Technical Impracticability Waiver as a Component of a Site-Wide Remedy at a Fractured Bedrock Superfund Site in New England

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Waiver of chemical-specific ARARs at a fractured bedrock site in New England was determined to be appropriate for Source Area Groundwater as a component of a site-wide remedy. Detailed hydrogeologic characterization of the fractured bedrock indicated that it was highly heterogeneous. Elevated concentrations of chlorinated volatile organic compounds (VOCs) in the groundwater indicated that dense, non-aqueous phase liquid (DNAPL) was most likely present in the bedrock beneath the Site and was a continuing source of dissolved VOCs to groundwater.

In an interim ROD, the USEPA acknowledged that it was uncertain whether either Source Area groundwater or Non-Source Area Groundwater plume could be restored to drinking water standards within a reasonable period of time. Therefore, a Technical Impracticability (TI) Evaluation was conducted to address questions in the Interim ROD regarding remedial timeframes, and to provide the technical basis for completion of the final ROD for the entire Site.

Findings from the TI Evaluation supported the conclusion that a TI Waiver would be appropriate for the Source Area portion of the Site. All data supported the conclusion that the VOC plume was in a stable configuration. Exposure control was aggressively implemented at the site through institutional controls, provision of public water, and routine monitoring of residences. There is no current risk to public health at the Site, because residents are not consuming groundwater that does not meet prescribed standards. Hydraulic containment of the Source Area Groundwater coupled with a TI Waiver of chemical-specific ARARs for the Source Area Groundwater, continued monitoring of Non-Source Area Groundwater, expansion of the public waterline to additional residents, if needed, and maintenance of institutional controls, will prevent exposure and provide an appropriate remedial response for the Site that is consistent with CERCLA and, to the extent practicable, the NCP.

Waiver of chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) at a fractured bedrock site in New England was determined to be appropriate for Source Area Groundwater as a component of a site-wide remedy. Site-specific and contaminant-specific information collected through multiple phases of investigation and evaluation since contamination was discovered in 1988 supported the conclusion that a Technical Impracticability (TI) Waiver is appropriate for a portion of the Site. This paper presents the determination of an Interim Record of Decision (ROD) for the Non-Source Area portion of the Site, and the subsequent TI Evaluation conducted to provide technical basis for completion of the ROD for the entire Site. The final Site-Wide ROD incorporated a TI Waiver for the Source Area portion of the Site.

Site Description and History

The Site is a 17-acre lot located in a rural section of east-central Maine with mixed woods and open fields. The Site is located near the top of a hill. Ground surface elevation decreases in all directions, with a steeper drop to the north and west. The Site area is covered by grass and trees, and includes a small, unnamed pond and associated wetlands in the eastern portion. Figure 1 shows the general setting and the vicinity of the Site.

The Site was originally operated as a waste oil storage and transfer facility for 15 years. Investigations in the 1980s and 1990s defined a 2-acre portion of this 17-acre parcel of land as the area where the waste oil company conducted its operations. According to USEPA's Site ranking records, more than 235,000 gallons of waste oil and other liquids were received at the facility for storage and transfer during the 1965 to 1980 operations of the transfer facility.

During a pre-purchase environmental assessment of the Site in 1987, MEDEP found chlorinated volatile organic compounds (VOCs) in groundwater from several residential wells. Contaminated groundwater also was detected in on-Site and off-Site monitoring wells, and soil contamination was detected in the 2-acre portion of the Site. The Maine Department of Environmental Protection (MEDEP) undertook emergency response measure for all homes found to have contaminated water, and began a Removal Action process under CERCLA in 1989. The Emergency Removal Action, conducted by USEPA in 1990 and 1991, included the excavation of 847 tons of contaminated soil from the 2-acre fenced area. The Site was placed on the National Priorities List (NPL) in 1995.

In August 1995, USEPA and MEDEP installed a public water supply system as an alternative to private residential wells near the Site and initially provided water to 37 residential dwellings. A residential well monitoring program of residences not connected to public water was implemented by USEPA in 1996 to prevent the consumption of contaminated groundwater by residents in the vicinity of the Site. The potentially responsible party (PRP) Group took over implementation of the program from USEPA in March 1998.

