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SRSNE Site Group

Thermal Wellfield Implementation Support Plan

Solvents Recovery Service of New England, Inc.
(SRSNE) Superfund Site
Southington, Connecticut

December 2013

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Prepared for:

SRSNE Site Group

Prepared by:

ARCADIS U.S., Inc.
160 Chapel Road
Suite 201
Manchester
Connecticut 06042-1625
Tel 860 645 1084
Fax 860 645 1090

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1. Introduction

1.1 Purpose and Scope

One component of the planned remedial approach for the Solvents Recovery Service of New England (SRSNE) Superfund Site in Southington, Connecticut (Figure 1) is in-situ thermal remediation (ISTR) of an area where non-aqueous phase liquid is present in a defined area of overburden soils in and near the former Operations Area of the site (Figure 2). The SRSNE Site Group – an unincorporated association of Settling Defendants that is undertaking the work – selected TerraTherm, Inc. to design and implement the thermal remediation component. As part of the design process, the layout of the thermal wellfield was submitted to the United States Environmental Protection Agency (USEPA) in September 2011, and subsequently approved for installation on September 23, 2011. Site preparation activities necessary for ISTR implementation – including regrading, utility installation, utility and culvert relocation, and other preparatory work – were performed between 2010 and 2012. Having completed that work, installation of the thermal wellfield is anticipated to start in the first quarter of 2013. This schedule allows for the wellfield to be substantially constructed during the time that the remainder of the thermal design is prepared and subject to review and approval by the USEPA and Connecticut Department of Energy and Environmental Protection (CT DEEP).

The overall purpose of this Thermal Wellfield Implementation Support Plan (ISP) is to provide a consolidated plan of activities to be performed by various firms in support of the thermal wellfield installation process. The specific purposes of this document include:

- Summarize anticipated process for thermal wellfield installation
- Identify roles and responsibilities for personnel/firms involved in the work
- Consolidate/reference pertinent information presented in other plans and documents
- Identify waste materials expected to be generated, and the planned approach for management and disposal of each type of waste
- Summarize perimeter and work zone air monitoring programs

Although not a required submittal under the Remedial Design/Remedial Action Statement of Work (RD/RA SOW), this ISP will be provided to the USEPA and CT DEEP for informational purposes to describe the selected approach for wellfield installation.

The planned wellfield includes 593 heater wells (up to 32 feet deep), 534 vapor extraction wells (up to 8 feet deep), and 7 groundwater monitoring wells (estimated as up to 17 feet deep, with final depth equal to top-of-bedrock depth). Installation of this well network is expected to require several months. While TerraTherm will primarily be responsible for installing the wells, the process will involve and be supported by the work of other firms engaged in removal of non-aqueous phase liquid (NAPL) from boreholes (if and as needed), identification of the top of bedrock in boreholes, waste material management, perimeter air monitoring, and independent quality assurance. To this end, clarification of the roles and procedures is appropriate to facilitate efficient and coordinated efforts among the team.

The ISP also describes other activities that will be performed in support of the thermal wellfield installation, including management and disposal of drill cuttings and other generated materials and characterization of the energy content of recovered NAPL. These components are further discussed in subsequent sections of the ISP.

1.2 Document Organization

The remainder of this document is organized into four sections. The sections and a brief summary of their respective contents are as follows:

- **Section 2 – Scope of Work:** summarizes key components of the thermal wellfield installation process and identifies roles and responsibilities of personnel involved. It also summarizes the approach for confirming that the top of bedrock has been encountered when drilling and setting heater wells.

- **Section 3 – Material Handling and Management:** summarizes the anticipated generation, handling and management approach for the various materials associated with the thermal wellfield installation.

- **Section 4 – Air Monitoring:** provides information regarding two air monitoring programs to be performed in conjunction with the wellfield installation activities: work zone air monitoring (as required by the Site Health and Safety Plan) and perimeter air monitoring.

- **Section 5 – References:** summarizes the various documents referenced herein.

In addition to the text, this report includes and references various figures and attachments that provide specific additional information pertinent to the thermal wellfield installation process. Reference is made to various separately bound documents that provide supporting information, including:

- Health and Safety Plan (HASP) [Attachment D to the Remedial Design Project Operations Plan (RD POP; ARCADIS November 2010a, with subsequent updates)] – Establishes the minimum health and safety procedures applicable to site workers. Individual firms may develop additional site/project-specific plans or addenda, provided that those plans meet the minimum requirements of the HASP.

- Draft *In-Situ Thermal Remediation Remedial Action Work Plan and Project Operations Plan* (TerraTherm, July 2011), with subsequent and pending revisions.

- IQAT Work Plan (de maximis, April 2010), as modified February 2013 for thermal wellfield installation work.

2. Scope of Work

This section summarizes the scope of work associated with the thermal wellfield installation, and identifies the roles and responsibilities of the various firms that will support the process. It also summarizes the approach for confirming that the top of bedrock has been encountered when drilling and setting heater wells. Determining the depth to bedrock is considered a key project responsibility due to its significance with regard to installing heater wells to the target depth and its somewhat interpretive nature using sonic drilling methods and the presence of till, weathered bedrock, and competent bedrock.

2.1 Overview of Work

The thermal wellfield includes an array of heater wells that will be used to apply heat into the thermal treatment zone, and nearly all of the heater wells include a corresponding shallower vapor extraction well approximately 3 feet from the heater well. The network of heater wells is shown on Figure 2. In addition, a series of horizontal vapor extraction wells will be installed in an area where shallow groundwater precludes the use of vertical vapor extraction wells, and borings will be advanced for installation of temperature probes, pressure sensors, and groundwater monitoring wells. The various types of wells/borings are further described as follows:

- **593 Thermal Heater Wells (Heater Wells):** The heater wells will deliver heat to the thermal treatment zone (TTZ) by thermal conduction. The heater wells will be installed on an approximately 14-foot hexagonal grid spacing and will extend from approximately 3 feet above to a depth of three or more feet below the bedrock surface. Expected drilling depths range from 16 to 32 feet. Actual drilling depths will depend on the depth weathered bedrock is encountered. The heater wells will be comprised of a 3-inch diameter Schedule 40 carbon steel casing with an internal heating element.

- **534 Vertical Vapor Extraction Wells (VEWs):** Vertical VEWs will be screened in the unsaturated zone and used to extract vapors generated during heating of the soil and water during the thermal treatment process. These wells will be located approximately three feet from heater wells and set at depths of 7 to 8 feet below ground surface. Each Vertical VEW will be constructed with a 2-inch Schedule 40 (or 80) carbon steel riser pipe and a 2-inch stainless steel screen.

- **260 Linear Feet of Horizontal Vapor Extraction Wells:** Horizontal VEWs will be installed in the eastern portion of the thermal treatment zone where the anticipated shallow depth to groundwater renders the use of vertical vapor extraction wells impracticable. The horizontal orientation will provide the same service as the VEWs. These VEWs will be located in clean fill placed during Pre-ISTR site preparation activities, with the approximate location indicated on Figure 2. The Horizontal VEWs will be constructed with 3-inch stainless steel screened pipe.

- **98 Temperature Monitoring Sensors (Temperature Sensors):** Temperature sensors will be installed to monitor the heating process within the thermal treatment zone. The design includes 71 sensors installed at the centroids of the heater well grid, 13 installed approximately 3 feet from designated heater wells, 11 sensors installed along the eastern and northern perimeter of the thermal treatment zone, and 2 installed at "other" locations within the treatment zone. Temperature monitoring sensors will consist of a 1.5-inch diameter carbon steel pipe placed in a minimum 3-inch diameter borehole at depths ranging from 13 to 22 feet below ground surface. The depths of the sensors will be adjusted in the field so that they extend down to 2 feet into bedrock.

- **64 Combined Vacuum/Pressure and Groundwater Level Monitoring Points (Monitoring Points):** These monitoring points will be spaced evenly throughout the well field and will be located at depths of 7 and 12 feet below ground surface installed with a minimum 4" borehole. These monitoring points will be used to ensure pneumatic and hydraulic control throughout the TTZ. Each monitoring point will be constructed with a 2-inch carbon steel riser pipe and a 2-inch stainless steel, 10 slot screen.

- **7 Groundwater Monitoring Wells:** Overburden groundwater monitoring wells will be used to monitor VOC concentrations in groundwater prior to and throughout thermal remediation. The wells will be dispersed throughout the TTZ and will be installed at estimated depths of 14 to 17 feet below ground surface (i.e., extending 2 feet into bedrock at the specific well location), with a minimum 6" borehole. Each monitoring well will be constructed with a 2-inch Schedule 40 carbon steel riser pipe and a 2-inch, 10 slot stainless steel screen. Each well will include a 2-foot long, grouted sump as a contingency for dense, non-aqueous phase liquid (DNAPL) collection.

Sonic drill rigs will be used to install these borings and wells using maximum 10-foot runs. Sonic rigs can efficiently advance borings in overburden, rock, and concrete (which will be encountered in former foundation areas). They can also advance casing and core barrels while maintaining a comparatively tight seal between the outer casing and the surrounding soil, thus reducing the potential for NAPL migration during the installation process.

TerraTherm's SOP for the installation of heater wells is provided in Attachment A. In overview, the rotosonic method allows the independent advancement of the outer casing and inner core barrel. In normal operation, the core barrel is advanced first followed by the outer casing. The core barrel is then removed once the outer casing has been advanced. This procedure is repeated until the top of bedrock is encountered with the core barrel. Once the top of bedrock has been encountered, the outer casing will be advanced and seated into the top of rock and the inner core barrel will be removed.

