvised and up-grades are needed, but expensive to maintain the present system.

During EPA's interview with the Water District Commissioners (see Section VI.F.) the Commissioners stated that a change in water supply is appropriate based on the above concerns and the perception that cleanup levels at the Tibbetts Road site will not be attained within the next 10 years. The Water District is in possession of an abutting, undeveloped 61-acre parcel. The Commissioners believe that a bedrock water supply well on this property, approximately 1 kilometer from the site, would alleviate the afore-mentioned concerns as well as reduce the overall operating costs. The distance from the site, a zone of contribution covering 61 pristine acres, and the lower contaminant mass at the site would minimize the risk of contamination from the site or other source areas from potentially impacting a bedrock water supply well on the abutting parcel.

V. Progress Since the Last Review

EPA completed the last Five-Year Review in September 2003. During that Five-Year Review the EPA found that the remedy was functioning as set forth in the 1998 Amended Record of Decision, that cleanup levels remained protective, and that no new information was available that would question the protectiveness of the remedy. The 2003 Five-Year Review did raise a concern regarding the potential for vapor intrusion of VOCs from contaminated ground water entering nearby homes. The EPA recommended that in order for the ground water remedy to be protective in long-term, several actions needed to be undertaken at the site. A summary of the recommendations from the 2003 Five-Year Review and actions implemented to date are shown in Table 3. Also noted in Table 3, ARCADIS submitted several reports to EPA and NHDES responsive to the 2003 Five-Year Review. Although these reports have not been completely reviewed, several preliminary conclusions may be drawn from them that are outlined in Table 3. It is anticipated that these reports will be reviewed, finalized and released to the public in January 2009.

Table 3 Issues, Recommendations and Follow-up Actions
Adapted from Table 4 of 2003 Five-Year Review

Issue	Recommendation	Actions Performed to Address Recommendation
Overburden Aquifer not at cleanup levels	Continue monitoring ground water to assess progress of bioremediation and phytoremediation.	Semi-annual monitoring continues. ARCADIS submitted a report in December 2007 regarding biogeochemical conditions to the agencies. That document is currently under review. A preliminary review shows that concentrations continue to decline throughout the site.
Bedrock Aquifer not at cleanup levels	Implement pilot test using *in-situ* oxidation technology and evaluate results.	The scheduled pilot test was conducted. ARCADIS submitted the final report in May 2008 to the agencies. That document is currently under review. However, the results indicate that further injections may not advance remedial efforts at the site.
Bedrock Aquifer not at cleanup levels	Continue monitoring ground water and review monitoring program.	Monitoring expanded greatly and additional wells were installed in this area due to complex bedrock hydrogeology.
Vapor Intrusion Pathway	Review current guidance and site data to see what additional steps may need to be taken to investigate this potential exposure pathway.	This pathway was examined prior to its milestone date of Fall 2004 and was shown not to be a complete pathway. Evolving guidance from both EPA and the State warranted additional examination. That examination resulted in a report submitted in April 2008 by ARCADIS that is currently being reviewed by the agencies. The report indicates that the indoor air exposure pathway remains incomplete.

VI. Five-Year Review Process

A. Administrative Components

The Remedial Project Manager, Darryl Luce, conducted the Tibbetts Road Superfund site Five-Year Review with assistance from Thomas Andrews, NHDES Project Manager and ARCADIS, consultants to Ford Motor Company. The Five-Year Review consisted of:

- Reviewing relevant documents listed in the reference section of this document;
- Conducting a review and technical assessment of data collected during implementation of the selected remedy, and;
- Performing interviews and a site inspection.

B. Community Notification and Involvement

No public meetings were held regarding the Five-Year Review for this site. The EPA published a notice of the initiation of the Five-Year Review in the local newspaper, the Union Leader, on December 2007 noting that the Five-Year Review process will be completed and publicly available in May 2008. A copy of the public notice is included in Appendix A.

The level of community interest in the site has been low to moderate within the last decade. The most recent public meeting took place on September 23, 2002, when members of the local community and Barrington Town Officials were invited to attend a meeting held at the site. The purpose of the meeting was to provide the public and local officials with an opportunity to tour the site as well as update them as to the progress of the cleanup. The potential future uses of the site were also discussed with the neighbors stating that they wished for the site to remain as it is. Approximately ten residents and five Town officials attended the meeting. Also present were representatives of EPA, NHDES, ARCADIS, Ford, and the Wildlife Habitat Council. In general, at that time, local residents and officials were satisfied with the current condition of site as well as the cleanup progress being made. There was a request made from several residents who live near the site for the following work to be done: 1) remove the remaining portions of the chain-link fence surrounding the site; 2) make some minor changes to the configuration of the driveway to the site to make it less appealing to teenagers to use; and 3) re-grade the site along portions of the western edge of the site to prevent runoff from entering neighboring properties. Ford agreed to perform the work and completed it during the summer of 2003.

Currently, the site appears to be a vacant lot within an area of light residential development. No one has paid taxes on the property for more than 10 years. The property and its current conditions are shown on Figure 2, an aerial view, and photographs are supplied in Appendix C to give a perspective of the site.

C. Document Review

This Five-Year Review consisted of a review of relevant documents including O&M Records and monitoring data. The 1992 Record of Decision and 1998 Amended Record of Decision and various literature sources were also consulted. A Reference Section is provided at the end of this Five-Year Review.

D. Data Review

The EPA analyzed trends in ground water and other media from the site and the areas surrounding the site. No site contaminants have been found in surface water bodies surrounding the site, including Swain's Lake. Air monitoring, conducted prior to and during the active VER ground water remediation, showed no contaminants in the air. Ground water remains the sole contaminated media at the site.

VOC contaminant levels in the overburden aquifer beneath most areas of the site appear to be at or approaching the ICLs identified in the ROD and Amended ROD. One well in the overburden aquifer in the area of former drum storage Area A has exhibited fluctuating concentrations which have been above the cleanup levels. Overburden wells immediately adjacent, some as close as 15 feet, have maintained concentrations well below cleanup levels. Also, a small portion of the overburden aquifer located beneath former drum storage Area B and the weathered bedrock aquifer located to the northeast of Area B have shown more limited progress in achieving the required cleanup levels for VOCs. There are a few wells in these areas that remain above cleanup levels with respect to organic compounds.

The bedrock aquifer in this area still presents challenges with respect to monitoring and remediation. Concentrations of some contaminants in bedrock appear to have increased; however, this is because additional wells have been installed to find the areas of highest concentration. To address the bedrock problem, a pilot test using the in-situ chemical oxidation technology was conducted during the fall of 2003, and again in 2006 in this area. The objective of the pilot test was to evaluate the effectiveness of sodium permanganate in reducing the concentrations of VOCs remaining in the ground water in this area. Upon completion of the pilot test, a report was produced in May 2008. The report, although still being evaluated by EPA and NHDES found that further applications of this oxidizing agent to the subsurface will not be effective in reducing contaminant concentrations in the bedrock. The initial applications were effective in reducing target contaminants in most areas; however, it was noted that contaminants that were not susceptible to the oxidant were also reduced.[25]

Inorganic contaminants, primarily arsenic and manganese, exceed cleanup levels in both the overburden and bedrock aquifers. Arsenic and manganese are believed to be native contaminants originating in the native aquifer matrix. Their presence in the ground water beneath the site is the result of changes which took place in the subsurface environment due to the contamination. In particular, the discharge of contaminants high in organic carbon caused the aquifer to become anaerobic. This environment caused the arsenic and manganese to be

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[25] *In-situ* Chemical Oxidation Pilot Testing, Tibbetts Road Site, Barrington, New Hampshire, May 2008. (ARCADIS: Andover, MA), p. 6 & 7.

liberated from the native rock. It is expected that as ICLs for organic contaminants are met throughout the aquifer, the ICLs for arsenic and manganese will also be attained.

A more complete analysis of contaminant conditions and trends at the site is in Appendix D - Technical Assessment to this Five-Year Review.

E. Site Inspection

Mr. Luce (USEPA) conducted a site visit on April 15, 2008. In addition to walking the site, the inspection included the area surrounding the site. With respect to the site, no issues were noted that created either a hazard or nuisance. The trees appeared to be healthy and the ground surface appeared to be undisturbed. Some of the trees had sustained snow damage, but appeared to be re-growing. The only off-site issues noted were construction of a single family home within the GMZ near the site and the construction of a residential subdivision just outside the GMZ. The home within the GMZ is connected to the water supply system. The homes outside the GMZ will obtain drinking water through domestic wells.

EPA also conducted a review of the site health and safety plan and OSHA-certification and medical monitoring for sampling personnel at the ARCADIS office. All administrative aspects of site remediation, including the maintenance of environmental liability insurance, appear to be satisfied at the time of this review.

The site inspection activities are documented in a checklist and photolog included as Appendix B and C, respectively.