In addition to the public water system, the PRP Group has led the effort to establish institutional controls within an Institutional Control Zone (ICZ) at the Site, including the

adoption of a groundwater protection ordinance by the Town and execution of restrictive covenants by area property owners.

Through the efforts of the PRP Group, three water mains have been extended, and additional connections to the public water system were made at lots within the ICZ. Further upgrades to the water system made by the PRP Group include the installation of a water storage tank, water level control system and associated equipment, which has also been deeded over to the local water district.

Pursuant to the restrictive covenants, property owners have agreed not to extract groundwater at the restricted property by any means or for any purposes and to allow all existing groundwater wells at each restricted property to be permanently decommissioned and sealed. The well decommissioning program is in progress.

Site Characterization Through the RI/FS

The Site has been characterized through a series of environmental investigations that began following the discovery of contaminated groundwater. Based on the initial Site Conceptual Model (SCM) and the objectives of the remedial investigation/feasibility study (RI/FS) activities to define the nature and extent of contamination, Woodard & Curran conducted RI field activities, including: geologic mapping, VLF/magnetometry geophysical survey, and aerial photographic interpretation; installation of additional monitoring wells in the Source Area and Non-Source Area; collection of groundwater samples from existing residential wells and monitoring wells; collection of soil samples within the 2-acre fenced area; collection of surface water and sediment samples; and collection of ambient air samples.

The hydrogeologic characterization of the fractured bedrock unit, including its structure and hydraulic conductivity, indicates that it is highly heterogeneous. The RI confirmed the presence of high concentrations of chlorinated VOCs, particularly tetrachloroethene (PCE), in groundwater in the Source Area. Dense non-aqueous phase liquid (DNAPL) was not directly observed in the fractured bedrock at the Site. However, elevated concentrations of VOCs in the groundwater provide strong evidence that DNAPL is present in the fractured bedrock beneath the Site. Indirect evidence of DNAPL rather than direct observation is to be expected in a highly complex, fractured bedrock environment. In addition, a groundwater plume contaminated with the same chlorinated VOCs extends beyond the Source Area.

The baseline human health and ecological risk assessment performed as part of the RI was completed prior to the PRP Group's implementation of the institutional control program. The human health risk assessment (HHRA) found no unacceptable health risks attributed to contaminants detected in surface water, sediment and soil. Based on the assessment in the HHRA using a potential future residential groundwater exposure scenario, both Source Area and Non-Source Area Groundwater are currently not suitable as a domestic water supply source. No residences, however, are currently exposed to Site groundwater, because the public water supply system completed in the mid-1990s provides safe water to residents whose water supplies were affected by Site-related contaminants. Exposure risks from groundwater have been largely eliminated due to the provision of the public water supply

system, the connection of residences to that system, and the implementation of institutional controls. The environmental risk assessment identified aquatic, avian and terrestrial species as current and future receptors at the Site. and concluded that no significant ecological risks are associated with Site surface water or sediment.

Woodard & Curran used the three-dimensional finite-difference groundwater flow model, MODFLOW, to construct the flow model for the Site during the RI. A three-dimensional contaminant transport model, MT3D, was used in conjunction with the flow model to aid in determining the potential long-term fate and transport of the contaminant plume including plume stability; and aid in evaluating the feasibility of different Site remedies. The groundwater model developed for the Site during the RI was used in the FS to assist in the evaluation and costing of groundwater remedial alternatives

With USEPA and MEDEP approval, the PRP Group conducted a pilot test of *in-situ* chemical oxidation to remediate the DNAPL Source Area. The results of the pilot test indicated that full-scale application of *in-situ* chemical oxidation is not likely to be an effective remedial technology, because of the high natural oxidant demand, the prolonged remedial time frame potentially required to treat the Source Area with this technology and the total cost of applying enough oxidant to treat the Source Area.

The July 2002 FS Report developed remedial alternatives for the Non-Source Area Groundwater associated with the Site and evaluated those alternatives according to the criteria specified in the NCP. Based on the initial screening three remedial alternatives were retained for further evaluation in the detailed analysis of alternatives for remediation of Non-Source Area Groundwater:

- Alternative GW-1: No Further Action.

- Alternative GW-2: Limited Action, including protection to human health by preventing or controlling potential exposures to contaminated groundwater through institutional controls and environmental monitoring with a contingency for providing public water;

- Alternative GW-3: Hydraulic Containment, including containment of Source Area Groundwater within both shallow and deep bedrock, treatment of the extracted groundwater and reinjection of the treated groundwater outside the Source Area.