Although the drilling procedure was developed to minimize the potential for downward DNAPL mobilization during the boring process, it is possible that mobile NAPL could enter the borehole or that pooled DNAPL could be present near the top of bedrock or within the upper portion of the bedrock at some locations. Accordingly, the soils within the interval of 3 to 5 feet above the top of bedrock will be evaluated for the presence of visible NAPL. During previous subsurface investigations in the vicinity of the thermal treatment area, NAPL encountered in soil samples was dark brown, often with a colorful sheen, and had a pungent odor. If any visible NAPL is present in this interval just above the bedrock, the bottom of the cased borehole will be evaluated for the presence of any DNAPL accumulation, and it will be removed, if present. Then grout will be placed into the bottom of the outer casing immediately before advancing the inner core barrel any further into the rock. The grout is intended to seal the overburden/bedrock interface and reduce, to the extent practicable, the potential for DNAPL to migrate into the bedrock. Once the boring is advanced to the target depth, the borehole will again be checked for the presence of DNAPL, and it will be removed. Following this assessment, the heater wells and temperature monitoring points will be set in place and backfilled with heat resistant grout as the core barrel/casing is removed.

A flow chart illustrating the anticipated process of soil boring, rock coring, and NAPL assessment is provided in Figure 3. A detailed description of drilling is provided in Attachment A. The SOP for assessing the presence of DNAPL in the bottom of these boreholes (and for removal of such DNAPL if present) is included in Attachment B.

In overview, the preferred approach for NAPL assessment and removal (detailed in Attachment B) involves lowering a pump or pump tubing[1] into the borehole and removing accumulated liquids. If DNAPL is observed in the pump discharge, pumping will continue until DNAPL is no longer present in the pump discharge. If no DNAPL is present after 1 minute of pumping, it will be concluded that DNAPL is not present at the base of the borehole at this location. After removing any accumulated DNAPL or concluding that none is present, the drillers will immediately resume boring or well installation activities, as appropriate.

In addition to the well installation and DNAPL assessment/removal, various other supporting activities will be concurrently performed. These activities include management/disposal of drill cuttings, management of NAPL and co-generated groundwater removed from boreholes, implementation of air monitoring programs, and general site observation and documentation activities (including activities of the IQAT field team). These supporting activities are further discussed in the following sections of this ISP.

2.1.1 NAPL Visual Assessment

The purposes for NAPL visual assessment are:

- To identify soils targeted for segregation and offsite disposal based on NAPL content (as further discussed in Section 3)
- To determine whether to implement the NAPL assessment and removal procedure in the borehole upon reaching the top of bedrock, and before coring the remainder of the borehole into the bedrock.

[1] The SOP in Attachment B also includes contingent provisions for use of a bottom-loading bailer if the preferred pump-based approach is not feasible for any reason.

During previous subsurface investigations in the vicinity of the thermal treatment area, NAPL encountered in soil samples was dark brown, often with a colorful sheen, and had a pungent odor. If significant NAPL is visible in any recovered core or section thereof, the core (or section thereof) will be segregated for offsite disposal (see Section 3.1.1). The assessment of visible NAPL for disposal purposes will be made by ARCADIS and/or ***de maximis*** field staff, and its presence and approximate depth range will be recorded on the boring log (Section 3.1). The soils to be segregated for off-site disposal will not include those containing only small, isolated, disconnected "residual" NAPL; rather, the soils for off-site disposal will be those that contain apparent, visible "pools" of NAPL with significant NAPL saturation within the soil.

As discussed above, if *any* NAPL is visible in the soil within 3 to 5 feet of the top of bedrock, its approximate depth interval (to the nearest foot) will be estimated and recorded, and the bottom of the borehole will be evaluated for any accumulated DNAPL as described in Attachment B, and grout will be added to the outer casing immediately prior to advancing the core barrel deeper. To reduce the potential for missing visible NAPL in the soil interval just above the bedrock, these soils will be split and manipulated with a trowel if needed during visual assessment.

During the NAPL Delineation Pilot Test (BBL December 2003), soil cores from the thermal treatment zone and surrounding area were evaluated for the presence of NAPL by USEPA's geologist, USEPA's hydrogeologic consultant, Dr. Bernard H. Kueper, BBL's field geologist, and/or ***de maximis***. Ten soil samples were interpreted to contain pooled NAPL; in all of those samples, NAPL was readily visible to the naked eye without any additional testing (shake test, sheen test, hydrophobic dye test, etc.). These previous NAPL observations indicate that the NAPL is dark brown in color and often imparts a colorful sheen to the surface of the soil matrix. Based on the NAPL characterization and confirmed visibility from the prior investigations, direct visual observation for NAPL will be used during the thermal wellfield installation program.

2.2 Project Roles and Responsibilities

Construction of the thermal wellfield will involve various firms and onsite personnel carrying out multiple work tasks that are necessary to install the wellfield safely, efficiently, and in accordance with the design and intent. The following table summarizes the primary roles and responsibilities of participants involved. All parties also have the overriding responsibility to coordinate among the team to ensure that work progresses in an orderly, safe, efficient, and effective manner.

Organization	Role
de maximis, inc. (***de maximis***)	· Project Coordinator (Mr. Bruce Thompson) · Overall project management and coordination of consultants, contractors and subcontractors · Provide onsite Construction Manager to direct and document the various work activities · Provide onsite observer to monitor well installation progress and document total boring depths · Assist in assessing cuttings for NAPL presence (for triggering disposal requirements or borehole NAPL removal procedures) · Coordinate with disposal facility(ies) for profiling and transport of materials subject to offsite disposal
de maximis (IQAT Team)	· Independent Quality Assurance Team (IQAT) to observe and document field conformance with design
TerraTherm	· Provide and direct subcontractors (driller and surveyor) for well installations · Provide direct oversight of the drilling contractor and enforce design specifications · Create soil boring logs · Transfer drill cuttings to designated disposition areas · Construct and manage the onsite consolidation area for drill cuttings (see Section 3) · Install wells and monitoring devices · Construct and operate an equipment decontamination pad · Work zone air monitoring of personnel · Maintain existing erosion control measures
ARCADIS	· Implement perimeter air monitoring · Provide onsite personnel to identify bedrock depths, assess cuttings for NAPL presence, and implement NAPL removal measures as needed · Collect and ship DNAPL samples for analysis of BTU content
Weston Solutions	· Operation of the existing groundwater treatment system (which will be used for treatment of waters generated during the wellfield installation)

The attached Table 1 provides additional detail regarding specific project roles and areas of primary and secondary responsibility during the wellfield installation. Certain of the roles are further described in the following sections.

2.3 Bedrock Depth Interpretation

2.3.1 Geologic Background

During the Remedial Investigation (BBL 1998), the overburden and bedrock geology were characterized in detail in the area targeted for the thermal remedy. The overburden geology beneath the Operations Area and former Cianci Property site consists of three main unconsolidated layers. The shallowest unit consists of silty, sandy *fill* materials, observed where grading operations have reworked the upper few feet of soil and filled low areas. The shallowest natural geologic layer, referred to as *outwash*, consists of reddish-brown silty sand and gravel deposits, interbedded with discontinuous layers of silt and relatively well-sorted sand and gravel. The lowest overburden layer consists of glacial *till*, a generally unstratified and discontinuous unit consisting of reddish-brown clay, silt, sand, gravel, cobbles, and boulders. The vertical zone targeted for thermal treatment is the overburden.

Beneath the overburden, core samples and drilling observations at the SRSNE Site indicate that the upper 5 feet of bedrock is severely weathered and partially decomposed (*weathered bedrock*). Split-spoon samplers can typically be driven into the top of the weathered rock during standard penetration testing, and hollow-stem augers can typically be advanced 5 feet or more into the weathered bedrock.

2.3.2 Top-of-Bedrock Surface Maps

Figure 4 shows elevation contours of the top of bedrock surface in the area of interest. This map is based on the most recent available data set, including soil borings, monitoring well boreholes, former on-site interceptor system wells, rotosonic test borings performed by TerraTherm, and bedrock encountered during the installation of the extended sheet-pile wall during site preparation activities. The top of weathered bedrock was interpreted in the hollow-stem auger and splitspoon borings based on the observation of solid, lithified pieces of arkosic sandstone in split-spoon samples. Alternatively, the top of weathered bedrock at many of the direct-push (PTB-series) borings identified the top of bedrock as the depth of refusal with the direct-push drilling equipment. At select hollow-stem auger borings where bedrock was not encountered, the contours were adjusted to one foot below the bottom depth of the borings to maintain consistency between boring logs and contours.

Figure 5 shows contours of the depth to bedrock (i.e., overburden thickness). This map was produced by subtracting the top-of-bedrock elevations (as shown on Figure 4) from the current ground-surface elevations, following the PIPP regrading activities. This map will provide a basis to estimate the depth of bedrock at any drilling location within the thermal treatment area, prior to drilling.

2.3.3 Identifying Top of Weathered Bedrock during Rotosonic Drilling

As discussed above, the thermal treatment wellfield will be installed using rotosonic drilling methods. A rotosonic drilling rig uses an oscillator or head with eccentric weights driven by hydraulic motors to generate high sinusoidal force in a rotating drill casing. The frequency of vibration (generally between 50 and 120 cycles per second) of the drill bit or core barrel can be varied to allow optimum penetration of subsurface materials. The dual string assembly that will be used at the SRSNE Site will allow advancement of an outer casing and an inner casing (also referred to as a "core barrel"), which will be used to collect samples. Small amounts of water will likely be used to remove the material between the inner and outer casings. The vibratory action of rotosonic drilling will partially pulverize the weathered bedrock.

The top of the weathered bedrock will generally be identified as the depth of the first consolidated sandstone or diabase rock material encountered in the boring near the anticipated top-of-bedrock depth (Figure 5). In core samples from rotosonic test borings performed by TerraTherm in January 2011, the top of weathered bedrock was typically described as "pinkish-gray rock and rock powder". Based on the large number of pre-existing data used to contour the top-of-bedrock depth, in most cases the weathered bedrock should be encountered within a few feet of the anticipated depth. However, in some cases, the top of weathered bedrock may be encountered shallower or deeper than anticipated because of undulations in the top of weathered bedrock surface. In locations were the top of weathered bedrock is deeper than anticipated, TerraTherm will adapt the well depths, as necessary, based on actual depth to the top of weathered bedrock. At all heater well locations, the borings and heater well casing will be installed a minimum of 3 feet into the top of the weathered bedrock. If the top of rock is encountered at shallower depths than anticipated, the borings and heater well casing will be installed to the full design depth.