F. Interviews and Public Input

EPA and NHDES conducted interviews with representatives of Ford Motor Company, Town Officials, representatives of the Swain's Lake Village Water District, and neighbors to the site. Generally, no issues were raised that currently impact the protectiveness of the remedy. However, concerns were voiced regarding the future operations of the drinking water treatment plant and future ground water withdrawals from wells that may cause contaminants in the weathered bedrock to migrate and affect other areas. The specific comments follow:

<u>Interview with Representatives of Ford Motor Company</u>

On December 5, 2007 Darryl Luce, the EPA site project manager, met with Debra Stake of ARCADIS and Matt Dodt of Ford Motor Company who was present over the phone. The discussion centered on data needs for this Five-Year Review, site progress, monitoring, and future plans. EPA, ARCADIS and Ford discussed the findings of the most recent report at that time and the need for completing reports regarding indoor air issues and the injection of oxidizing agents. At the time of this meeting no issues were identified that would compromise the effectiveness of the remedy.

Interview with Swain's Lake Village Water District

The EPA site manager, Darryl Luce, met with Stanley Swier, Philip Treadwell and Richard Myer, the Commissioners of the Swains Lake Village Water District on April 15, 2008. All three gentlemen are neighbors to the site as well. They expressed overall satisfaction with the performance of the remedial efforts at the site. However, the Commissioners expressed grave concerns regarding future operations at the drinking water treatment plant.

In an introductory address, Mr. Luce stated that although much progress had been made at the site and that no current risk existed, it would be greater than 5 years before ICLs would be attained. Ultimately, once site remediation is complete and ICLs are attained the drinking water treatment plant will be decommissioned and residents within the GMZ will need to re-establish drinking water wells. Therefore, continued efficient operation of the drinking water treatment plant is necessary. Based on that information the Commissioners led Mr. Luce on a tour of the treatment plant and then explained the problems they see becoming problematic in the future.

Most of the problems associated with the drinking water treatment plant stem from the source of the water, Swains Lake. These source problems may be summarized thusly:

- The bathymetry and origin of Swains Lake, a shallow former wooded area that was impounded has high levels of total organic carbon (TOC).
- Swains Lake has seasonal influxes of pollen and TOC from wetlands during the spring.
- Increasing development around the lake and in the general area introduces additional pollutants and modifies the dynamics of the lake. Many new homes have been introduced around the lake and many former seasonal cottages have been converted to year-round residences.
- The lake has seen increased swimming, boating and other uses over the past 10 years.

Because the treatment plant draws from a surface water supply it is necessary to pre-chlorinate the water, pass the water successively through an infra-red source, granular activated carbon system, and a final chlorination dose. Despite these treatment measures, high total organic carbon (TOC) levels in the lake, seasonal pollen blooms and runoff events severely impact the finished drinking water. Although the drinking water meets standards, there are episodic events when the finished water has a brown color (TOC and tannins) or greenish-yellow color (pollen). There have been periodic detections of methyl tert-butyl ether (MTBE) and hexachlorocyclopentadiene that have necessitated quarterly testing of water. The MTBE is most likely due to the boat use and runoff from the streets. The source of the hexachlorocyclopentadiene is unknown but suspected to be part of the treatment system, whether from the equipment or the chlorination process. Moreover, the Commissioners expressed concern over meeting future EPA requirements as set for surface water supplies and for chlorination by-products.

The Commissioners also pointed out that many of the components are worn. The drinking water treatment plant is now 20 years old. Back-up equipment has been installed to monitor and control the treatment system that is not the most compatible equipment or application. The Commissioners also made the point that they are the operators of the system and responsible for responding to emergencies, maintaining the aging equipment, and maintaining their training credentials. The operators are minimally compensated and devote a considerable amount of time to operate the treatment plant. During a tour of the drinking water treatment plant it became quite evident that the Commissioners devote a considerable amount of effort into operating and maintaining the plant. During a discussion regarding alternatives one of the Commissioners, Mr. Swier, stated that the next step may need to be to treat with aluminum sulfate. Mr. Swier continued that after evaluating the use of aluminum sulfate, the Commissioners decided that the risks in handling the material and the increased effort in applying it would be unacceptable.

Therefore, the Commissioners are interested in establishing a bedrock ground water supply source on an abutting 61 acre parcel of land to the drinking water treatment plant. The 61± acres is in its natural state and should be isolated from the contamination at the site. The drinking water treatment plant currently draws approximately 6,000 gallons per day with a maximum withdrawal of approximately 15,000 gallons per day. Prior to establishing any bedrock well source, bedrock should be characterized in this area.

Town of Barrington, NH Interviews

On April 15, the EPA project manager, Darryl Luce, interviewed Carol Reilly, Town Administrator for the Town of Barrington. Overall, Ms. Reilly expressed satisfaction with the progress of the remedy and said that the property ownership may become an issue in the near future but stated that any claim of ownership will need to address the considerable back taxes that are owed on the property.

An overriding concern of Ms. Reilly that bore on conditions at the site was the establishment of a water bottling company in Nottingham, New Hampshire. This water bottling company, USA Springs, is permitted by the state to remove 307,000 gallons of water per day and there have been indications that the company is seeking to increase the amount pumped. The concern expressed by Ms. Reilly is that the permitted withdrawal or additional withdrawals may exert an influence on contaminants at the site.

Public Input

Written concerns were expressed regarding the site, both electronically and through traditional mail. A summary of these concerns was detailed in letters which are attached to this Five-Year Review as Appendix E. In essence, the letter writers are concerned that a state-permitted water withdrawal may affect contaminant migration from the site. The concern appears to be centered on the state-permitted USA Springs water bottling plant in Nottingham, NH approximately 3 miles from the site. The concern is that the influence of pumping at the USA Springs facility may pull contaminants towards the USA Springs facility and into the capture zone of intervening residential wells such as along France Road which lies between the USA Springs facility and the site.

VII. Technical Assessment

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

YES – The active components of the cleanup remedy as described in the ROD (e.g., VER system, expansion of the alternate water supply, institutional controls, and disposal of remaining drums stored at the site) and as later modified in the Amended ROD (e.g., bioremediation and phytoremediation) have been implemented and the results of ground water monitoring indicate that the current remedy is functioning as intended. However, the restoration timeframe to attain the interim cleanup levels in the Amended ROD may likely take longer than anticipated.

The trends seen in the ground water for the site for inorganic contaminants, primarily arsenic and manganese, are not as clearly evident at this time. As stated in Section VI. D. it is believed that the increase in arsenic and manganese is the mobilization of native minerals and that once ICLs for organic contaminants are attained, inorganic ICLs will be attained as well.

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

YES - Data provided and analyzed in Appendix D indicate no change in site conditions which would warrant a re-evaluation of risk. However, in February 2002, EPA revised the MCL for arsenic from 50 parts per billion to 10 parts per billion. This will likely further extend the estimated timeframe for reaching cleanup goals. This change will not affect the risk calculated at the site; however, it is a relevant and appropriate requirement.

The 1992 ROD established an interim cleanup level of 3,650 ppb for dissolved manganese in ground water based on human consumption over a 30-year period. That interim cleanup level was retained in the 1998 Amended ROD. However, it has been noted that current risk assessments have established cleanup levels for drinking water greater than an order of magnitude lower, 300 ppb. Therefore, it is anticipated that the interim cleanup level for the site, 3,650 ppb, will need to be lowered to 300 ppb, based on further examination, for future ground water users.

EPA will need to prepare the appropriate decision document to formally document these changes to the 1992 ROD and 1998 AROD.

Table 4: Changes in Chemical-Specific Standards

Contaminant	Media	Cleanup Level	Standard		Citation/Year
Arsenic	groundwater	10 ug/L	Previous	50 ug/L	SDWA 1988
			New	10 ug/L	SDWA 2002

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

NO - An evaluation of VOC vapor intrusion pathway although previously screened out is being reviewed to ensure that it is in compliance with current guidance. (see Section IX, Recommendations and Follow-up Actions).

Technical Assessment Summary

Select inorganic and organic contaminants in limited areas of the bedrock and overburden aquifers are at concentrations that exceed interim cleanup levels. VOC and metal contamination is found in limited areas of the overburden aquifer and in the weathered bedrock. The lateral extent of these areas is quite limited and the affected wells in these areas are surrounded by wells that are below the interim cleanup levels. Active ground water remedial efforts, followed by periodic hotspot actions in these areas, have greatly reduced concentrations.

VOC contamination in the overburden ground water exceeds cleanup levels only within former drum storage Area B. Bedrock VOC ground water contamination is limited to a small area north of the property boundary.[26] Concentrations of VOCs in one well in former drum storage Area A have fluctuated and at times has been above cleanup levels, yet is surrounded by wells, some as close as 15 feet, that are below the cleanup standards. A summary and depiction of the extent of VOC contamination is in Appendix D.

Arsenic and manganese are more pervasive, and present in many wells in both the overburden and weathered bedrock aquifers. Although no work has been done thus far to demonstrate the origin of the arsenic or manganese, it is believed that they were not introduced to the site through the contaminants. Several authors have cited that such occurrences are the result of altered environmental conditions mobilizing a suite of metals from native aquifer matrix.[27] It is expected that as conditions in the aquifer return to their natural state, the present reducing environment will become an oxidizing environment and the metals will not pose a risk.

Although there is no current risk posed from site contaminants to drinking water users or from surface water, there may be a future risk. Future risk may occur if contaminated ground water were to migrate out of the GMZ and be used for drinking water purposes or if a drinking water well were to be operated within the GMZ. However, the extent of contamination is small, the overall source area concentrations are low, and concentrations are declining for all contaminants in all wells. However, a revised cleanup time-frame for ground water needs to be established. A more detailed analysis of the progress toward interim cleanup levels is presented further in the Technical Assessment in Appendix D.