The FS evaluation indicated that no existing remedial technology has been identified or demonstrated to have the capability to restore DNAPL-contaminated groundwater in fractured bedrock to groundwater cleanup standards. Consistent with this understanding, the remedial time frames estimated for the identified alternatives were hundreds of years or longer.

Interim ROD

In September 2002, following approval of the FS and preparation of the Proposed Plan, USEPA issued an Interim ROD for a portion of the Site (Operable Unit [OU] One: Non-Source Area Groundwater).

The September 2002 ROD included four remedy components:

- Installation and operation of a groundwater containment system to cut off the Source Area Groundwater;
- Implementation of institutional controls to prevent exposure to contaminated groundwater;
- Access to public water; and
- Long-term monitoring of groundwater, sediment and surface water.

In issuing the Interim ROD, USEPA acknowledged that due to the possible presence of DNAPL within the Source Area, it was uncertain whether this part of the groundwater plume could be restored to drinking water standards. USEPA also concluded that it was uncertain whether Non-Source Area Groundwater could be restored to drinking water standards within an acceptable period of time. The Interim ROD noted that a further evaluation of the technical practicability of restoring Source Area Groundwater to drinking water standards and a revised analysis of the time estimate for the restoration of Non-Source Area Groundwater was necessary before USEPA could propose a final remedy for the entire Site.

TI Evaluation

The PRPs conducted a TI Evaluation to address the questions raised in the Interim ROD regarding remedial time frames, and to provide the technical basis for completion of the final ROD for the entire Site. The focus of the 2004 TI Evaluation field investigation was the bedrock in, and to the east of, the Source Area. The following work was completed in accordance with USEPA-approved work plan in 2004:

- Installation of two angled borings, seven vertical borings completed as monitoring wells, one vertical boring completed as a pumping well, and one vertical boring completed as an observation well.
- Geophysical measurements in the new borings, including caliper, single-point resistance (SPR), acoustic televiewer (ATV), and Heat Pulse Flow Meter (HPFM) measurements.
- Double packer testing of selected intervals of the deep vertical well;

- Sampling of core from the two cored borings and analysis for porosity, bulk density and fraction of organic carbon (f_{oc}).

- Groundwater sampling of existing and new monitoring wells and laboratory analysis of VOCs.

- Completion of a single constant discharge pumping test in the new pumping well.

The SCM was updated based on information obtained during the TI Evaluation field investigation and provided the basis for evaluating potential remedial actions and restoration potential of the Site, and supported the finding that restoring groundwater beneath a portion of the Site is technically impracticable.

The Source Area and Non-Source Area Groundwater VOC contaminant plume defined by the data collected during the TI Evaluation confirmed the nature and distribution of the contaminant plume delineated in the RI and FS, particularly regarding its maximum extent under current conditions. In addition, the data collected during the TI Evaluation served to refine the understanding of the Site conditions including fracture orientation and distribution, hydrogeology and Near-Source contaminant distribution, and to confirm the results and conclusions summarized in the RI Report. The overall groundwater contaminant plume configuration is elongated and has spread in a north-northeasterly direction that is consistent with the orientation of the primary fracture set observed during surface mapping and confirmed using borehole geophysics.

The highest PCE concentrations in groundwater were detected in the bedrock beneath the Source Area at the Site (see Figure 2). PCE concentrations in the groundwater historically were variable with depth. Several lines of evidence, however, suggest that DNAPL migration to the deeper bedrock may have been limited by either completely impermeable zones in the bedrock or by a capillary pressure barrier. DNAPL has not been directly observed in any of the Source Area Groundwater monitoring wells. However, a "remnant source" of PCE (the "probable DNAPL Zone") was identified in the shallow bedrock and deep bedrock as a zone where PCE concentrations in groundwater are greater than 10,000 µg/L beneath the excavated soil area and to the east of the 2-acre fenced area. The probable DNAPL Zone is equivalent to the Source Area (and Source Area Groundwater).

The groundwater contaminant plume includes both the Source Area Groundwater and the Non-Source Area Groundwater (see Figure 1). In addition to the presence of DNAPL in bedrock, which provides the primary long-term source for elevated groundwater contaminant concentrations, the diffusion of dissolved-phase contamination into the porous matrix of the bedrock and then back to groundwater may also provide a long-term source of VOC contamination to the groundwater.