2.4 Project Team Coordination

Coordination among the various personnel engaged in the thermal wellfield installation process is a key to the safe and efficient completion of fieldwork. Accordingly, daily morning meetings will be held among the field crew. The purposes of these meetings will be to review safety procedures, coordinate daily work activities, share air monitoring data, and work cooperatively to resolve any issues that arise in the course of the work.

In addition to the daily coordination meetings among field staff, weekly team calls will be held among representatives of the various firms, and the regulatory agencies at their discretion, to review the progress and status of the work. These meetings will be arranged for a consistent time each week, and hosted and documented by ***de maximis***.

3. Material Handling and Management

Installation of the thermal wellfield will generate various materials to be managed or disposed during the course of the work. Most notably, this includes soil cuttings from the boring activities. Other materials likely to require management include NAPL from boreholes, co-generated water from NAPL removal activities and equipment cleaning procedures, and general “investigation derived wastes” (IDW) such as spent PPE and disposable equipment. Specific procedures to handle and manage these materials are described below.

With regard to the potential generation of NAPL during the well installation processes, this section also includes provisions for collecting a limited number of representative NAPL samples for analysis of BTU content.

3.1 Soil Cuttings

The estimated volume of drill cuttings to be generated during the thermal wellfield installation is approximately 285 cubic yards (cy). This is based on the expected 19,000 linear feet of drilling with a 6-inch borehole to install the heater and vapor extraction wells, plus a 25% contingency to account for other wells and monitoring points and other potential increases. Note that excavation associated with the installation of horizontal VEWs is not included in this estimate because those wells will be installed in clean fill that will be backfilled around the pipes once installed (i.e., no impacted cuttings/spoils will be generated as a result of installing the horizontal VEWs).

The rotosonic drill rigs will advance core barrels up to 10-foot length increments. Upon removal of each core run, the drill rig will vibrate the accumulated soils into a container (e.g., bobcat bucket) for visual assessment of disposal requirements. Any core segments within 3 feet of the estimated top of bedrock will be clear plastic sleeve for visual characterization as part of the NAPL assessment process (Section 2.1). In general, TerraTherm will visually observe each recovered core and document observations on a location-specific boring log (Attachment C). At a minimum, information to be recorded on the boring logs include general soil description, estimated depth of the weathered bedrock surface, presence and approximate depth(s) of visible NAPL, and total boring depth.

Following collection and visual characterization/logging, each recovered core will be subject to management and disposal. Depending on the degree of impacts within a given section of core, two methods of disposition are anticipated. If significant NAPL (as qualified below and in Section 2.1.1) is visible in any recovered core or section thereof, the core (or section thereof) will be segregated for offsite disposal. The assessment of visible NAPL for disposal purposes will be made by ARCADIS and/or ***de maximis*** field staff. The soils to be segregated for off-site disposal will not include those containing only small, isolated, disconnected "residual" NAPL; rather, the soils for off-site disposal will be those that contain apparent, visible "pools" of NAPL with significant NAPL saturation within the soil. Recovered sections of soil and rock core that contain such levels of visible NAPL will be placed into drums for offsite disposal. The remaining sections of soil and rock core will be consolidated within a designated area within the TTZ and subject to thermal remediation as part of the ISTR process.

While there is a desire to minimize off-site disposal volumes, the planned approach includes off-site disposal of the most heavily impacted soil cuttings. This approach reduces the potential for air emissions, NAPL accumulation in the on-site consolidation area, and odors associated with handling NAPL-containing materials.

The approach associated with each method of soil cutting disposition, as well as management of other materials to be generated during the wellfield installation process, is further discussed in the following subsections.

3.1.1 Soil Cuttings Containing NAPL

As indicated above, each recovered soil core run will be subject to visual inspection upon recovery. While visible NAPL should be readily identifiable by any field staff, one or more ***de maximis*** and/or ARCADIS staff will be designated for interpreting the presence or absence of NAPL for the purpose of implementing this approach.

Core segments that contain significant visible NAPL (not just small, isolated, disconnected "residual" NAPL blobs, but significant NAPL "pools") will be transported (via a bobcat bucket or other suitable method) to a designated drum storage area and placed directly into drums. Drums will be stored in the on-site drum storage unit to be established at the approximate location indicated on Figure 2. Once the drums are full, the ***de maximis*** construction manager will notify The Environmental Quality Company (EQ) for disposal. A disposal profile will be generated prior to commencing the drilling work such that full drums can be promptly removed. Core segments that do not contain visible NAPL can be handled as other soil cuttings discussed in Section 3.1.2.

The use of drums to containerize soils that contain visible NAPL is based on the expectation that only a very small fraction of the total volume of soil cuttings will contain saturated NAPL. If, in the course of the work, it is determined that the volume of such soils is substantially larger than anticipated, ***de maximis*** will coordinate with EQ to arrange for larger containers to be used for accumulation and subsequent off-site disposal of the soils. Such containers would be sealed and covered to minimize volatile emissions, rainwater accumulation, and/or release of any liquids that may accumulate in the containers.

3.1.2 Other Soil Cuttings

Based on prior drilling activities in the former Operations Area, it is anticipated that the vast majority of soil cuttings from the drilling activities will <u>not</u> contain visible "pools" of NAPL or significant NAPL saturation within the soil. As generated, these cuttings will be transported (via a bobcat bucket or other suitable method) to a designated consolidation area to be constructed in the eastern portion of the thermal treatment zone at the approximate location shown on Figure 2. This location and configuration were selected based on the following considerations:

- The area lies within the thermal treatment area, so that the cuttings will be subject to treatment as part of the thermal process.

- The target area encompasses a surface area of approximately 2,500 square feet. This size would accommodate the maximum estimated volume of soil cuttings generated from installation (e.g., assuming none of the soils require offsite disposal) at a thickness of 2 feet. The specific location selected is an area where up to nearly six feet of clean soil fill were placed and compacted to achieve the prepared site grade. Excavating to a depth of 2.5 feet in this area allows for placement of two feet of cuttings, followed by re-placement of six inches of the excavated fill material. The soil cover reduces emissions and exposure potential, and allows for the subsequent heating process to treat impacted soils rather than the clean fill currently present.

- Placing the cuttings in a subgrade area facilitates containment and reduces potential for migration or exposure during the accumulation period.

- The size of the consolidation area is flexible. In the event that less soil is consolidated in this area (e.g., because the total volume of cuttings is less than estimated or a portion of the soils are disposed offsite as discussed above), the unneeded portion could remain unexcavated, or be backfilled with a portion of the clean fill excavated to create the area.

The consolidation area will be constructed and managed as follows:

- Existing fill materials will be excavated to a depth of approximately 2.5 feet within the location/configuration shown on Figure 2. The excavated soils will be staged in a nearby, out-of-the-way location to be agreed upon by the field team based on planned work phases and staging areas. The soils will be covered with a securely fastened tarp (or equal) for subsequent use as needed.

- A shallow collection sump will be placed at a topographic low point within the consolidation area. To the extent possible, water collecting in the low point will be allowed to infiltrate the ground surface and into the TTZ. In the event that the rate of water accumulation exceeds the infiltration rate, the sump can be used to collect and containerize water for treatment using the onsite treatment system (see Section 3.3).

- A tarp will be provided and anchored at the perimeter of the consolidation area so that it can be rolled out to cover the consolidated soils as needed. Sand bags will be used to secure the tarp when deployed. Construction fence will also be placed around the perimeter of the consolidation area for safety and as a visual indicator of the grade change during the well installation period.

- TerraTherm will drill and install wells located outside the consolidation area. As cuttings are generated from drilling operations, the cuttings (excluding plastic liner bags, when used) will be deposited into the consolidation area progressing from east to west. These soils will be placed to a thickness of no more than two feet such that approximately 6 inches of free board exists between the existing grade and the consolidated materials. As work progresses, soil from the stockpile of clean excavated soils will be placed atop the consolidated material to provide a barrier against volatile emissions, odor, and direct exposure.

- Once borings located outside the consolidation area have been completed, it will be necessary for TerraTherm to install planned borings within the limits of the designated consolidation area. At that time, additional cover soils will be placed atop the consolidated cuttings (as needed), and the area will be compacted to re-establish the prepared grade elevation and provide a surface upon which drill rigs can access to install the wells. To the extent that a small area can remain open for consolidation, cuttings from the final borings will be placed into that area for subsequent cover and compaction. Any cuttings generated by the final wells installations that cannot be placed into the consolidation area will be designated for offsite disposal if another suitable consolidation area cannot be identified based on the volume and site conditions at that time.

The use of a soil cover and covering tarp is anticipated to minimize the potential for volatile emissions from the consolidation area. A conceptual representation of the consolidation area is presented in Figure 6. If warranted based on the results of work zone or perimeter air monitoring data (Section 4.1), additional control measures may be used specifically for the consolidation area. Potential measures include covering of individual cells within the consolidation area or other suitable measures as warranted by the field conditions and the apparent source of volatile emissions (Section 4.3).

It should be noted that consolidation of soils cuttings within the TTZ is consistent with the USEPA's Area of Containment (AOC) Policy (55 FR 8759). This policy states USEPA's belief "that movement of waste within a unit does not constitute 'land disposal" for purposes of application of the RCRA LDRs." In remediation settings, USEPA has interpreted broad areas of contamination (such as the former Operations Area of the SRSNE site) to essentially be the same as a RCRA unit, such as a landfill. Under the AOC Policy, soils can be moved within the AOC without triggering LDRs or "generating" new waste. It is this policy that allows for the relocation and management of soils for the purpose of facilitating remedy implementation. Therefore, handling, relocation, and consolidation of soil cuttings within the boundaries of the TTZ is consistent with the AOC Policy as long as the materials are not removed from the AOC during the process.