[26] Evaluation of Current Biogeochemical Conditions and Applicability of Monitored Natural Attenuation, Tibbetts Road Site…December 2007 (ARCADIS: Lowell, MA) p. 5 – 13.
[27] Hounslow, A.W. Ground-water geochemistry: arsenic in landfills. Ground Water 18: 331-333 (1980).

VIII. Issues

Based on the information contained in this Five Year Review, a number of issues exist for the Tibbetts Road Superfund site. These include the following:

- Cleanup Levels will not be attained by the estimate of 2012: Based on trends presented in various site documents, it appears that it will take additional time for the ground water to attain the interim cleanup levels, as specified in the 1998 AROD. In addition, In February 2002, the Drinking Water Standard for arsenic was lowered from 50 parts per billion to 10 parts per billion at both the Federal and State levels. Ground water at the site has not yet attained the 10 part per billion standard. Throughout the site, concentrations of arsenic and manganese remain significantly above cleanup levels due to a number of geochemical factors.
- The existing drinking water treatment plant has potential future operational problems: Although these problems do not cause violations of water quality standards, problems may be exacerbated through a number of means in the future.
- Ground water use pressures in the surrounding area may impact site contaminants: A number of water withdrawals may cause migration of contaminants in the bedrock aquifer. Contaminated ground water may migrate outside the GMZ to ground water users.
- Vapor Intrusion: In April 2008 EPA received a report evaluating the potential for vapor intrusion to create an inhalation risk for residents that may lie over the site. EPA is still reviewing this report.
- Evaluate bedrock aquifer remedies: In May 2008 EPA received a report evaluating a pilot test to address VOC contaminants in bedrock. EPA is still reviewing this report.

Table 5 summarizes the issues for this Five-Year Review.

Table 5: Summary of Issues

Issues	Affects Protectiveness (Y/N)	
	Current	**Future**
1) Clean up levels for all contaminants will not be attained by 2012 (also, current arsenic MCL changed from 50 ppb to 10 ppb).	N	Y
2) Drinking water treatment plant experiencing difficulty in operating.	N	Y
3) Additional bedrock aquifer withdrawals may affect site contaminants.	N	Y
4) Vapor intrusion pathway not fully characterized	N	Y
5) Evaluate bedrock aquifer remedies	N	Y

IX. Recommendations and Follow-up Actions

The issues identified above point to a number of actions that need to be taken to ensure long-term protectiveness at the site. Table 6 summarizes the recommendations and follow up actions for this Five-Year Review.

Table 6: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
1)	Perform additional ground water and geochemical investigation to determine appropriate cleanup times and controls on contaminants. The following activities will assist: ▪ Construct a preliminary Conceptual Site Model to determine the location, mass, and flux of contaminants in each area of the site. Identify potential controls. ▪ Evaluate current monitoring network and analytical parameters. ▪ Perform additional sampling; evaluate MAROS software package and implement, as appropriate ▪ Install additional monitoring wells as appropriate to supply data for the CSM. ▪ Determine potential cleanup dates.	Ford	EPA	Performed annually December 2008 – March 2009 and update annually January - March 2009 Annual update June 2009 December 2010	N	Y
2)	Evaluate potential alternative water supplies for Swains Lake Village Water District.	Ford	EPA	July 2009	N	Y
3)	Evaluate potential for additional ground water withdrawals outside of the GMZ to impact bedrock contaminants and monitor migration.	Ford	EPA	July 2010	N	Y
4)	Complete the vapor intrusion pathway evaluation	Ford	EPA	March 2009	N	Y
5)	Evaluate other options to address high concentrations of VOCs in bedrock	Ford	EPA	April 2010	N	Y

X. Protectiveness Statement

Because the remedial actions undertaken at the site are protective in the short-term, the site is protective of human health and the environment in the short-term. However, in order to be protective in the long-term, a number of follow-up actions are recommended. These measures include, but are not limited to: installation of additional monitoring wells, additional geochemical analyses, updated and more accurate ground water and geochemical modeling efforts, and continued implementation of institutional controls (e.g., an approved GMZ, at a minimum).

XI. Next Review

This site requires on-going, policy, Five-Year Reviews. The next review will be conducted and issued in 2013, five years from the date of signature of this report.

References

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APPENDIX A: PUBLIC NOTICE TO START FIVE-YEAR REVIEW

EPA Starts 'Five-Year Review' of Tibbetts Road Superfund Site

The U.S. Environmental Protection Agency (EPA) is beginning its second Five-Year Review of the Tibbetts Road Superfund Site, in Barrington, NH. Five-Year Reviews are required by law and occur every five years. The reviews determine if the cleanup is protective of human health and the environment. This Five-Year Review will be completed by May 2008 and the results will be publicly available.

The Tibbetts Road Superfund Site cleanup plan included the removal of the deteriorated and leaking drums, soil excavation, vacuum extraction and pumping and treating of groundwater, and the planting of poplar trees to reduce groundwater flow and enable micro-organisms to consume contaminants. Current efforts include periodic injections of potassium permangate into the bedrock to oxidize contaminants.

Contaminants at the site included solvents, PCBs, and dioxin in the soil. Volatile Organic Compounds exist in the groundwater. Since 1987, residents with wells contaminated from the site have received clean water from a water supply system.

More information about the cleanup can be found on-line at www.epa.gov/superfund/sites/tibbetts or at the Barrington Public Library, Star Route, Barrington.

EPA
United States
Environmental Protection
Agency New England

For more information, contact:
Darryl Luce
Toll Free 1-888-372-7341, ext.81336
luce.darryl@epa.gov
www.epa.gov/superfund/sites/tibbetts

APPENDIX B: INSPECTION CHECKLIST

Site Inspection Checklist

I. SITE INFORMATION	
Site name: Tibbetts Road	**Date of inspection:** 15 April 2008
Location and Region: Barrington, NH; EPA Region I	**EPA ID:** NHD989090469 **NH Site ID:** 0101208
Agency, office, or company leading the five-year review: EPA Region I	**Weather/temperature:** Sunny, cool and dry, temperature approximately 35° Fahrenheit

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☑ Access controls
- ☑ Institutional controls
- ☑ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☑ Other____phytoremediation ______
- ☑ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☑ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** _______Debra Stake____ _Project Manager, ARCADIS, Inc. _December 5, 2007_
   Name Title Date
   Interviewed ☐ at site ☐ at office ☑ by phone Phone no. ______________
   Problems, suggestions; ☐ Report attached ___None______

2. **O&M staff** ______________ ______________ ______________
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. ______________
   Problems, suggestions; ☐ Report attached ______________

Site Inspection Checklist (Continued)

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________________

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________________

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________________

Agency ______________________
Contact ______________________ ______________ ________ __________
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached ______________________________________

4. **Other interviews** (optional) ☑ Reports attached in Section VI.F. of the Five-Year Review.

Carol Reilly, Town Administrator, Town of Barrington, NH. Report attached.

Stanley Swier, Richard Myers, Philip Treadwell, Commissioners, Swains Lake Village Water District

Site Inspection Checklist (Continued)

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐ O&M manual — ☑ Readily available — ☑ Up to date — ☐ N/A
   - ☐ As-built drawings — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☐ Maintenance logs — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks___

2. **Site-Specific Health and Safety Plan** — ☑ Readily available — ☑ Up to date — ☐ N/A
   - ☐ Contingency plan/emergency response plan — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

3. **O&M and OSHA Training Records** — ☑ Readily available — ☑ Up to date — ☐ N/A

   Remarks___

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☑ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☑ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☑ N/A
   - ☐ Other permits___ — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

5. **Gas Generation Records** — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

6. **Settlement Monument Records** — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

7. **Groundwater Monitoring Records** — ☑ Readily available — ☑ Up to date — ☐ N/A

   Remarks___

8. **Leachate Extraction Records** — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☑ N/A
   - ☐ Water (effluent) — ☐ Readily available — ☐ Up to date — ☑ N/A

   Remarks___

10. **Daily Access/Security Logs** — ☐ Readily available — ☐ Up to date — ☑ N/A

    Remarks___

Site Inspection Checklist (Continued)

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☑ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other___

2. **O&M Cost Records**

☐ Readily available ☐ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate___ ☐ Breakdown attached

Total annual cost by year for review period if available

From (Date)	To (Date)	Total cost	
___	___	___	☐ Breakdown attached
___	___	___	☐ Breakdown attached
___	___	___	☐ Breakdown attached
___	___	___	☐ Breakdown attached
___	___	___	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: ___

V. ACCESS AND INSTITUTIONAL CONTROLS ☑ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☑ N/A

Remarks_Fence was removed at neighbors request. No risk associated with trespassing, fence was initially intended to thwart deer from snacking on the phytoremediation remedy (poplar trees) during their whip stage.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks___**No trespassing signs are posted along the property boundary at Tibbetts Road**__

Site Inspection Checklist (Continued)

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
Site conditions imply ICs not properly implemented ☐ Yes ☑ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☑ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) _Visual inspections_________________________
Frequency _Periodic____
Responsible party/agency _Swains Lake Village Water District_____________________
Contact _Stanley Swier___ _Water Commissioner___ _1-603-664-3354_____
Name Title Phone no.
______________________ ______________________ ______________________
Name Title Phone no.