In order to evaluate hydraulic properties of the aquifer for use in refining the site conceptual model, during the 2004 TI field investigation, a single constant discharge pumping test was conducted in the new pumping well (PW-207) to observe the response of the bedrock groundwater system to pumping. The bedrock drawdown plots from the pumping test show

a northeast-southwest trending ellipsoidal area of drawdown that extends up to 2000 feet along the major axis and up to 800 feet along the minor axis. The northeast-southwest orientation of the drawdown ellipse is consistent with the orientation of likely water-bearing fractures as identified from geophysical logging during the TI investigation.

ARARs

As part of this TI Evaluation process, specific ARARs for which waivers were sought were presented in the TI Report. Under certain circumstances, a remedial alternative that does not meet an ARAR may be selected, and a waiver of the necessity to comply with the ARAR may be granted. The NCP (40 CFR Part 300) describes six sets of circumstances in Section 300.430(f)(1)(ii)(c) for which ARAR waivers may be granted. Of these circumstances, one was considered applicable to the Site and was the basis for the TI Waiver request:

Compliance with the requirements is technically impracticable from an engineering perspective.

No waivers for location-specific ARARs or action-specific ARARs were sought for the TI Evaluation for the Site. Certain chemical-specific ARARs, however, were appropriate for a TI waiver. The remediation goals for groundwater were selected based on the results of the final baseline Human Health Risk Assessment and were set at the more stringent of the Federal Safe Drinking Water Act (Maximum Contaminant Levels or MCLs) or the Maine Drinking Water Rules (Maximum Exposure Guidelines or MEGs) for the contaminants of concern (COCs) at the Site.

Due to the probable presence of a remnant source of DNAPL in the subsurface at the Source Area, and the fact that no existing remedial technology has been demonstrated to have the capability to restore DNAPL-contaminated groundwater in fractured rock to groundwater cleanup standards, the TI Evaluation supported a waiver of the chemical-specific ARARs (Federal MCLs and 1992 Maine MEGs) for the groundwater COCs at the Source Area. ARAR waivers were also sought for all VOCs detected in the Source Area, which includes the PCE daughter products trans-1,2-dichloroethene and vinyl chloride that were not at concentrations or frequency to warrant them being given preliminary remediation goals (PRGs) in the FS or cleanup levels in the ROD.

TI Zone

Determination of the extent over which the TI waiver would apply (the "proposed TI Zone") was based primarily on the extent of the probable DNAPL zone, which was evaluated using the groundwater VOC concentration data collected from wells installed during the RI and TI field investigations. The proposed TI Zone encompasses the portion of the horizontal extent of the VOC plume shown in Figure 2 and extends vertically to the deep bedrock. The proposed TI Zone encompasses the area where VOCs are present in groundwater at concentrations above 10,000 μg/L (Source Area), the probable DNAPL Zone, and the majority of the area to be contained by installation of the hydraulic containment system, subsequently called the Containment Area, a non-regulatory-based area.

The proposed TI Zone extended outside of the Source Area and Containment Area to follow established property boundaries, to the extent practical, in order to simplify description and deed recording of the area included in the TI Zone. All residences on those lots or portions of lots included in the TI Zone, other than the 17-Acre parcel of land on which the Source Area is located, were connected to the public water system when it was constructed in 1995.

All data, modeling, and historical field data support the conclusion that the plume has reached its maximum extent and exhibits only minor variability in concentration at the perimeter. Based on the evaluation presented in the FS and TI reports, ARARs for groundwater are not expected to be met in the Source Area for more than 100 years even with active remediation of the Containment Area through the hydraulic containment alternative.

Restoration Potential for the Site

Remediation of the Source Area is not considered possible at the Site within a reasonable period of time due to the nature of the contaminant release and the hydrogeologic conditions at the Site, including:

- The likely presence of DNAPL.
- Fractured bedrock that is extremely heterogeneous.
- Bedrock that has a low matrix porosity and hydraulic conductivity.
- The potential for diffusion of groundwater contaminants into the bedrock matrix, which can provide a long-term source of groundwater contamination through slow back diffusion of the contaminant into the groundwater.