3.2 NAPL Disposal and BTU Analyses

As discussed in Section 2.1 and Attachment B, the soil boring program will involve assessment and removal (if present) of DNAPL from the bottom for the borehole if NAPL is observed in the last core section above the rock surface prior to drilling deeper, and at all borings that extend into bedrock upon reaching the final depth but before commencing well installation. DNAPL and groundwater removed from boreholes will be collected in a graduated container (e.g., carboy or drum with scale); volumes for both will be recorded in a field book. If NAPL is not recovered at a given location, the groundwater removed from that location will be transferred directly into a container for treatment using the onsite treatment system (Section 3.3). If NAPL is present, the recovered liquids will be segregated to the extent possible by allowing the DNAPL to settle and then decanting water for onsite treatment. The remaining DNAPL will then be transferred into a designated, labeled drum in the containment unit (Figure 2). When full, drums will be appropriately manifested and transported for offsite disposal. ***de maximis*** will coordinate with EQ for characterization, transport, and disposal of the drummed wastes.

To date, one site-specific NAPL sample has been analyzed for BTU content. TerraTherm's design is based, in part, on that analytical result. To further assess the degree of variability that may be associated with NAPL throughout the TTZ, additional samples will be collected for BTU analysis, if possible, in conjunction with the NAPL removal and handling process. Provided that sufficient NAPL is encountered and removed over the course of the wellfield installation process, up to 10 NAPL samples will be collected by ARCADIS and submitted for laboratory analysis of BTU content.

To the extent possible, NAPL samples submitted for BTU content analysis will be collected from distributed locations throughout the TTZ. If the total number of NAPL-producing borings is 10 or less, the samples will be collected from those locations. However, if the number of NAPL-producing locations is greater, representative locations will be selected based on their distribution across the TTZ. Because the number and location(s) of NAPL-producing wells is presently unknown, samples may initially be collected from multiple locations when NAPL is encountered, and then temporarily held at the site. Depending on the number of aliquots collected, up to 10 samples representative of distributed areas may be submitted while the remaining collected aliquots are disposed in drums with the collected NAPL.

NAPL samples subject to BTU analysis will be submitted to SPL laboratory in Houston, Texas for analysis using ASTM-D-240. A minimum of 10 mL of NAPL per sample will be placed in labeled 40 mL jars and shipped via an express carrier under “excepted quantity” shipping provisions. The analytical results will be presented to TerraTherm to confirm design parameters and material variability. In the event that the results indicate that the materials may have a significantly different BTU content than suggested by the prior analysis (i.e., either greater or lesser), the need for design or operational modifications will be evaluated and presented to the USEPA and CT DEEP.

3.3 Water

Various water sources will be generated in the course of the wellfield installation activities. These include:

- Groundwater extracted as part of the NAPL assessment and removal procedures
- Water generated from equipment cleaning operations
- Accumulated water removed from the onsite soil cutting consolidation area

Water from these sources will be collected and containerized for treatment using the onsite treatment system. Weston will be responsible for pumping the containerized water from a designated location into the treatment system.

3.4 Investigation Derived Wastes

Other IDW will also be generated in the course of the wellfield installation. Such materials include, but are not necessarily limited to, spent personal protective equipment, used tubing from NAPL assessment and removal activities, used tarps, used bailers, and extra well installation materials. ***de maximis*** will provide a dumpster or other suitable container for accumulation of these materials. The waste will then be characterized and subject to offsite disposal in accordance with applicable regulations. ***de maximis*** will coordinate with EQ for profiling and disposal of these materials.

4. Air Monitoring

Activities to be performed at the thermal wellfield installation process have the potential to generate localized impacts to air quality. These actions include, but may not be limited to, drilling and well installation, NAPL removal, and material handling/transfer/storage. The types of air quality impacts potentially associated with these activities include release of VOCs or dust associated with handling soil cuttings or NAPL.

Two types of air monitoring will be conducted in conjunction with the work: work zone air monitoring and perimeter air monitoring. Each is further discussed below, along with control measures that will be implemented if action levels are exceeded.

4.1 Work Zone Air Monitoring

Work zone air monitoring will be performed in the breathing zone of personnel involved in the fieldwork. This monitoring is applicable during active work shifts. The intent of this monitoring is to ensure that workers are not exposed to unsafe levels of site-related COCs in the performance of the work. The monitoring results will also be used to select appropriate PPE and trigger any mitigation measures as needed (Section 4.3).

Work zone monitoring will be performed in accordance with procedures and action levels established in the site-specific HASP (Attachment D to the RD POP), or any more stringent contractor-specific HASP that me be developed for the work. For convenience, a copy of the work zone air monitoring action levels established in the site-specific HASP is provided in the attached Table 2. The monitoring devices to be used are an MIE PDR 1000 particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (PID with a 10.6 eV lamp or equivalent).[2]

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[2] Note that alternate equipment, monitoring requirements, or action levels may be employed if warranted by more stringent contractor-specific plans, provided those plans are deemed more conservative than the overall site HASP.

Although procedures for work zone air monitoring are generally described in the HASP, the purpose of this section is to provide additional guidance on the how the monitoring will be conducted given the multiple roles and activities being performed by the wellfield installation team. It is not anticipated that every member of the field team will be subject to routine monitoring. Rather, the monitoring should target personnel with potential “worst case” exposures to ensure the safety of all personnel. In general, it is anticipated that monitoring will be performed by personnel engaged in the drilling activities since those personnel will be in close proximity to the primary generation processes for dust or VOCs (e.g., drilling and placement of cuttings in a consolidation area). In the event that multiple drilling crews are working simultaneously, it may be appropriate to monitor multiple individuals (i.e., one from each crew), or to rotate the monitoring among the crews since it will initially be unknown which crew may be working in the most impacted areas.

Work zone monitoring should also be performed in a manner that allows for readings to be taken while employees are engaged in different activities. This is particularly true at the start of the work, as it may help identify certain activities that have an increased potential for exposure so that appropriate measures can be taken to mitigate those exposures. For example, if diverse initial monitoring suggests that the potential for exposure during drilling is low, but the potential for exposure during NAPL handling or soil consolidation is greater, it may be appropriate to implement exposure control measures for higher-exposure activity(ies). Depending on the nature of those activities, such measures may include PPE upgrades, shift rotation, or other control measures discussed in Section 4.3.

Work zone monitoring data will be recorded on the Air Monitoring Form (Attachment D, or equal) and made available to the various personnel and firms engaged in the work. It will also be discussed at periodic safety meetings to ensure that the team is aware of the monitoring results, that the data continue to be representative of “worst case” conditions, and to allow personnel to select PPE appropriate for their respective work tasks.

4.2 Perimeter Air Monitoring

A perimeter air monitoring program was developed and implemented as part of the pre-ISTR site preparation activities (see Section 4 of the RAWP [ARCADIS

2010b]). The program to be implemented during the wellfield installation is based on the prior program, but modified as follows:

- Revised to include the use of data logging equipment capable of reading instantaneous and time-weighted average (TWA) values rather than only collecting instantaneous readings
- Expanded action levels to reflect TWA and instantaneous readings
- Use four perimeter monitoring stations rather than three
- An onsite meteorological monitoring station will be used rather than obtaining local data from a National Weather Service monitoring station

Program modifications reflecting these program enhancements are reflected in the description of the perimeter air monitoring program in the following subsections.

4.2.1 Equipment Selection

Air monitoring equipment and technical assistance will be provided under contract by Emilcott. The air monitoring system discussed in this section is known as Emilcott's Greenlight Environmental Monitoring System. The air monitoring system will consist of four perimeter stations (approximate locations depicted in Figure 2) each having a MiniRAE-3000, DUSTTRAK II, a headless central processing unit (CPU) data-logger, and a GEMS-3000 Communicator. These instruments will be located in durable cases secured to a stand. The perimeter station locations are several hundred feet from the nearest fixed location of an off-site receptor, and thus serve as highly conservative monitoring locations relative to potential nearby receptors. Note also that the locations may be adjusted as needed depending on wind direction or the nature of site activities.

Total organic vapor monitoring will be performed with a MiniRAE-3000 photoionization detector equipped with a 10.6 eV lamp and calibrated to 100 parts per million (ppm) isobutylene. The MiniRAE is capable of providing instantaneous readings every second at a range of 0 to 15,000 ppm. Each reading will then be incorporated to calculate rolling TWA readings. When used with the 10.6 eV lamp, the MiniRAE-3000 measures volatile concentrations, including those associated with ionizing chlorinated compounds. The MiniRAE-3000 will be powered with a removable, rechargeable battery.

A DUSTTRAK II will be used for airborne particulate monitoring. The DUSTTRAK II is particulate monitor that measures aerosol concentrations corresponding to PM1, PM2.5, PM10 or respirable size fractions. The DUSTTRAK II is capable of providing instantaneous every second at a range of 0.001 to 400 mg/m^3. Each reading will then be incorporated to calculate rolling TWA readings. The DUSTTRAK II will be powered by a removable, rechargeable battery.

Each MiniRAE and DUSTTRAK will be connected to a CPU data-logger that polls the instruments for current data. The data-logger will acquire the readings from the instruments, package the data and transfer it, through a GEMS-3000 Communications Controller, to a remote web-based server at Emilcott's datacenter. Due to the common fluctuations with PIDs, the data-logger will poll the PIDs every second (1 reading per second), calculate a 15-second TWA for each and transfer the data to the server. For the DUSTRAK II, the CPU will poll the instruments every 15 seconds, obtain instantaneous readings and transfer the data to the server. Once the data are transferred from all the instruments, it can be viewed in the database server remotely (on-site) through computers and other web-enabled device. The database will be capable of calculating time-weighted averages as well as implementing action levels. The database will be accessible to and monitored by designated ***de maximis*** and ARCADIS personnel.