Reporting is up-to-date ☑ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☑ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☑ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☑ No ☐ N/A
Other problems or suggestions: ☐ Report attached
_Institution controls have been in place through the Consent Decree that binds the Water District in maintaining drinking water supplies to all residents within the GMZ._______________________

2. **Adequacy** ☑ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☑ No vandalism evident
Remarks____

2. **Land use changes on site** ☑ N/A
Remarks____

3. **Land use changes off site** ☑ N/A
Remarks____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☑ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☑ N/A
Remarks____

Site Inspection Checklist (Continued)

B. Other Site Conditions

Remarks ______________________________

VII. LANDFILL COVERS ☐ Applicable ☑ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent______________ Depth____________
   Remarks______________________________

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths____________ Widths___________ Depths__________
   Remarks______________________________

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent______________ Depth____________
   Remarks______________________________

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent______________ Depth____________
   Remarks______________________________

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks______________________________

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks______________________________

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent______________ Height____________
   Remarks______________________________

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
   ☐ Wet areas ☐ Location shown on site map Areal extent______________
   ☐ Ponding ☐ Location shown on site map Areal extent______________
   ☐ Seeps ☐ Location shown on site map Areal extent______________
   ☐ Soft subgrade ☐ Location shown on site map Areal extent______________
   Remarks______________________________

Site Inspection Checklist (Continued)

9.	**Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability Areal extent______________ Remarks______________
B. Benches	☐ Applicable ☑ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)
1.	**Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay Remarks______________
2.	**Bench Breached** ☐ Location shown on site map ☐ N/A or okay Remarks______________
3.	**Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay Remarks______________
C. Letdown Channels	☐ Applicable ☐ N/A (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)
1.	**Settlement** ☐ Location shown on site map ☐ No evidence of settlement Areal extent______________ Depth____________ Remarks______________
2.	**Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation Material type______________ Areal extent______________ Remarks______________
3.	**Erosion** ☐ Location shown on site map ☐ No evidence of erosion Areal extent______________ Depth____________ Remarks______________

Site Inspection Checklist (Continued)

4.	**Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting Areal extent______________ Depth____________ Remarks____
5.	**Obstructions** Type____________________ ☐ No obstructions ☐ Location shown on site map Areal extent______________ Size____________ Remarks____
6.	**Excessive Vegetative Growth** Type____________________ ☐ No evidence of excessive growth ☐ Vegetation in channels does not obstruct flow ☐ Location shown on site map Areal extent______________ Remarks____
D. Cover Penetrations ☐ Applicable ☑ N/A	
1.	**Gas Vents** ☐ Active ☐ Passive ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
2.	**Gas Monitoring Probes** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
3.	**Monitoring Wells** (within surface area of landfill) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A Remarks____
5.	**Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A Remarks____

Site Inspection Checklist (Continued)

E. Gas Collection and Treatment ☐ Applicable ☐ N/A		
1.	**Gas Treatment Facilities** ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ☐ Needs Maintenance Remarks________________	
2.	**Gas Collection Wells, Manifolds and Piping** ☐ Good condition ☐ Needs Maintenance Remarks________________	
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ☐ Good condition ☐ Needs Maintenance ☐ N/A Remarks________________	
F. Cover Drainage Layer ☐ Applicable ☐ N/A		
1.	**Outlet Pipes Inspected** ☐ Functioning ☐ N/A Remarks________________	
2.	**Outlet Rock Inspected** ☐ Functioning ☐ N/A Remarks________________	
G. Detention/Sedimentation Ponds ☐ Applicable ☐ N/A		
1.	**Siltation** Areal extent________ Depth________ ☐ N/A ☐ Siltation not evident Remarks________________	
2.	**Erosion** Areal extent________ Depth________ ☐ Erosion not evident Remarks________________	
3.	**Outlet Works** ☐ Functioning ☐ N/A Remarks________________	
4.	**Dam** ☐ Functioning ☐ N/A Remarks________________	

Site Inspection Checklist (Continued)

H. Retaining Walls ☐ Applicable ☑ N/A	
1.	**Deformations** ☐ Location shown on site map ☐ Deformation not evident Horizontal displacement________ Vertical displacement________ Rotational displacement________ Remarks________
2.	**Degradation** ☐ Location shown on site map ☐ Degradation not evident Remarks________
I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☐ N/A	
1.	**Siltation** ☐ Location shown on site map ☐ Siltation not evident Areal extent________ Depth________ Remarks________
2.	**Vegetative Growth** ☑ Location shown on site map ☐ N/A ☐ Vegetation does not impede flow Areal extent________ Type________ Remarks________
3.	**Erosion** ☐ Location shown on site map ☐ Erosion not evident Areal extent________ Depth________ Remarks________
4.	**Discharge Structure** ☐ Functioning ☐ N/A Remarks________
VIII. VERTICAL BARRIER WALLS ☐ Applicable ☑ N/A	
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent________ Depth________ Remarks________
2.	**Performance Monitoring** Type of monitoring________ ☐ Performance not monitored Frequency________ ☐ Evidence of breaching Head differential________ Remarks________

Site Inspection Checklist (Continued)

C. Treatment System	☐ Applicable ☑ N/A
1.	**Treatment Train** (Check components that apply) ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation ☐ Air stripping ☐ Carbon adsorbers ☐ Filters_____ ☐ Additive (*e.g.*, chelation agent, flocculent)_____ ☐ Others_____ ☐ Good condition ☐ Needs Maintenance ☐ Sampling ports properly marked and functional ☐ Sampling/maintenance log displayed and up to date ☐ Equipment properly identified ☐ Quantity of groundwater treated annually_____ ☐ Quantity of surface water treated annually_____ Remarks_____
2.	**Electrical Enclosures and Panels** (properly rated and functional) ☑ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
3.	**Tanks, Vaults, Storage Vessels** ☑ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks_____
4.	**Discharge Structure and Appurtenances** ☑ N/A ☐ Good condition ☐ Needs Maintenance Remarks_____
5.	**Treatment Building(s)** ☑ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair ☐ Chemicals and equipment properly stored Remarks_____
6.	**Monitoring Wells** (pump and treatment remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance ☑ N/A Remarks_____
D. Monitoring Data	
1.	Monitoring Data ☑ Is routinely submitted on time ☑ Is of acceptable quality
2.	Monitoring data suggests: ☑ Groundwater plume is effectively contained ☑ Contaminant concentrations are declining

Site Inspection Checklist (Continued)

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☑ Properly secured/locked ☑ Functioning ☑ Routinely sampled ☑ Good condition
☑ All required wells located ☑ Needs Maintenance ☐ N/A
Remarks_Technical assessment of the remedy is located in Appendix D of the Five-Year Review Report.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

_Soil vacuum extraction was implemented to remove mass. Once a sufficient amount of mass was removed, operations were discontinued, operated on a hotspot and periodic basis. To attain cleanup levels phytoremediation coupled with bioremediation was selected by the agencies to attain the final cleanup levels.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

_The attached technical assessment finds that there are data assessment functions that need to be examined to adjust the environmental monitoring program. The ROD interim cleanup level for arsenic of 50 parts per billion has decreased to 10 parts per billion. As noted in the last Five-Year Review, the lowering of the standard will lengthen the time required to meet cleanup levels.

Site Inspection Checklist (Concluded)

C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. _None
D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. _The attached technical assessment in Appendix D identifies recommendations regarding the collection of additional data.

APPENDIX C: PHOTOGRAPHS DOCUMENTING SITE CONDITIONS

PHOTOGRAPHY LOG SHEET
Tibbetts Road Superfund Site ● Barrington, New Hampshire

SCENE: Tibbetts Road facing west, the site is on the right hand side behind the stone wall.
DATE/TIME: November 28, 2007 **PHOTOGRAPHY BY:** D. Luce

SCENE: Standing on Tibbetts Road looking northward into the site. The former Johnson residence stood behind the Sugar Maple before it was removed in 1995.
DATE/TIME: November 28,2007 **PHOTOGRAPHY BY:** D. Luce

SCENE: Standing on the northern edge of the property line for the site and looking southward towards Tibbetts Road. The poplar trees were planted as part of the phytoremediation and are now 10 years old.
DATE/TIME: April 15, 2008 **PHOTOGRAPHY BY:** D. Luce

SCENE: Standing on the northern edge of the property line for the site and looking northward at wells 69R and 169R.
DATE/TIME: April 15, 2008 **PHOTOGRAPHY BY:** D. Luce

PHOTOGRAPHY LOG SHEET
Tibbetts Road Superfund Site ● Barrington, New Hampshire

SCENE: The Swains Lake Village Water District Treatment House Building looking northward towards Swains Lake (covered in ice).
DATE/TIME: April 15, 2008 **PHOTOGRAPHY BY:** D. Luce

APPENDIX D: TECHNICAL ASSESSMENT

Appendix D
Technical Analysis of Contaminant Status

Tibbetts Road
Barrington, New Hampshire
June 2008

1. Purpose

This document summarizes the information contained in an evaluation of site conditions prepared by ARCADIS[28] and utilizes the figures in the attached Five-Year Review. Within each of the identified areas at the site, issues are identified and recommendations are developed to help determine the underlying mechanisms and refine the Site Conceptual Model.

Although EPA has yet to complete its review and comment on the Evaluation of Biogeochemical Conditions that ARCADIS has prepared, EPA has read the report and generally accepts the conclusions presented, at this time.