These Site conditions are among the most difficult for groundwater restoration (USEPA, 1993c; NRC, 1994; USEPA, 2003).

The refined site conceptual model was, in turn, used to recalibrate the flow model and to aid in the design of the hydraulic containment system being constructed under the authority of the Administrative Order by Consent (AOC) for the Remedial Design (RD). Travel times calculated from the groundwater flow model, along with measured f_{oc} values, and estimated retardation factors, were used to calculate remedial time frames. These time frames significantly exceeded 100 years for the two Non-Source Area remedial alternatives, assuming no containment of the Source Area Groundwater.

For the Source Area Alternative, the time to flush the plume outside the containment zone was estimated to range from approximately 40 to 80 years. This flushing occurs concurrently with hydraulic containment of the Source Area Groundwater, and restoration of the Non-Source Area Groundwater would begin immediately upon implementation of hydraulic containment of the Source Area Groundwater. The time required for the Non-Source Area

Groundwater to reach federal MCLs and Maine MEGs is considerably less than the time required for dissolution of the DNAPL within the Source Area.

The remedial approach for the Non-Source Area is unchanged from the approach described in the Interim ROD for OU-1. Per USEPA's direction, remedial technologies and alternatives presented in the FS were not re-evaluated in this TI Evaluation Report. However, alternatives discussed in the FS for Non-Source Area Groundwater that included components appropriate for the Source Area were considered for further evaluation. Source components and Non-Source components were integrated into three Site-wide remedial alternatives.

The evaluation supported the long cleanup time frames estimated for the Site and indicate that it will not be possible to remediate the Source Area Groundwater in a reasonable period of time. In such situations, CERCLA and the NCP allow for the waiver of ARARs due to technical impracticability from an engineering perspective. For the Site, waiver of select chemical-specific ARARs is an appropriate alternative for Source Area Groundwater. The TI Zone encompasses the area where VOCs are present in groundwater at concentrations above 10,000 μg/L.

Because none of the new technologies identified for the TI Evaluation were retained at the end of the technology screening process, per USEPA's direction, the alternatives presented in the TI Report were the same as those presented in the FS for Non-Source Area Groundwater, with the addition of a TI Waiver for the Source Area Groundwater. These alternatives provided a combination of technologies that range from no further action to treatment of groundwater such that the alternatives will meet the remedial action objectives presented in the FS.

The three remedial Site alternatives presented in the TI Report were:

- Alternative SGW-1: No Further Action;
- Alternative SGW-2: Limited Action with TI Waiver for Source Area Groundwater; and
- Alternative SGW-3: Hydraulic Containment of the Source Area with TI Waiver for Source Area Groundwater.

These remedial alternatives were evaluated in accordance with the NCP (USEPA, 1990, 1993b and 1994) and USEPA guidance (USEPA, 1988), with respect to effectiveness, implementability, and cost based on the criteria.

This hydraulic containment alternative would actively control the migration of contaminated groundwater by containing the Source Area Groundwater through an extraction and treatment system, thereby allowing the possible restoration of Non-Source Area Groundwater through natural processes to meet federal MCLs and Maine MEGs in a shorter period of time than without containment. It includes the following major components:

1. Installation of a Hydraulic Containment System that contains Source Area Groundwater (i.e., groundwater containing total VOC concentrations greater than or equal to 10,000 µg/L) within and adjacent to the 2-acre fenced area of the Site;

2. Construction and operation of a groundwater treatment system;

3. Monitored natural attenuation (MNA) of the Non-Source Area Groundwater;

4. Environmental monitoring with a contingency for providing public water;

5. Institutional controls;

6. Five-year site review; and

7. Technical Impracticability Waiver of chemical-specific ARARs in the Source Area.

Implementation of Institutional Controls, monitored natural attenuation, and environmental monitoring would ensure the continued protection of human health and the environment outside the containment area. In the event that environmental monitoring indicates an exposure that presents an unacceptable risk in groundwater used for drinking water, the affected resident would be connected to the public water system. ICs limit access to and use of groundwater thereby reducing exposure to contaminated groundwater and avoiding an increase in migration of contaminated groundwater. Future potential exposure to contaminants in groundwater would then be prevented, effectively eliminating this exposure pathway. In addition, five-year Site reviews would be conducted to ensure the continued protection of human health and the environment.