In addition to air monitoring stations, an on-site weather station (WXT520 or equivalent), capable of providing temperature, humidity, barometric pressure, wind direction and wind speed will be installed to provide real time accurate on-site weather readings. Weather information will be transferred electronically, in the same fashion as the monitoring data, to the same database. With this information upwind/downwind locations will be instantly determined by Emilcott's data system. Weather data is transferred electronically allowing for a historical review of weather corresponding to monitoring data.

Another feature of the Emilcott Greenlight system is the ability to send alerts and alarms if established thresholds are exceeded at one (or more) of the perimeter stations. Alerts and alarms can be sent in the form of emails or text messages to involved and responsible personnel. Using the on-site weather data, upwind/downwind stations can be incorporated to determine if exceedances were produced from Site-related sources. At a minimum, alerts will be made to ***de maximis*** and ARCADIS personnel coordinating site activities. Alert notifications can also be made to other site personnel as warranted.

4.2.2 Action Levels

4.2.2.1 Volatile Organic Compounds

Perimeter action levels were developed to represent “instantaneous” (measured as a 15-second average reading), 30-minute TWA values and an 8-hour TWA values. The associated action levels were developed considering the maximum concentrations in soil for all locations in the site database that fall within the thermal treatment zone (i.e., the soils that may be encountered during the drilling activities). The associated analytical data (provided in Attachment E) were used to calculate a perimeter action level using the State of Connecticut Hazard Limiting Values (HLVs) located in Section 22a-174-29 “Hazardous Air Pollutants” regulation. The action levels were calculated using the 30-minute and 8-hour HLVs for constituents found in the site soil and are further described in Attachment E. In addition, a 15-second “instantaneous” warning level was established as a real-time indication of elevated concentrations so that corrective actions could be taken as appropriate prior to triggering a 30-minute action level. Other warning levels were also established as a trigger for investigation and implementing corrective measures, as needed, prior to exceeding action levels.

For VOCs, warning and action levels are based on concentrations relative to the background (i.e., upwind) concentration. The Emilcott system, in combination with the site weather station monitoring data, is capable of calculating the action levels relative to the measured background (upwind) location. Action levels in exceedance at ***any*** of the downwind stations will be subject to actions specified in the tables below.

The established VOC-based warning and action levels are summarized as follows:

Time Period	Warning Level		Action level	
	Value	Basis	Value	Basis
15-sec average	10 ppm	Conservative value to be protective of 30-minute TWA	25 ppm	Health and Safety Plan
30-min TWA	1 ppm	50% of action level	2 ppm	Attachment E
8-hr TWA	0.3 ppm	75% of action level	0.4 ppm	Attachment E

Actions to be taken based on the perimeter VOC monitoring data are summarized in the following table:

Time Period	Downwind Concentration	Action
Instantaneous (15-second average)	0 ppm to < 10 ppm above background at ***any*** downwind station	Normal Operations; continue hourly perimeter readings
	> 10 ppm above background at ***any*** downwind station	Continue working, assess/address sources
	> 25 ppm above background at ***any*** downwind station	Immediately stop work; implement corrective measures
30-minute rolling average	0 ppm to < 1 ppm above background at ***any*** downwind station	Normal Operations; continue hourly perimeter readings
	1 ppm to < 2 ppm above background at ***any*** downwind station	Continue working, assess/address sources
	> 2 ppm above background at ***any*** downwind station	Immediately stop work; implement corrective measures
8-hour rolling average	0 ppm to < 0.3 ppm above background at ***any*** downwind station	Normal Operations; continue hourly perimeter readings
	0.3 ppm to < 0.4 ppm above background at ***any*** downwind station	Continue working, assess/address sources
	> 0.4 ppm above background at ***any*** downwind station	Immediately stop work; implement corrective measures

4.2.2.2 Airborne Particulate Monitoring

Perimeter action levels for particulates were developed considering the maximum soil concentration data for existing metals (which are the constituents most likely associated with respirable dust) in soil that may be disturbed during ISTR activities. Analytical data were considered for all locations in the site database that fall within the thermal treatment zone (i.e., the soils that may be encountered during the drilling activities). The action levels consider both the 30-minute and 8-hour HLVs located in Section 22a-174-29 “Hazardous Air Pollutants” regulation, as well as other applicable standards (i.e., for total particulates). In overview, the maximum detected metals concentrations in the representative soils were considered in conjunction with their corresponding HLVs to calculate airborne dust concentrations that correlate to ambient air levels below the HLVs. In doing so, it was also determined that the USEPA 24-hour average ambient air quality standard for ***total*** particulates (0.15 mg/m^3) is the most stringent basis for a particulate action level on both an 8-hr TWA and 30-minute TWA basis.

Based on the calculation of particulate action levels in Attachment E, particulate-based warning and action levels are summarized as follows:

Time Period	Warning Level*		Action Level*	
	Value	Basis	Value	Basis
30-min TWA	3.5 mg/m^3	50% of action level	7 mg/m^3	Attachment E
8-hr TWA	0.34 mg/m^3	75% of action level	0.45 mg/m^3	Attachment E

* Particulate based warning and action levels are based on total particulates, and are not relative to background (upwind) values.

Actions to be taken based on the perimeter particulate monitoring data are summarized in the following table:

Particulates Time Period	Concentration	Action
30-minute rolling average	0 mg/m^3 to < 3.5 mg/m^3 at ***any*** location	Normal Operations; continue hourly perimeter readings
	3.5 mg/m^3 to < 7 mg/m^3 at ***any*** location	Continue working, assess/address sources
	> 7 mg/m^3 at ***any*** location	Immediately stop work; implement corrective measures
8-hour rolling average	0 mg/m^3 to < 0.30 mg/m^3 at ***any*** location	Normal Operations; continue hourly perimeter readings
	0.30 mg/m^3 to < 0.45 mg/m^3 at ***any*** location	Continue working, assess/address sources
	> 0.45 mg/m^3 at ***any*** location	Immediately stop work; implement corrective measures

4.2.3 Data Collection and Reporting

Air monitoring data will be automatically transferred from PID and PM10 monitors into an electronic database that can be accessed on demand. The database can be accessed at any time to view real time data. In the event of an exceedance of an action level (for either airborne particulate or VOCs), the field personnel will notify the Project Manager (or designee) at the time the exceedance is observed (i.e., real time). The field personnel will follow up with the Project Manager (or designee) within 24 hours of the observed exceedance summarizing the data, the cause of the exceedance, and any corrective measures implemented as a result of the exceedance.

Sometimes, an exceedance is caused by non-site-related sources, such as high humidity affecting the instruments, exhaust emissions from operating equipment, or other factors unrelated to the site media. Taking in wind direction, if such a source is suspected to be the cause of the exceedance, and other potential sources are adequately investigated and ruled out, this will be recorded in the field documentation.

4.2.4 Monitoring Schedule

Real-time VOC and airborne particulate monitoring and will commence concurrent with the thermal wellfield drilling activities, and be performed for the duration of each work day.

4.3 Air/Dust Emissions and Control Measures

Air emissions control and fugitive dust suppression measures will be implemented as needed based on the results of the air monitoring programs. Control measures will be used to limit the potential for organic vapor and dust emissions at levels that exceed work zone or perimeter-based action levels. The following vapor and dust control measures may be used during these activities, depending upon specific circumstances, visual observations and air monitoring results:

- Water spray to reduce dust levels
- Water/BioSolve® spray to reduce dust and odors
- Polyethylene sheeting (e.g., for covering soil cuttings or other exposed soils)
- Vapor suppression foam (Rusmar, or equivalent)
- Use clean soil to cover consolidated soil cuttings

de maximis will provide BioSolve® (or approved equivalent) and vapor-suppressant foam (including application equipment) at the site prior to initiating drilling activities and will maintain an adequate supply of such materials for the duration of intrusive activities in the event they are needed over the course of the work.

4.4 Instrument Calibration

Calibration of the air monitoring instrumentation will be conducted at the beginning of each workday (at a minimum) in accordance with each of the equipment manufacturer's calibration and quality assurance requirements. Calibrations will be recorded in the field logbook.

Records for calibrated equipment must include the following minimum information:

- Type and identification number of equipment
- Calibration frequency and acceptance tolerances
- Calibration dates
- The individual and organization performing the calibration
- Reference equipment and/or standards used for calibration; standards for calibration will be consistent with those recommended by the manufacturer (e.g., 100 ppm isobutylene standard for a PID)
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external organizations
- Documentation of calibration acceptance or failure and of repair of failed equipment

Additional information related to instrument calibration is provided in the RD POP – Attachment B (Field Sampling Plan [FSP]) and Attachment C (Quality Assurance Project Plan [QAPP]).

5. References

ARCADIS. 2010a. Remedial Design Project Operations Plan (RD POP), Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site, Southington, Connecticut. [Attachment B: Field Sampling Plan (FSP), Attachment C: Quality Assurance Project Plan (QAPP), and Attachment D: Health and Safety Plan (HASP)], November 2010.

ARCADIS. 2010b. Remedial Action Work Plan (RAWP) for Pre-ISTR Preparation. SRSNE Superfund Site, Southington, Connecticut. April 2010.

BBL. 1998. Remedial Investigation Report, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut. June 1998.

BBL. 2003. NAPL Delineation Pilot Study, SRSNE Site – Southington, Connecticut. December 2003.

CTDEP. 2006. Hazardous Air Pollutants. Section 22a-174-29 with an effective date of April 4, 2006.

TerraTherm. 2011. ISTR Remedial Action Work Plan/Project Operations Plan. Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut. June 2011.