2. Overburden Aquifer

Cleanup at the site focused on the overburden glacial materials that constitute the upper 20 feet of aquifer at the site. The three former drum storage areas A, B and C (see Figure 4 in this Five-Year Review) are the source areas for the respective plumes. Initial actions at the site in the 1980's consisted of removal of the bulk contaminated soil in the drum storage areas from the surface to the water table, and disposal off-site. In the late 1990's vacuum extraction removed greater than 800 pounds of volatile organic compounds from the overburden aquifer. During this time EPA identified natural, biologic, attenuation of the contaminants that transformed the higher chlorinated compounds into DCE and other lower toxicity compounds.[29] The work of Drs. John and Barbara Wilson of EPA's Robert S. Kerr Lab found, through microcosm work, that chlorinated compounds were degraded to ethane end-members and that benzene was similarly degraded. Generally, the plumes from drum storage areas A and C migrate southward and consisted primarily of gasoline components such as benzene, ethylbenzene, xylene and toluene. The plume from drum storage area B was of much higher concentration than areas A and C and contained more chlorinated organics such as trichloroethylene.

The extent of ground water contaminated with organic compounds is shown in the following figure from the *Evaluation of Current Biogeochemical Conditions and Applicability of Monitored Natural Attenuation*, December 2007:

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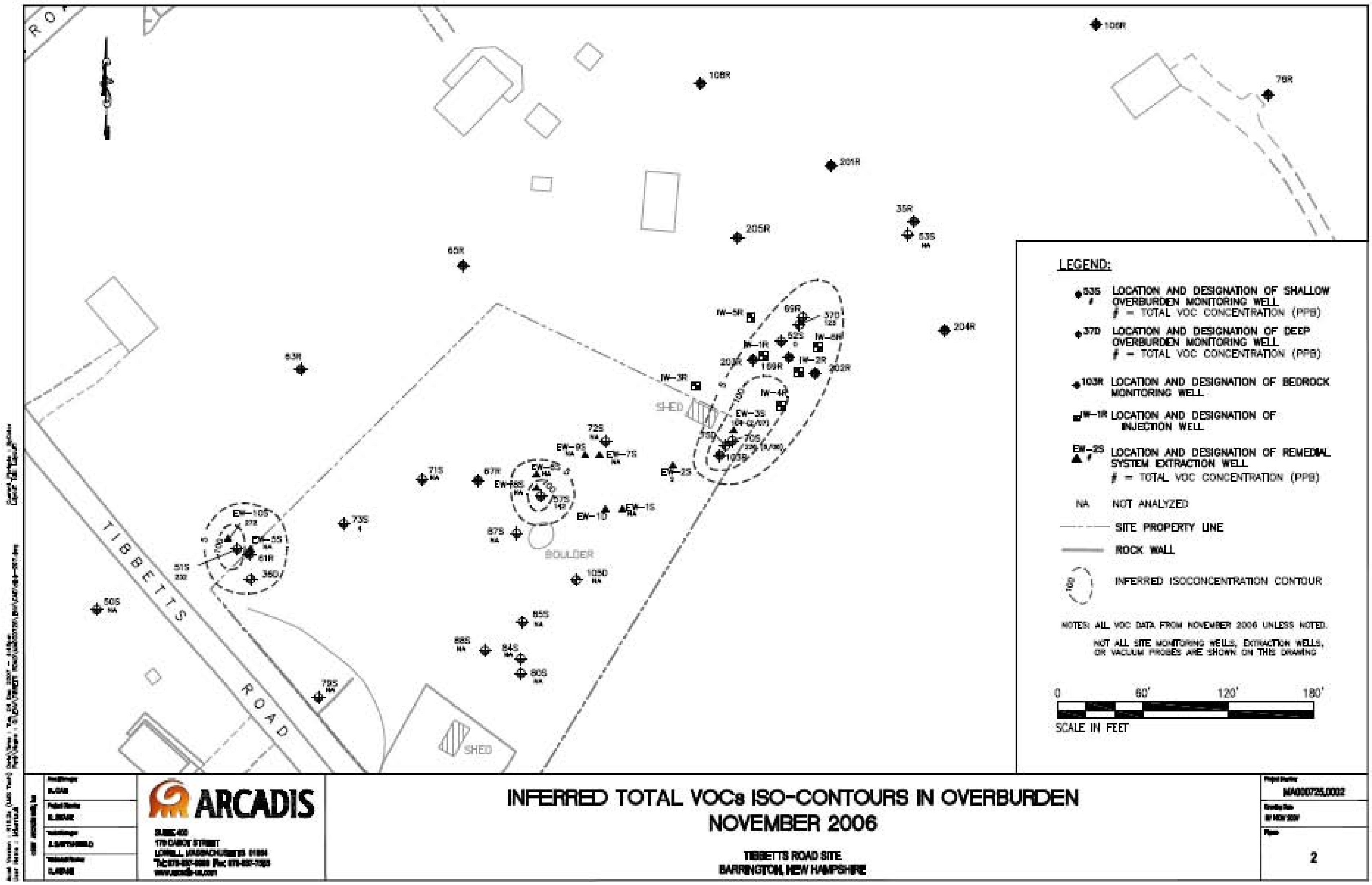
[28] Evaluation of Current Biogeochemical Conditions and Applicability of Monitored Natural Attenuation, Tibbetts Road Site…December 2007 (ARCADIS: Lowell, MA).
[29] Memorandum from Darryl Luce, Hydrogeology Support to Neil Handler, Site RPM, September 13, 2003.


LEGEND:
LOCATION AND DESIGNATION OF SHALLOW OVERBURDEN MONITORING WELL
= TOTAL VOC CONCENTRATION (PPB)
LOCATION AND DESIGNATION OF DEEP OVERBURDEN MONITORING WELL
= TOTAL VOC CONCENTRATION (PPB)
LOCATION AND DESIGNATION OF BEDROCK MONITORING WELL
LOCATION AND DESIGNATION OF INJECTION WELL
LOCATION AND DESIGNATION OF REMEDIAL SYSTEM EXTRACTION WELL
= TOTAL VOC CONCENTRATION (PPB)
NA NOT ANALYZED
SITE PROPERTY LINE
ROCK WALL
INFERRED ISOCONCENTRATION CONTOUR
NOTES: ALL VOC DATA FROM NOVEMBER 2006 UNLESS NOTED.
NOT ALL SITE MONITORING WELLS, EXTRACTION WELLS, OR VACUUM PROBES ARE SHOWN ON THIS DRAWING
0 60' 120' 180'
SCALE IN FEET
TIBBETTS ROAD
SHED
BOULDER
ARCADIS
INFERRED TOTAL VOCs ISO-CONTOURS IN OVERBURDEN
NOVEMBER 2006
TIBBETTS ROAD SITE
BARRINGTON, NEW HAMPSHIRE
2

As seen in the preceding figure, any contamination is limited to essentially the footprint of the former drum storage areas. Table 1 presents the maximum concentrations found in the shallow, overburden aquifer at the site at critical junctures in the site's history. Overall, as seen in Table 1, below, concentrations are at or near their cleanup levels for nearly all the compounds with the exception of arsenic. All compounds have downward trends that indicate progress towards attaining cleanup levels. These concentrations reflect all contaminants from the drum storage areas A, B, and C as well as their associated plumes.

Table 1: Site Contamination and Remedial Progress in the Overburden Aquifer

Contaminants	Cleanup Level (parts per billion)	Maximum Concentration (parts per billion)[a]			
		1984 – 1990 Site Discovery	1990 - 1995 Pre-Remedial Action	2003 Post-Remedial Action, 1st 5 Year Review	2007 Latest Sample, 2nd 5 Year Review
Inorganic compounds					
Arsenic	10[b]	185	446	298	280
Chromium	100	353	130	NA	NA
Manganese	3,650[d]	19,900	44,500	7,100	8,710
Nickel	100	252	63	NA	NA
Vanadium	256	290	25	NA	NA
Volatile Organic Compounds					
1,1,1 Trichloroethane	200	28	22	ND	ND
Trans-1,2 dichloroethene	100	e	e	ND	ND
Cis-1,2 dichloroethene	70	4,000	18,000	200	120
Bis(2-ethylhexyl)phthalate	4	8	2	NA	NA
Trichloroethene	5	27,000	7,800	8	2
Tetrachloroethene	5	3,200	310	19	12
Benzene	5	4,100	2,900	4	2
Toluene	1,000	140,000	28,000	820	5,700
Ethylbenzene	700	4,700	3,400	210	330
Xylene	10,000	29,000	8,400	720	3,600
4-Methyl-2-pentanone	1,825	96,000	3,800	ND	ND
Naphthalene	1,460	440	360	NA	NA
Styrene	100	330	25	1	ND

Notes:

[a] This represents the maximum concentration found at the site during that time period and may not be an overall indicator of progress at the site.

[b] MCL of 10 became effective as of 22 February 2002 replacing the former value of 50 ppb.

[c] The clean up goal of 70 parts per billion of Trans-1,2 dichloroethene adopted in 1996 Amended Record of Decision is not consistent with the MCL for this compound (100 parts per billion) and a decision document will be published in the near future to address and correct this Interim Cleanup Level goal.

[d] The concentrations presented from 2003 on are skewed by the injection of potassium permanganate.