The actual time that may be necessary to deplete the DNAPL source is unknown, however it will be long due to both site-related and contaminant-related factors. The long restoration time frame for the Source Area is consistent with constraints to remediation posed by DNAPL in fractured bedrock. This understanding is consistent with USEPA guidance (USEPA, 1993a).

Final ROD

The September 2002 Interim ROD for the Site addressed the Non-Source Area Groundwater, defined as the groundwater underlying the Site where total VOC concentrations were below 10 ppm (equivalent to 10,000 µg/L or ppb).

The 2006 ROD set forth the final remedy for the Site, augmenting the remedy components selected in the 2002 ROD. The final remedy includes the following components:

- A determination that with the installation and operation of the groundwater containment system, restoration of the Non-Source Area Groundwater will occur within a reasonable timeframe through MNA;

- A TI Waiver for the Source Area Groundwater;

- An investigation of, and response to, if necessary, the potential vapor intrusion pathway from the contaminated groundwater into indoor air; and

- Five-year reviews.

The final remedy is a comprehensive approach that addresses all current and potential future risks associated with groundwater contamination. As a result of previous response actions, contaminated groundwater is the only medium requiring remedial action.

Summary and Conclusions

The TI Evaluation Report has been prepared to address questions raised in the Interim ROD for the Site regarding the practicability of remediating contaminated groundwater to ARARs within a reasonable period of time, and to provide the technical basis for completion of the final ROD for the Site. The findings presented in the TI Evaluation Report support the conclusion that a TI Waiver is appropriate for the Source Area portion of the Site due to the presence of a DNAPL source in the fractured bedrock beneath this portion of the Site. This chemical-specific ARAR waiver is appropriate prior to implementation of a remedy, or in the words of the TI Guidance (USEPA, 1993a) a "front-end" TI decision.

Based on experience at many sites, USEPA and independent technical experts have concluded that the likely presence of DNAPL; a heterogeneous, fractured bedrock with low matrix porosity and hydraulic conductivity; and the potential for diffusion of contaminants into the bedrock matrix make compliance with ARARs technically impracticable in a reasonable amount of time. Our estimates of remediation time frames for the Site, which are based on the data collected during the years of investigation, corroborate this understanding that it will not be possible to complete remediation within a reasonable amount of time.

DNAPL remedial technologies were reviewed in the FS evaluation and the TI Waiver Evaluation and eliminated from consideration because they would not offer effective DNAPL removal in a bedrock environment or because they may promote uncontrolled migration of DNAPL. No existing remedial technology has ever been demonstrated to clean up DNAPL-contaminated groundwater in fractured bedrock to groundwater cleanup standards. The DNAPL source and residual DNAPL cannot be effectively removed or destroyed by any of the remedies considered.

Migration of contaminated groundwater beyond its current boundary is not occurring. All data support the conclusion that the plume has reached its maximum extent and exhibits only minor variability in concentration at the perimeter.

Although no remedial action for cleanup of the groundwater has been implemented, the TI Evaluation has been conducted simultaneously with the design of a hydraulic containment

system for the Source Area as required by the AOC for RD entered into between USEPA, the MEDEP, and the PRP Group subsequent to the issuance of the Interim ROD, in parallel with the implementation of institutional controls for the affected area, and subsequent to a pilot test of *in-situ* chemical oxidation for Source Area remediation.

Despite the impracticability of remediating Source Area Groundwater in a reasonable period of time, an ARAR waiver for Source Area Groundwater is appropriate only as a component of an overall remedy for the Site that is protective of human health and the environment. Since risk is only present when exposure occurs, exposure control plays an important and necessary role in the protectiveness of a remedial strategy. Exposure control is being aggressively implemented at the Site with institutional controls and provision of public water. There is no unacceptable current risk to public health at the Site because residents are not consuming groundwater that does not meet prescribed standards. Residences with wells in which contamination above drinking water standards had been detected have been connected to public water, and routine monitoring of certain residences is occurring even though no impact has been detected. All data and contaminant mass transport analysis support the conclusion that the VOC plume has reached its maximum extent and is in a stable distribution.

Hydraulic containment of the Source Area Groundwater coupled with a TI Waiver of chemical-specific ARARs for the Source Area Groundwater, continued monitoring of Non-Source Area Groundwater, expansion of the public waterline to additional residents, if needed, and maintenance of institutional controls, will prevent exposure and provide an appropriate remedial response for the Site that is consistent with CERCLA and, to the extent practicable, the NCP.