USEPA. 1990. RCRA Subtitle C, Area of Containment (AOC) Policy (55 FR 8759). March 1990.

USEPA. 2011. Approval Letter: ISTR Remedial Action Work Plan/Project Operations Plan July 2011. September 23, 2011.

Tables

Table 1 – Roles and Responsibilities

Thermal Wellfield Implementation Support Plan
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

Work Task	TerraTherm	*de maximis*	IQAT	ARCADIS
Project Coordination/Management	S	P	S	
Survey Well Layout	P	S	S	
Utility Locate	S	P	S	
Mark Well and Boring Locations	P			
Office Trailer/Office Power/Phone/DSL	P	S		
Toilets	P			
Dumpster (construction debris)	P	S		
Dumpster/roll off (contaminated debris)	S	P		
Soil roll off containers/drums (for NAPL-containing drill cuttings)	S	P		
Stage materials	P	S		
Emergency Procedures	S	P	S	S
Health and Safety	P	S	S	S
Secure Drilling Contractor	P			
Construct Decontamination Pad	P			
Drilling Oversight & Verify Drilling Locations	P	S	S	S
Evaluate Drill Cuttings for Disposal as high or low COC levels	S	P		S
Logging and Screening of Core material from Bedrock Interface	P			S
Confirm Bedrock Depth	S	S	S	P
Evaluate if NAPL Present	S	S	S	P
Extract NAPL (pump, bailers, containers, etc.)	S	S		P
Ensure proper quality assurance	S	S	P	S
Characterize Soil (“hot” vs. not) for Disposal	S	S	S	P
Transport cutting to storage area/containers	P			
Transport IDW to Roll off Containers	P			
Grouting of Borings (supervision of drillers)	P			
Disposal of Soil and PPE		P		
Personal Work Space Air Monitoring	P	S		
Perimeter Air Monitoring		S		P
Waste Characterization Sampling				P

Note: P = Primary Responsibility, S = Secondary/Support Responsibility

Table 2 – Work Zone Air Monitoring Summary Table

Thermal Wellfield Implementation Support Plan
Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site
Southington, Connecticut

Parameter	Reading in Work Area/ Worker Breathing Zone	Action
Total Organic Vapors (TOV)[1]	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring.
	>0.5 ppm to ≤ 25 ppm	Continue breathing zone monitoring and implement benzene and vinyl chloride-specific monitoring with the appropriate colorimetric tubes.
	> 25 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Benzene (as determined with colorimetric tube)	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring with PID.
	>0.5 ppm to ≤ 5 ppm	Upgrade to Level C; Increase PID monitoring frequency to every 15 minutes.
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Vinyl Chloride (measured with colorimetric tubes)	0 ppm to ≤ 0.5 ppm	Normal operations; Continue hourly breathing zone monitoring with PID.
	> 0.5 ppm to ≤ 5 ppm	Upgrade to Level C; Increase PID monitoring frequency to every 15 minutes.
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Airborne Particulates	0 ppm to ≤ 0.5 mg/m^3	Normal operations.
	> 0.5 to ≤ 1 mg/m^3	Begin soil wetting procedure (Level C protection would be needed beyond this point).
	> 1 mg/m^3	Stop work, fully implement dust control plan.
Flammable Vapors (LEL)	≤ 5% LEL	Normal operations.
	> 5% to ≤ 10% LEL	Continuous monitor, review engineering controls, proceed with caution
	> 10% LEL	Stop work; evacuate work area, ventilate work area; investigate source of vapors.
Carbon Monoxide	0 ppm to ≤10 ppm	Normal operations; continue monitoring.
	> 10 ppm to ≤20 ppm	Continuous monitor, review engineering controls, proceed with caution
	> 20 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.
Oxygen	19.5% to 23.5%	Normal operations.
	< 19.5% or >23.5%	Stop work; evacuate work area, ventilate work area; investigate source of readings.
Hydrogen Sulfide	0 ppm to ≤ 2.5 ppm	Normal operations; continue monitoring.
	> 2.5 ppm to ≤5 ppm	Continuous monitor, review engineering controls, proceed with caution
	> 5 ppm	Stop work; evacuate work area, ventilate work area; investigate cause of reading, reduce through engineering controls.

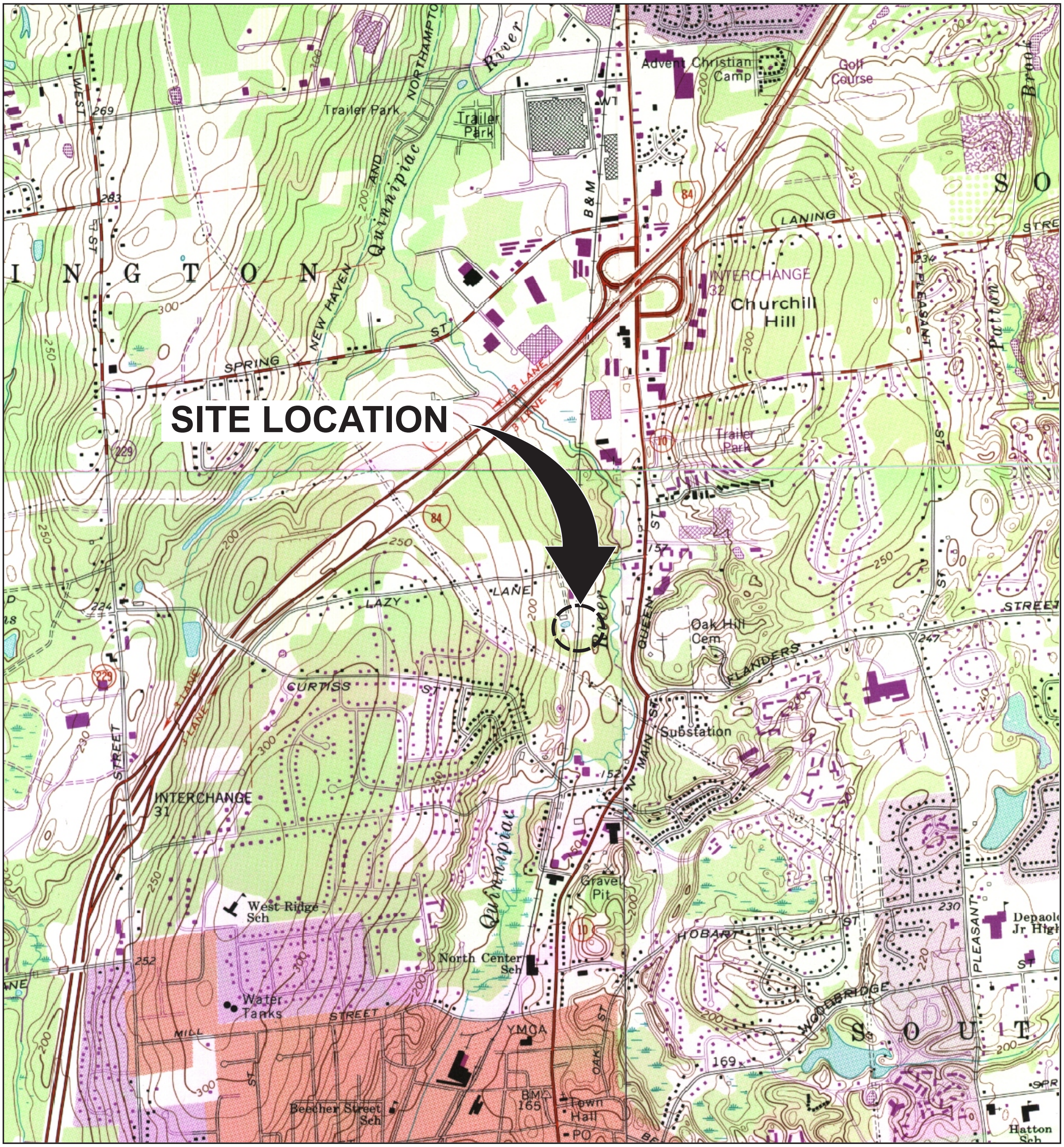
Notes:

1. PID readings are sustained for a period of two minutes at breathing zone height, measured with a calibrated PID with a 10.6 eV lamp.

Source:

1. HASP (RDPOP Attachment D)

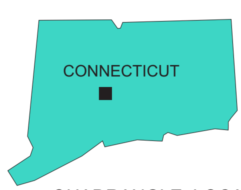
Figures



REFERENCE: SOUTHINGTON, CONN. USGS QUAD. 1968 PR 1992, MERIDEN, CONN. USGS QUAD. 1966 PR 1984, NEW BRITAIN, CONN. USGS QUAD. 1966 PR 1984, & BRISTOL, CONN. USGS QUAD 1967 PR 1984.