[e] 1,2 dichloroethene was reported as a total and included both trans-1,2 dichloroethene and cis-1,2 dichloroethene and is reported with the cis-1,2 dichloroethene concentrations below.

NA – constituent not analyzed for during this time frame
ND – constituent not detected

The overall cleanup in the overburden was largely successful in reducing contamination such that natural, polishing methods such as phytoremediation may address the contaminants. Table 2 below shows that many of the original contaminants are at, or below cleanup levels and that the five remaining contaminants above cleanup levels (yellow) are greatly reduced in concentration and that the overall trend is downward. It should be noted that these concentrations are the maximum concentrations found at the site. Present organic compound contamination in the overburden aquifer only exists consistently in a small portion of former drum storage area B. Arsenic and manganese contamination may be more wide-spread; however, is more variable in its distribution which lends further credence to the theory of it being a product of redox processes mobilizing native minerals.

Table 2: Overburden Aquifer
Maximum concentrations found in all wells
Concentration in parts per billion

Year of sampling>>		1990 – 1995	2003	2007	Analysis		
Contaminants with Cleanup Levels Established	Cleanup Levels	Pre-Remedial Action	Post-Remedial Action, 1st 5 Year Review	Latest Sample, 2nd 5 Year Review	X cleanup level (pre-remedy)	X cleanup level (present)	% reduction (from pre-remedy to present)
Arsenic	10	446	298	280	**44.6**	**28.0**	**37.2%**
Chromium	100	130	At, or below, cleanup levels after remediation				
Manganese	3650	44,500	7,100	8,710	**12.2**	**2.4**	**80.4%**
Nickel	100	63	At, or below, cleanup levels				
Vanadium	256	25	At, or below, cleanup levels				
1,1,1 Trichloroethane	200	22	At, or below, cleanup levels after remediation				
Trans-1,2 dichloroethene	100	18000	At, or below, cleanup levels after remediation				
Cis-1,2 dichloroethene	70	18,000	200	120	**257.1**	**1.7**	**99.3%**
Bis(2-ethylhexyl)phthalate	4	2	At, or below, cleanup levels				
Trichloroethene	5	7,800	At, or below, cleanup levels after remediation				
Tetrachloroethene	5	310	19	12	**62.0**	**2.4**	**96.1%**
Benzene	5	2,900	At, or below, cleanup levels after remediation				
Toluene	1,000	28,000	820	5,700	**28.0**	**5.7**	**79.6%**
Ethylbenzene	700	3,400	At, or below, cleanup levels after remediation				
Xylene	10,000	8,400	At, or below, cleanup levels after remediation				
4-Methyl-2-pentanone	1,825	3,800	At, or below, cleanup levels after remediation				
Naphthalene	1,460	360	At, or below, cleanup levels				
Styrene	100	25	At, or below, cleanup levels				

Below are summaries of the information from the Evaluation of Current Biogeochemical Conditions report prepared by ARCADIS along with information from subsequent sampling events later in 2007 with the interpretation of further efforts needed to address issues illuminated in the Five-Year Review.

Former Drum Storage Areas A and C

In 2007, after a decade of cleanup efforts, the cleanup levels for all organic compounds in the plumes and source areas associated with former drum storage areas A and C were met.[30] Concentrations in one well in the area of former drum storage area A (EW10S) have exhibited fluctuating concentrations and at times exceed the cleanup levels. Inorganic compounds, specifically arsenic and manganese, were not below cleanup levels; however they are believed to be the product of reductive mobilization from the ground mass of the aquifer. Although not supported by any research, it is likely that once the redox environment in the aquifer returns to pre-contamination conditions that arsenic and manganese will return to back-ground levels, which are estimated to be 30 and 2000 ppb, respectively; however, no formal studies have established those values.

> Issues: Arsenic and manganese exceed cleanup levels. One well in former drum storage area A (EW10S) exhibits concentrations of toluene and ethylbenzene that fluctuate from below cleanup levels to just above cleanup levels.
> Recommendation: Revise environmental monitoring plan to determine aquifer conditions with respect to redox and mineralogical conditions and if any remedial actions may reduce arsenic and manganese concentrations. Also, further evaluate conditions in the area of well EW10S.

Former Drum Storage Area B

Former drum storage area B has seen cleanup efforts over the past 10 years as well. Currently VOC contamination is found in four wells within an area of 100 feet diameter. Wells 70S, 75D and EW3S are within a 20 foot radius of each other and have concentrations of PCE, TCE and cis-1,2 DCE that have maximum concentrations of 8, 2, and 120 ppb, respectively. Well 37D, 100 feet north of the other three wells, had 120 ppb of cis-1,2 DCE in November of 2006; however, in February 2007 the concentration had dropped (and remains) below the cleanup levels for all compounds. With respect to arsenic and manganese, concentrations in this area still exceed cleanup standards in several wells. With respect to all contaminants in the overburden aquifer in drum storage area B, the concentrations of all contaminants are at or close to cleanup levels and declining.

> Issue: Concentrations are at, or just above, cleanup levels for volatile organic compounds in most wells and declining in concentration. Inorganic concentrations in this area are generally lower than those in Areas A & C.
> Recommendation: Revise environmental monitoring plan to determine aquifer conditions with respect to redox and mineralogical conditions and if any remedial actions may reduce arsenic and manganese concentrations. Also, determine time to attain cleanup levels in this area.

3. Bedrock Aquifer

The bedrock aquifer has been addressed through direct pumping of contaminated ground water and a pilot study of the use of oxidizing solutions to destroy organic contaminants in the bedrock

30 Evaluation of Current Biogeochemical Conditions… pp. 5, 6 & 7.

ground water. Progress in restoring the bedrock aquifer was primarily based on removing the overburden aquifer contaminant source in former drum storage area B. Below, Table 3 shows the maximum concentrations of contaminants in ground water in the bedrock aquifer in the area north of drum storage area B at diagnostic junctures in the remedial effort.

Table 3: Bedrock Aquifer Maximum concentrations found in all wells							
Year of sampling>>		Concentration in parts per billion 1990 – 1995	2003	2007	Analysis		
Contaminants with Cleanup Levels Established	Cleanup Levels	Pre-Remedial Action	Post-Remedial Action, 1st 5 Year Review	Latest Sample, 2nd 5 Year Review	X cleanup level (pre-remedy)	X cleanup level (present)	% reduction (from pre-remedy to present)
Arsenic	**10**	**53**	**150**	**71**	**5.3**	**7.1**	**-34.0%**
Chromium	100	30	At, or below, cleanup levels				
Manganese	**3650**	**2,360**	**5,300**	**289,000**	**0.6**	**79.2**	**-12146%**
Nickel	100	24	At, or below, cleanup levels				
Vanadium	256	32	At, or below, cleanup levels				
1,1,1 Trichloroethane	200	220	At, or below, cleanup levels after remediation				
Trans-1,2 dichloroethene	100	100	At, or below, cleanup levels after remediation				
Cis-1,2 dichloroethene	70	100	1,500	460	1.4	6.6	-360.0%
Bis(2-ethylhexyl)phthalate	4	1	At, or below, cleanup levels				
Trichloroethene	5	110	58	18	22.0	3.6	83.6%
Tetrachloroethene	5	1	At, or below, cleanup levels				
Benzene	5	4,000	4,000	730	800.0	146.0	81.8%
Toluene	1,000	9,000	At, or below, cleanup levels after remediation				
Ethylbenzene	700	1,100	At, or below, cleanup levels after remediation				
Xylene	10,000	5,000	At, or below, cleanup levels after remediation				
4-Methyl-2-pentanone	1,825	51,000	25,000	6,600	27.9	3.6	87.1%
Naphthalene	1,460	23	At, or below, cleanup levels				
Styrene	100	0	At, or below, cleanup levels				

Inorganic contaminants show a steady downward trend with the exception of manganese, which shows a dramatic increase due to the injection of sodium permanganate (manganese is a by-product) in an effort to reduce chlorinated and other organic contaminants. Technically speaking, arsenic also shows an upward trend; however, the difference in concentration, 53 ppb pre-remedial and 71 ppb presently, is an insubstantial difference. It is expected that as the environment in the bedrock changes to a more aerobic state, that concentrations of manganese and arsenic will attain cleanup levels.

Organic contaminants show a steady and consistent downward trend except for cis- and trans-1,2 dichloroethene which are the daughter products of PCE and TCE and therefore expected to increase as PCE and TCE decline. With the reduction of the parent compounds and the present, natural degradation, it is expected that dichloroethene concentrations will continue to decline in concentration.

Generally, the bedrock ground water contamination appears to be in a limited area of weathered bedrock. The area of primary concern in the bedrock is an area at the northern edge of the property boundary of the site, adjacent to former drum storage area B. The bedrock aquifer beneath former drum storage area B lies approximately 50 feet below the ground surface. Directly beneath the site an aquitard protects the underlying bedrock aquifer. However, this aquitard is of limited extent. Generally, it is believed to extend northward from Tibbetts Road to a short distance beyond the northern property line of the site, in the vicinity of well 69R and former drum storage area B.

Here it is believed that the contaminants flowing through the overburden till from drum storage area B, on top of the aquitard, enter the bedrock when the aquitard pinches out. Ground water that was formerly overburden ground water flows across and downward into a weathered bedrock zone dominated by sub-horizontal fractures that are cut by vertical fractures. This area appears to communicate with other portions of the bedrock fracture system albeit slowly.