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Biographical Sketches

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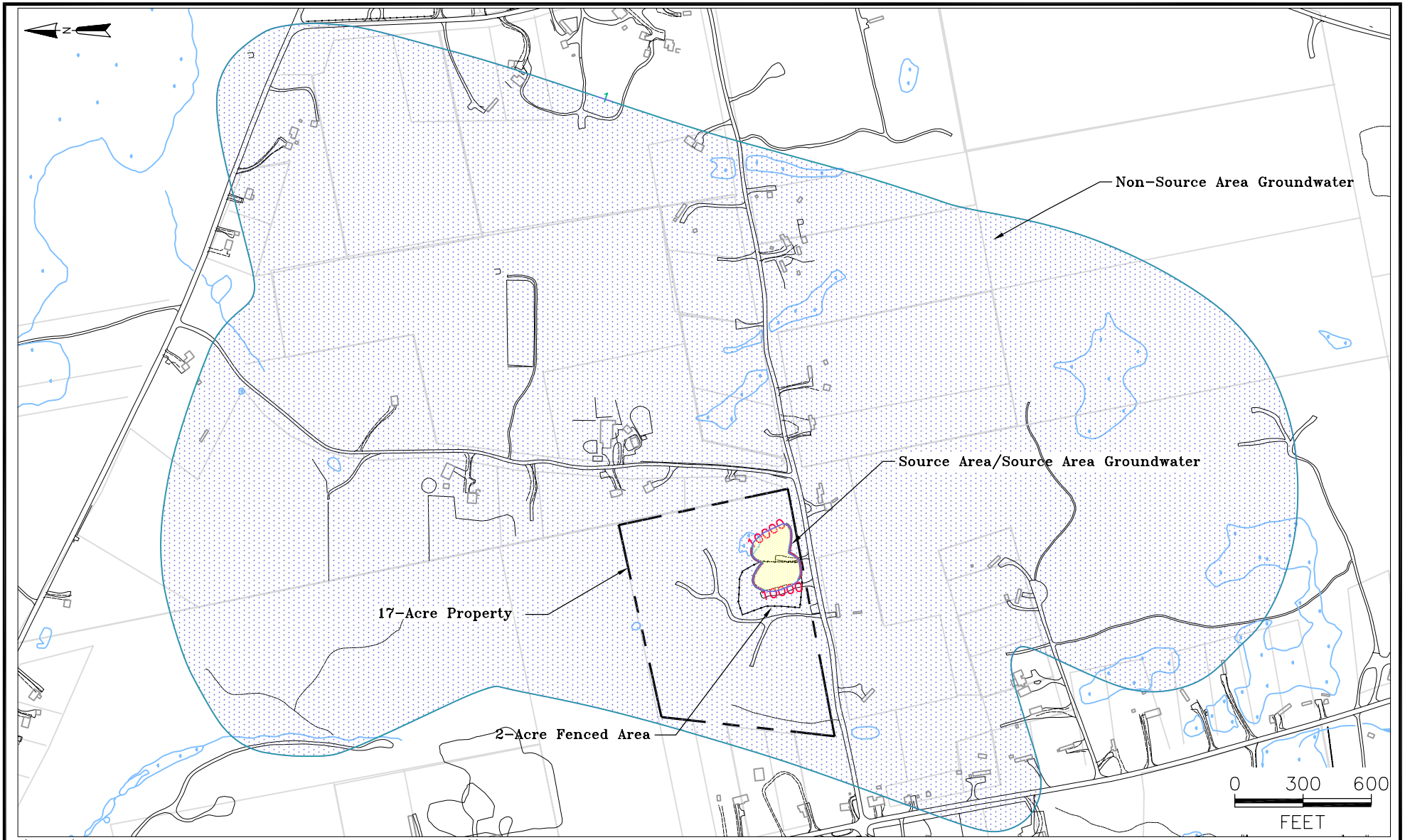

Legend:

VOC = Volatile Organic Compound
ug/L = Microgram per Liter
ppm = Parts per Million

Total VOC Concentration Contour (ug/L)

Notes:

1. Shaded areas based on Maximum Extent of total VOCs in any of the Sampling Events.

2. Source Area Groundwater is defined as groundwater with total VOC concentration equal to or greater than 10,000 ug/L (10 ppm).