2000' 0 2000'

APPROX. SCALE: 1" = 2000'



QUADRANGLE LOCATION

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

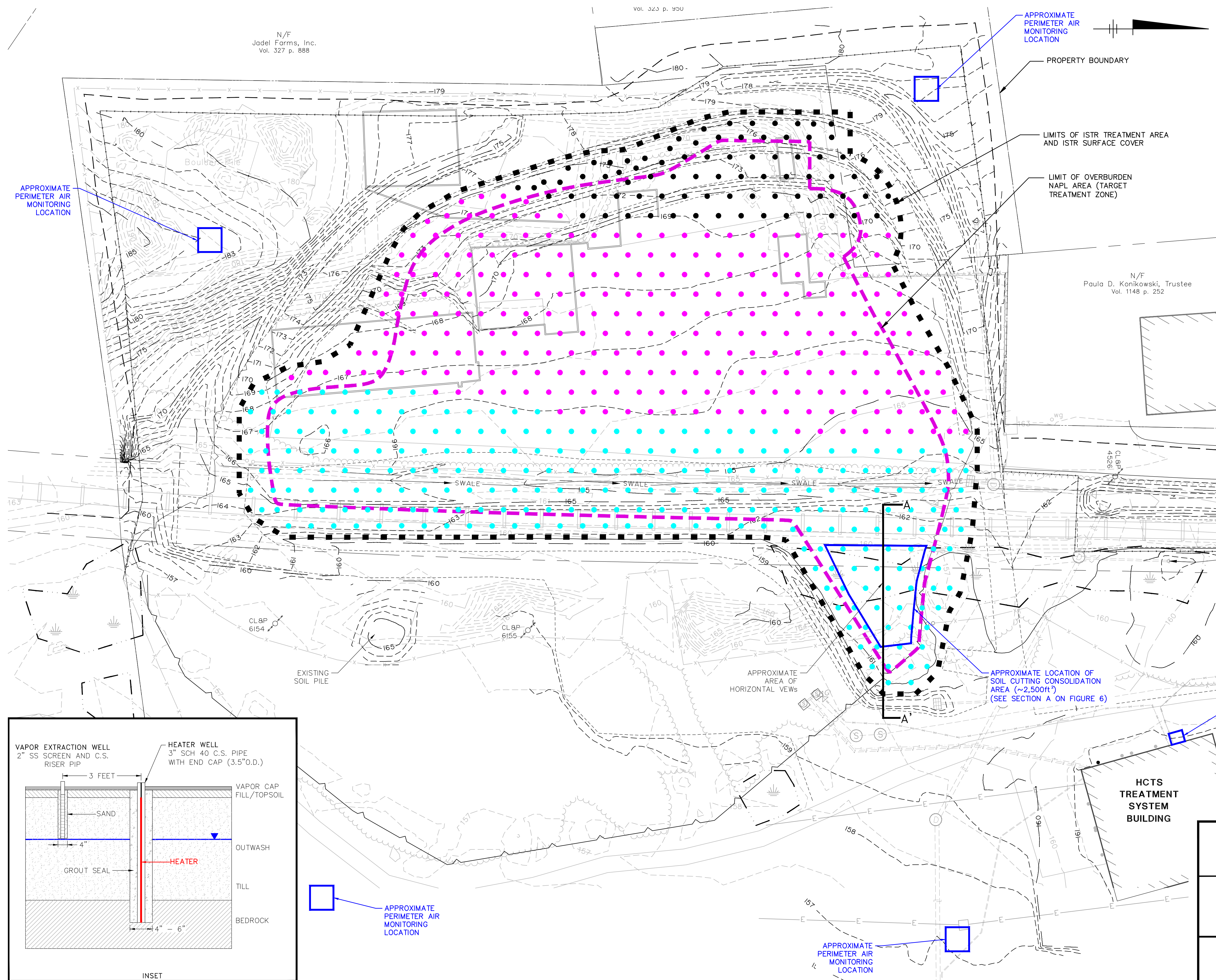
SITE LOCATION MAP

ARCADIS

FIGURE
1

04/19/2013 SYRACUSE, NY-ENV/CAD DJHOWES
B0054634\0000\03500\CDR\54634N01.CDR

CITY: SYRACUSE, NY DIV/GROUP: ENV CAD DB: B DECLERCQ LD: B DECLERCQ PIC: PM: K.FABIAN TM: J.MORGAN LYR:ON=*;OFF=*REF* ITEXT
G:\ENVCAD\Manchester\ACT\B0054634\0000\03500\Site Plan\54634B03.DWG LAYOUT: 2 SAVED: 4/9/2013 9:40 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/9/2013 4:13 PM BY: SMALL, BRIAN



LEGEND:

- PROPERTY LINE
- CONTOUR INDEX
- CONTOUR INTERMEDIATE
- ELECTRIC LINE
- GAS LINE
- TELEPHONE LINE
- WATER LINE
- CHAINLINK FENCE
- SANITARY SEWER
- SHEET PILE CONTAINMENT WALL
- SECTION LINE (FIGURE 6)
- PVC — POLYVINYL CHLORIDE PIPE
- RCP — REINFORCED CONCRETE PIPE
- wg — WATER GATE
- GAS VALVE
- CATCH BASIN
- MANHOLE SANITARY
- HYDRANT
- UTILITY POLE
- GUY
- MANHOLE DRAINAGE
- HEATER WELL LOCATION 16 FOOT DRILL DEPTH
- HEATER WELL LOCATION 19 FOOT DRILL DEPTH
- HEATER WELL LOCATION 25 FOOT DRILL DEPTH

NOTES:

1. BOLD TOPOGRAPHIC CONTOURS REPRESENT AS-BUILT PRE-ISTR PREPARED SITE CONDITIONS. GRAY CONTOURS REPRESENT PRE-EXISTING CONTOURS.
2. COLORED DOTS REPRESENT PLANNED HEATER WELL LOCATIONS. WITH THE EXCEPTION OF AREA NOTED FOR HORIZONTAL VAPOR EXTRACTION WELLS, EACH HEATER WELL WILL BE ACCOMPANIED BY A CORRESPONDING VAPOR EXTRACTION WELL (SEE INSET).

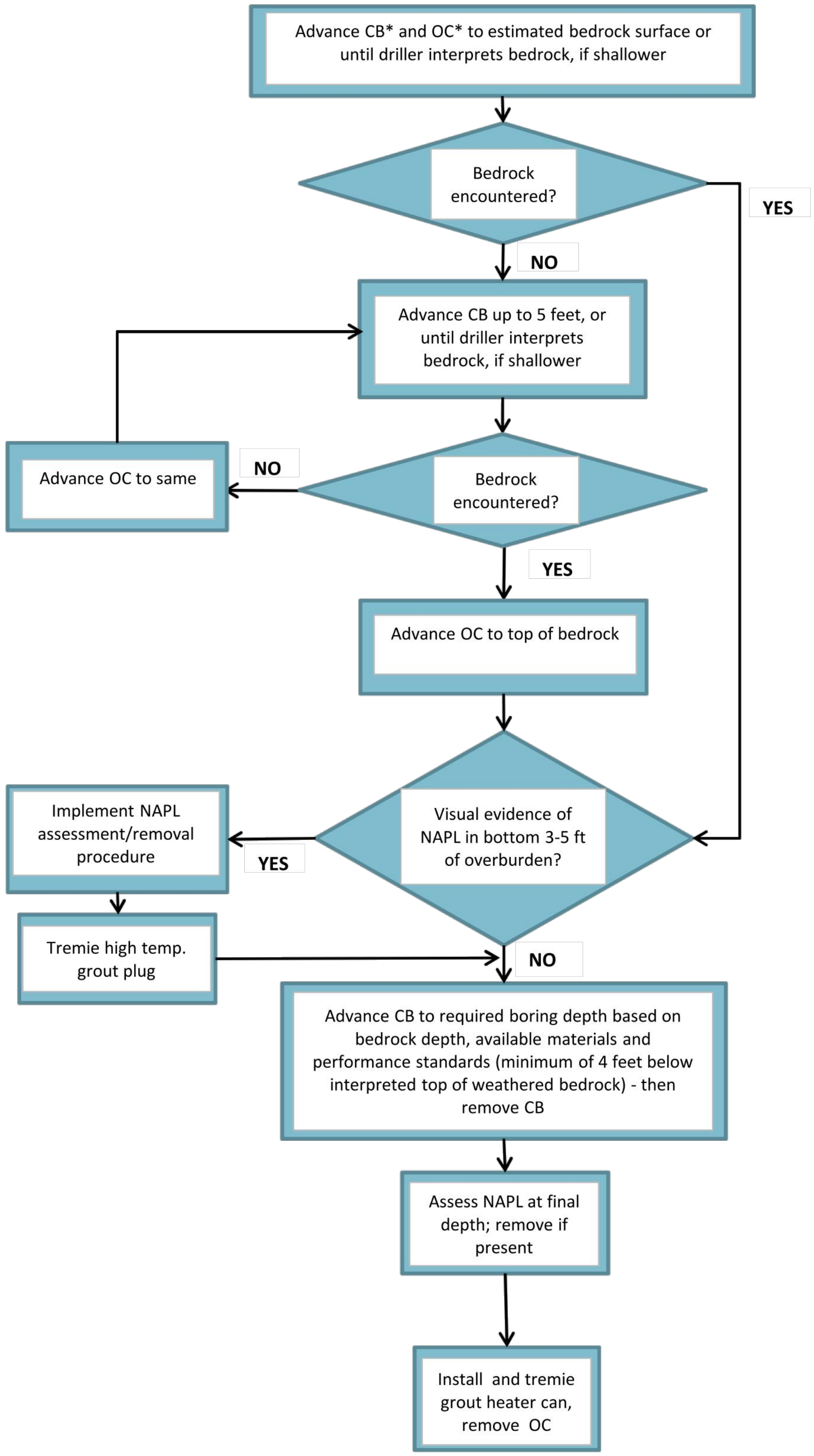
0 30' 60'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

SITE LAYOUT PLAN

ARCADIS

FIGURE
2



NOTES:

1. *CB = 4-INCH CORE BARREL; OC = 6-INCH OUTER CASING.