In the past, bedrock fractures in the area have been a conduit to transfer site contaminants. In 1993 EPA extended the water supply system to Len-Kay Campground, approximately 2 kilometers north of the site where seasonal pumping of 900,000 gallons over a five-month period had induced flow from the site that yielded concentrations of 5 parts per billion of trichloroethylene in the campground's water supply well. However, many other bedrock wells near the campground and near the site, have seen no contaminants. Borehole geophysical tests demonstrated that the contaminants in the weathered bedrock may have limited communication with the bedrock fracture system. Overall, this suggests that contaminants in the bedrock may not be susceptible to migration.

Bedrock wells south of Tibbetts Road have historically had little or no contamination in them. A bedrock residential well that was severely impacted by the site was found later to communicate with the overburden aquifer significantly. The distribution of the bedrock contamination may be due to a number of factors:

- The smaller mass of contaminants in drum storage areas A & C. Drum storage area B held the majority of the drums.
- The lower flux of ground water and contaminants in a southward direction. An aquitard, the lodgment till, appears to direct the majority of the contaminants to the north.
- The successful remedial efforts in Areas A & C.
- The topography and mineralogy of the bedrock in the area of former drum storage area B may not be conducive to transmitting the contaminants easily. The topography of the bedrock surface may contain the contaminants in a bowl-line setting. The mineralogy, considerable iron mineralization (perhaps jarosite) acts to constrict many of the fractures in this area.

Overall Site Conditions and Regional Bedrock Aquifer

Several new or proposed ground water users in the area surrounding the GMZ and the site may affect contaminated ground water that is in drum storage area B or in the bedrock aquifer near area B. The ground water withdrawals that may influence the site contaminants are:

- A water bottling plant that lies 3 miles to the southwest of the site that, once complete, will pump in excess of 300,000 gallons of water per day or more.
- A nearby, new subdivision, that while outside the GMZ will use ground water as a source of drinking water for approximately 18 homes.
- A proposed ground water source for the Swains Lake Village Water District that serves 72 homes and a seasonal campground. Presently, the Swains Lake Village Water District supplies over 2 million gallons a year for domestic purposes to people inside the GMZ.

Although these ground water withdrawals are in areas not affected by the site, the concern is that future increases in ground water use in outlying areas may cause migration of contaminants that will either be entrained in that use or affect other intervening ground water users. There are other ground water users in the area that are outside of the GMZ such as along Hall Road and French Road. Therefore, it is important to consider the overall potential for the site to contribute contaminants to the regional bedrock aquifer. The regional bedrock aquifer is considerable. During the Remedial Investigation pump tests indicated that bedrock well 76R was capable of producing over 400 gallons per minute from a single 6-inch fracture. Well 76R lies approximately 100 meters from the bedrock contamination at the north of the site and did show concentrations of toluene (3 ppb) and trichloroethylene (2 ppb) in 1991 but has shown none since. Anecdotal evidence from former ground water users surrounding the site emphasize the robustness, quantity, and quality of the bedrock aquifer that they used prior to the contamination at the site.

Table 4 (inorganic contaminants) and Table 5 (organic contaminants) assembles the data from Tables 1, 2 and 3 to allow for easy comparison, taking each contaminant and then displaying its maximum concentration for the overburden (upper) and the bedrock (lower) aquifers. These numbers represent essentially the narrow area in the vicinity of former drum storage area B and the weathered bedrock that lies just to the north.

Table 4 demonstrates that although there are significant concentrations of arsenic in the overburden and of manganese in the bedrock, that communication between the overburden and bedrock are slow.

Table 4: Inorganic Site Contamination and Remedial Progress					
Contaminants	**Cleanup Level** (parts per billion)	**Maximum Concentration** (parts per billion)[a]			
		1984 – 1990 Site Discovery	**1990 - 1995** Pre-Remedial Action	**2003** Post-Remedial Action, 1st 5 Year Review	**2007** Latest Sample, 2nd 5 Year Review
Inorganic compounds		Overburden / Bedrock			
Arsenic	10[b]	185	446	298	280
		80	53	150	71
Chromium	100	353	130	NA	NA
		221	30	NA	NA
Manganese	3,650	19,900	44,500	7,100	8,710
		11,400	2,360	5,300[d]	289,000[d]
Nickel	100	252	63	NA	NA
		80	24	NA	NA
Vanadium	256	290	25	NA	NA
		90	32	NA	NA

Notes:
[a] This represents the maximum concentration found at the site during that time period and may not be an overall indicator of progress at the site.
[b] MCL of 10 became effective as of 22 February 2002 replacing the former value of 50 ppb.
[d] The concentrations presented from 2003 on are skewed by the injection of potassium permanganate.
NA – constituent not analyzed for during this time frame

Table 5, below, shows that only toluene and xylene have higher concentrations in the overburden than the bedrock aquifer and therefore, the overburden has ceased to be a source to the bedrock aquifer of site contaminants. Moreover, the concentration of all organic contaminants in both the overburden and bedrock are declining.

Table 5: Organic Site Contamination and Remedial Progress

Contaminants	Cleanup Level (parts per billion)	Maximum Concentration (parts per billion)[a]			
		1984 – 1990 Site Discovery	**1990 - 1995** Pre-Remedial Action	**2003** Post-Remedial Action, 1st 5 Year Review	**2007** Latest Sample, 2nd 5 Year Review
Volatile Organic Compounds		Overburden / Bedrock			
1,1,1 Trichloroethane	200	28	22	ND	ND
		14	220	ND	ND
Trans-1,2 dichloroethene	100	e	b	ND	ND
		e	b	2	14
Cis-1,2 dichloroethene	70	4,000	18,000	200	120
		7	100	1,500	460
Bis(2-ethylhexyl)phthalate	4	8	2	NA	NA
		240	1	NA	NA
Trichloroethene	5	27,000	7,800	8	2
		3,000	110	58	18
Tetrachloroethene	5	3,200	310	19	12
		11	ND	4	2
Benzene	5	4,100	2,900	4	2
		4,800	4,000	4,000	730
Toluene	1,000	140,000	28,000	820	5,700
		3,300	9,000	10,000	560
Ethylbenzene	700	4,700	3,400	210	330
		1,500	1,100	880	200
Xylene	10,000	29,000	8,400	720	3,600
		1,800	5,000	3,700	472
4-Methyl-2-pentanone	1,825	96,000	3,800	ND	ND
		41,000	51,000	25,000	6,600
Naphthalene	1,460	440	360	NA	NA
		145	23	NA	NA
Styrene	100	330	25	1	ND
		ND	ND	4	ND

Notes:
[a] This represents the maximum concentration found at the site during that time period and may not be an overall indicator of progress at the site.
[b] 1,2 dichloroethene was reported as a total and included both trans-1,2 dichloroethene and cis-1,2 dichloroethene and is reported with the cis-1,2 dichloroethene concentrations below.

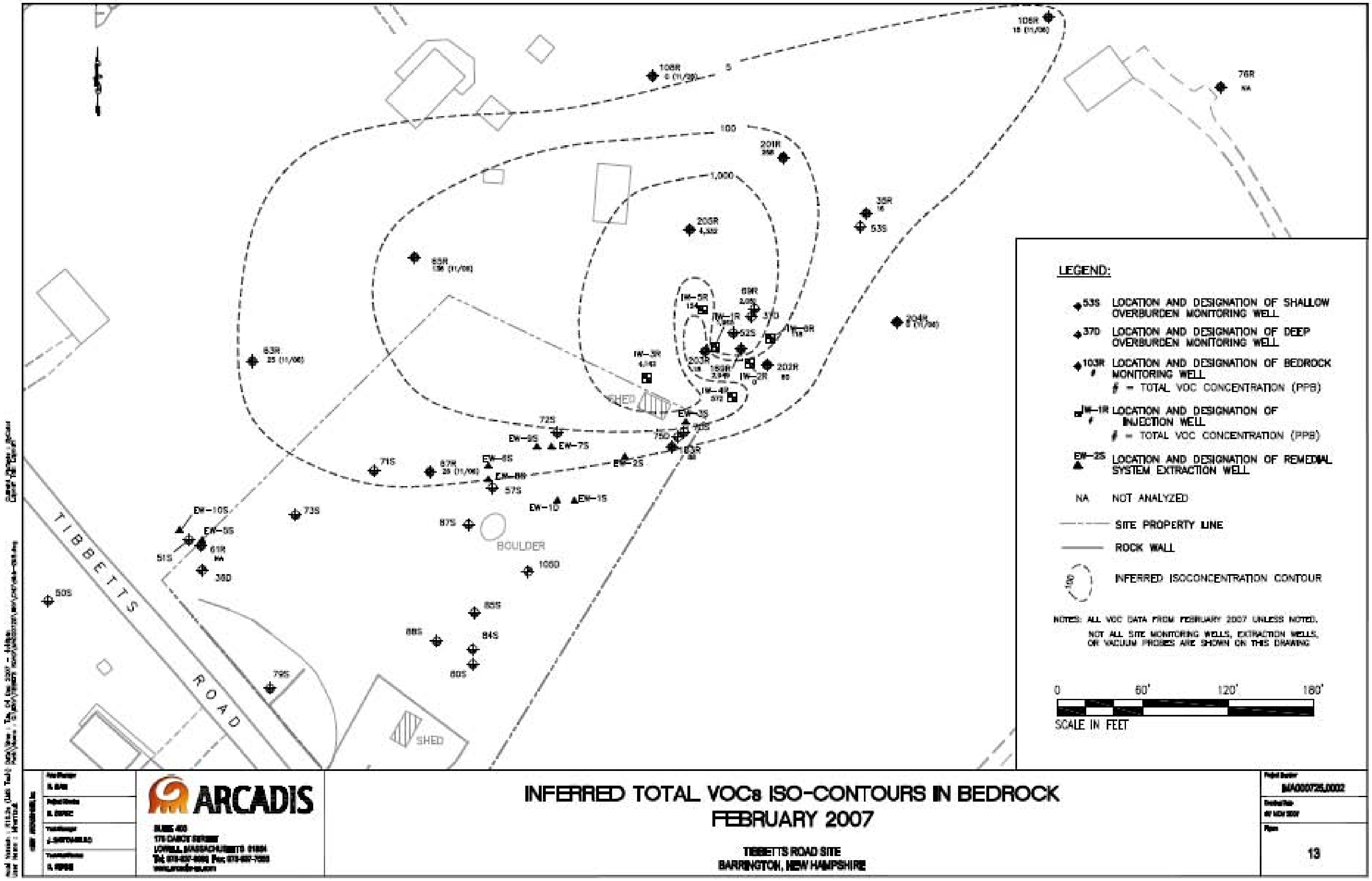
NA – constituent not analyzed for during this time frame
ND – constituent not detected