3. Non Source Area Groundwater is defined as groundwater with total VOC concentrations less then 10,000 ug/L (10ppm).

Figure 1
Site Plan Detail

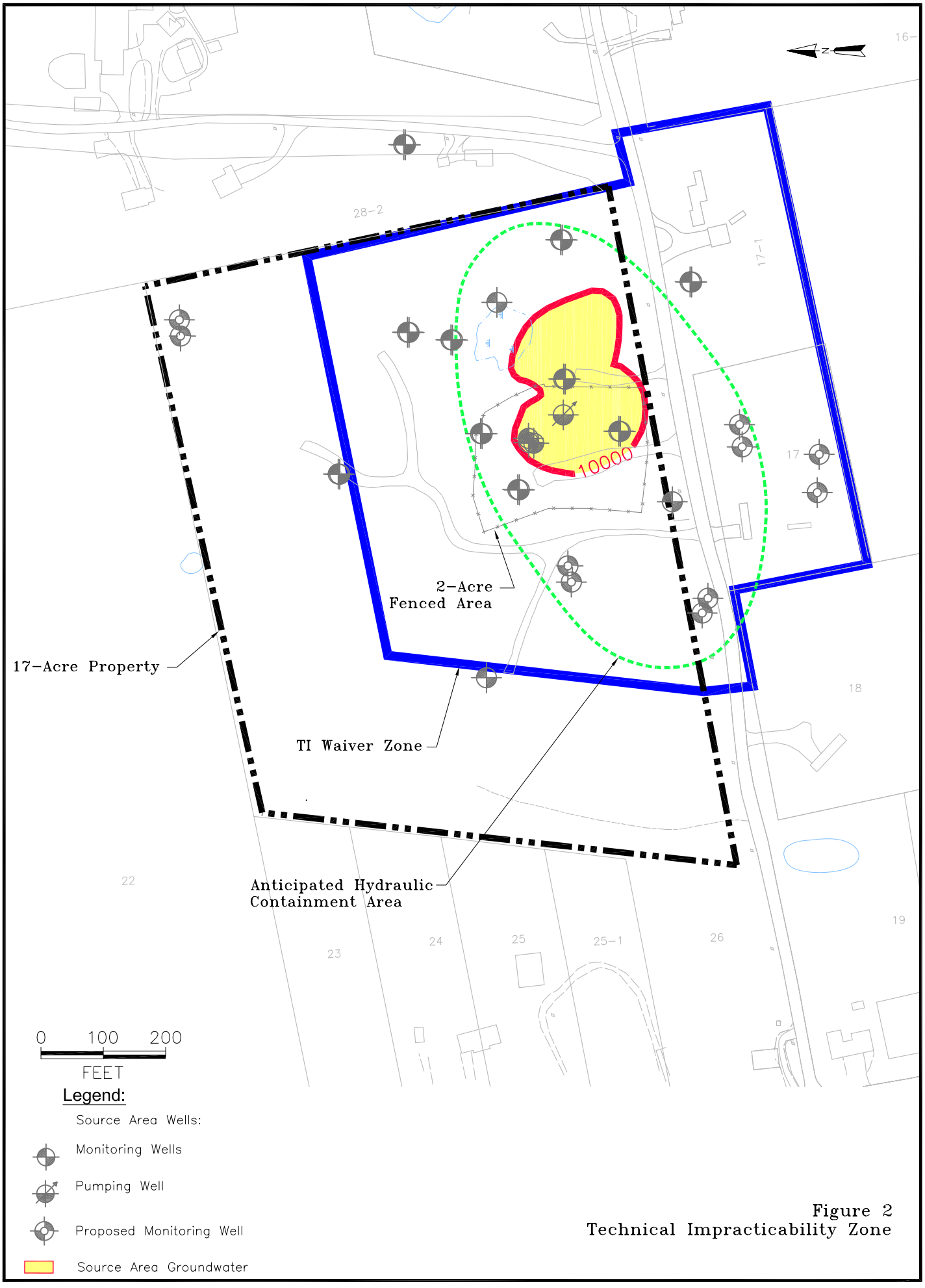

Figure 2
Technical Impracticability Zone