Additionally, Figure 15 from the *Evaluation of Biogeochemical Conditions…*, below, shows the extent of chlorinated compound contamination in the bedrock. Although this does not represent all of the contaminants, it provides a good depiction of the affected area and the scope of the problem. ARCADIS's Evaluation of Biogeochemical Conditions Report from December 2007 contains several figures and graphs that denote the decline of contaminant concentration, mass and extent for inorganic, chlorinated organic and non-chlorinated organic compounds. That analysis finds that site-wide concentrations of all contaminants are declining.[31]

Conclusion

Overall, the present low concentrations, the limited extent of contamination, and the apparent declining concentrations indicates that source areas have been depleted and that residual contamination should continue to supply few if any contaminants to the regional bedrock aquifer. However, it is apparent that monitoring of these conditions must be expanded to verify these conclusions. It is also evident that further investigations of the contaminant properties with respect to the aquifer conditions must be performed to determine means to ensure continued reduction of contaminant concentrations, and an re-evaluation of cleanup time-frames.

[31] Evaluation of Current Biogeochemical Conditions… pp. 13 & 14.


LEGEND:
53S LOCATION AND DESIGNATION OF SHALLOW OVERBURDEN MONITORING WELL
37D LOCATION AND DESIGNATION OF DEEP OVERBURDEN MONITORING WELL
103R LOCATION AND DESIGNATION OF BEDROCK MONITORING WELL
= TOTAL VOC CONCENTRATION (PPB)
IW-1R LOCATION AND DESIGNATION OF INJECTION WELL
= TOTAL VOC CONCENTRATION (PPB)
EW-2S LOCATION AND DESIGNATION OF REMEDIAL SYSTEM EXTRACTION WELL
NA NOT ANALYZED
SITE PROPERTY LINE
ROCK WALL
INFERRED ISOCONCENTRATION CONTOUR
NOTES: ALL VOC DATA FROM FEBRUARY 2007 UNLESS NOTED.
NOT ALL SITE MONITORING WELLS, EXTRACTION WELLS, OR VACUUM PROBES ARE SHOWN ON THIS DRAWING
0 60' 120' 180'
SCALE IN FEET
TIBBETTS ROAD
BOULDER
SHED
ARCADIS
INFERRED TOTAL VOCs ISO-CONTOURS IN BEDROCK
FEBRUARY 2007
TIBBETTS ROAD SITE
BARRINGTON, NEW HAMPSHIRE
13

APPENDIX E: SUPPLEMENTAL INTERVIEWS AND CORRESPONDENCE

Denise Hart
Michael Moroukian
291 France Road
Barrington, NH 03825
Telephone/Fax: 603•664•7469
E M A I L E D A N D F A X E D

March 17, 2008
Darryl Luce
Environmental Protection Agency – Region 1 New England
1 Congress Street, Suite 100
Boston, MA 02114-2023

RE: Tibbetts Road SuperFund Site, Barrington, NH Five-Year EPA Review

Dear Darryl Luce,

We are writing in response to the public notice published in Foster's Daily Democrat December 13, 2007 concerning the Five-Year Review of the Tibbetts Road SuperFund Site in Barrington, New Hampshire. The announcement stated that the "reviews determine if the cleanup is protective of human health and the environment."
We would like to bring to the attention of the Environmental Protection Agency (EPA) that since the last five-year review, the state of New Hampshire's Department of Environmental Services permitted a large groundwater withdrawal for 307,528 gallons/day for a water-bottling plant.

The proposed water extraction and bottling plant is within approximately three miles as the crow flies of the Tibbetts Road Superfund site. The company's site includes approximately 100 acres located along Route 4 in Barrington and Nottingham. The Barrington portion of the land includes one of the town's designated prime wetlands systems.

We are concerned that when the water withdrawal pumping begins from this company's site that it may have an effect on the plume emanating from the Tibbetts Road SuperFund site given the fractured bedrock geology of the area where we live.
As residents of France Road, located almost equidistant between the Tibbetts Road SuperFund site and the USA Springs, Inc. site, we are also concerned about what impacts this may have on particularly the water quality and also the quantity for the well that supplies drinking water for our home and those of neighboring homes and businesses in addition to the two nearby spring-fed lakes, Swains Lake (which provides the drinking water for those homeowners affected by the Tibbetts Road Superfund Site) and Mendums Pond.

In 2003 the state had denied this permit for 27 scientific findings following an investigation of the company's (USA Springs, Inc.) 10-day pump test that drew volatile organic compounds from an adjacent site further into the aquifer. It also denied the company's motion for rehearing. Seven months later, on July 1, 2004 under questionable circumstances the state reversed its two earlier denials and granted a conditional large groundwater withdrawal permit, establishing a 14.2 square mile "zone of influence" around the company's site.

Dr. Tom Ballestero, hydrogeologist and professor of Civil Engineering at the University of New Hampshire, served as the Town of Nottingham's consultant in the permitting process, and in several of the dozen-plus documents that he submitted to the Department of Environmental Services he noted that the so-called zone of influence could possibly extend as far as five or more miles due to the type of geology present in the area. He may be reached at 603.862.1405 or by email at tom.ballestero@unh.edu. A partial history of the Department of Environmental Services permitting decisions is located at: http://www.des.state.nh.us/dwspp/usasprings.htm

The above webpage pertains only to the large groundwater permit process with USA Springs, Inc. and the Drinking Water and Groundwater Bureau of the department. It excludes additional findings and decisions concerning this case from the Wetlands Bureau (relating to Barrington's Prime Wetlands and wetlands violations associated with this case) and the Waste Management bureau (which managed the hazardous waste incident as a result of the company's 2002 pump test).

We respectfully request that the EPA include an analysis of any potential impacts from the proposed USA Springs, Inc. large groundwater withdrawal in the 2008 Five-Year Review of the Tibbetts Road SuperFund Site and develop any mitigations necessary to protect human health and the environment. Please feel free to contact us by email or the telephone number on this letter if you have any additional questions.

Sincerely yours,
Denise Hart and Michael Moroukian

Sent Via Internet:

From: "Stan and Fran Swier" <stanswier@metrocast.net>
06/29/2008 02:20 PM
To: Darryl Luce/R1/USEPA/US@EPA
cc "'Richard Maier'" <retire03825@yahoo.com>, "'Philip Treadwell'"
<pjtreadwell@metrocast.net> bcc

Subject surface water concerns History: This message has been replied to and forwarded.

Hi Darryl,

The Commissioners of the water district were pleased to meet with you recently. We would like to restate our concern that Swains Lake should not be considered a long term source of our water. There are many reasons to consider a groundwater source. Since Swains is surface water we are always concerned with microbial and chemical contaminants. Chlorination used to kill the microbes causes disinfection by-products. In addition we also have to monitor for SOC's, VOC's, IOC's, nitrites, nitrates, MTBE, and radiologicals. We are also concerned with the possibility of an algal bloom and the introduction of milfoil. We feel that with development and recreational use, lake quality will deteriorate over time and it will become more difficult to meet federal and state standards. Even if we meet the standards, many chemicals are in our drinking water. You stated that we cannot go back on our groundwater wells for at least 10 years, and more likely 20 years or more. Faced with that conclusion, we must look for a groundwater source for the water district. We are a small water district. Even though Ford pays 75% of our 0&M, we cannot afford major costs such as construction, a plant overhaul, or an expensive maintenance regime. We are reluctant to raise our rates, as we did not cause the problem of contaminating our wells.

The Commissioners will work with you to expedite the process of finding and developing a groundwater source as soon as possible. We look forward to your progress report on the groundwater cleanup at the Tibbett's Rd Superfund site.

Thank you for your effort.

Sincerely,

Stan

Stanley Swier
Commissioner and Chief Operator
Swains Lake Water District