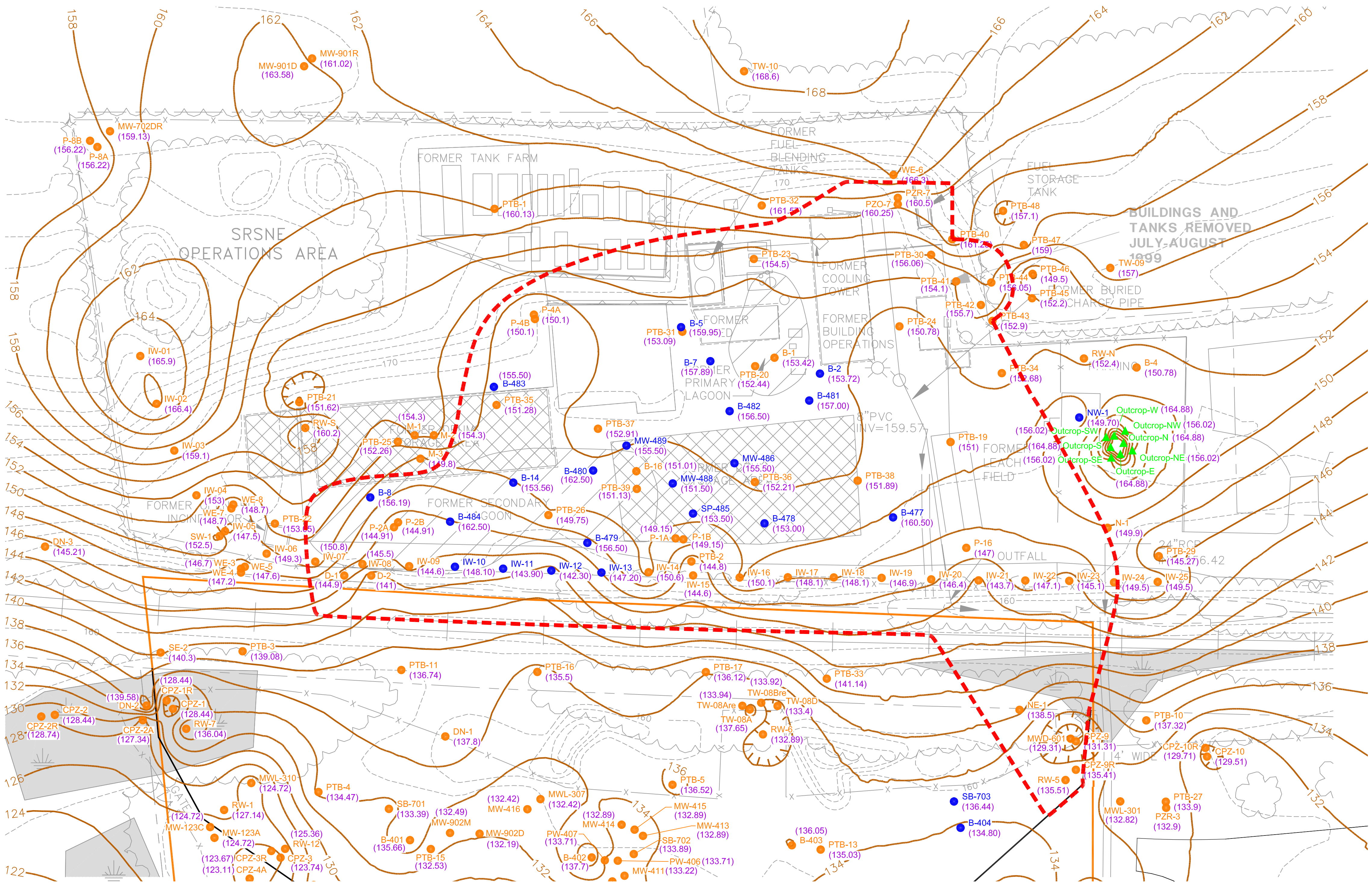
2. THIS FLOW CHART ASSUMES PLANNED WELL DEPTHS ARE ALL ADJUSTED TO BE GREATER THAN ESTIMATED BEDROCK DEPTHS PRIOR TO START OF INSTALLATION.

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

DRILLING ASSESSMENT FLOWCHART

ARCADIS

FIGURE
3



LEGEND:

- PROPERTY LINE
- EXISTING CONCRETE PAD
- WETLAND
- NTCRA 1 CONTAINMENT AREA
- FENCE
- VEGETATION
- PRE-EXISTING GROUND SURFACE CONTOUR (NOTE 6)
- 147-12 LOT NUMBER
- ABOVE-GROUND TANK
- 160 APPROXIMATE TOP OF BEDROCK ELEVATION CONTOURS – HATCHED AREAS INDICATE DEPRESSIONS IN THE SURFACE
- P-16 (147.00) BORING LOCATION, ELEVATION GIVEN IS THE ELEVATION WHERE BEDROCK WAS ENCOUNTERED
- B-477 (160.50) BORING LOCATION WHERE BEDROCK NOT ENCOUNTERED. ELEVATION GIVEN IS THE BOTTOM ELEVATION OF THE BORING. CONTOURS AT THESE LOCATIONS WERE ADJUSTED WHERE APPROPRIATE.
- Outcrop-SW (156.02) SURVEYED LOCATIONS OF BEDROCK ENCOUNTERED IN CONSTRUCTION-RELATED EXCAVATION
- EXTENT OF OBSERVED NAPL IN THE OVERBURDEN GROUNDWATER UNIT

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. APPROXIMATE TOP OF BEDROCK ELEVATION CONTOURS INTERPRETED FROM SOIL BORING DATA.
3. BEDROCK AND GROUND SURFACE ELEVATION CONTOUR INTERVAL IS 2 FEET.
4. ELEVATIONS ARE BASED ON NGVD 29.
5. TOP OF ROCK NOT ENCOUNTERED AT BORINGS IW-11, IW-12, NW-1, AND B-404. BASED ON REVIEW OF NEARBY BORINGS AND INITIAL INTERPOLATED BEDROCK CONTOURS, THESE VALUES WERE ASSIGNED A BEDROCK ELEVATION AT -1 FOOT BELOW THE BOTTOM OF THE BORING FOR USE IN CONTOURING. POSTED DATA ARE BOTTOM OF BORING ELEVATIONS.
6. TOPOGRAPHIC GROUND CONTOURS ON THIS FIGURE DO NOT REPRESENT SURFACE GRADE CHANGES MADE AS PART OF PRE-ISTR SITE PREPARATION ACTIVITIES.

0 30' 60'
GRAPHIC SCALE

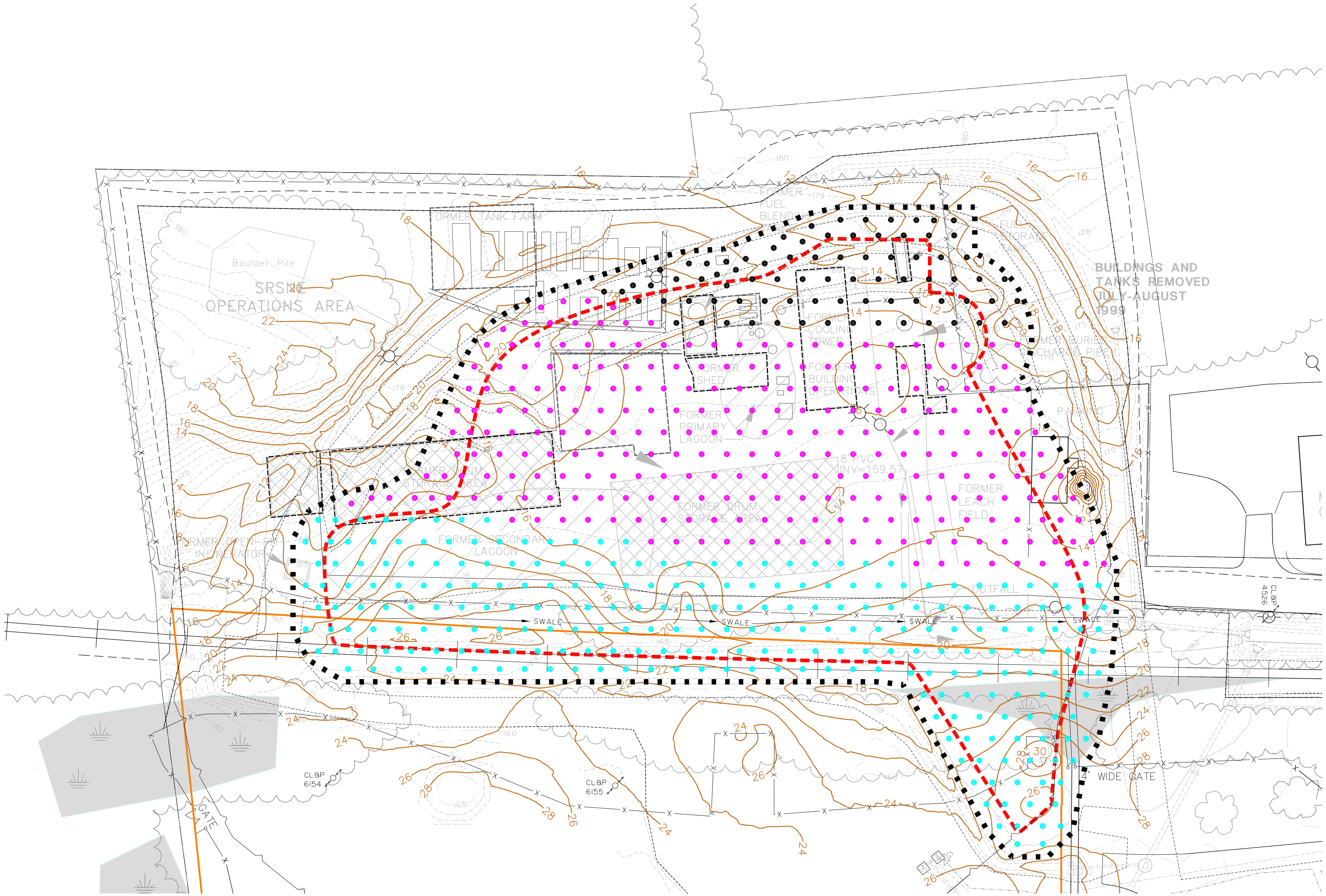
SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

TOP OF BEDROCK ELEVATIONS

ARCADIS

FIGURE
4

CITY:SYRACUSE GROUP:ENV DB:KMD PGL GMS PM:J. HOLDEN LYR:ON=*;OFF=REF
G:\ENVCAD\Manchester\ACT\B0054634\0000\03500\54634B03.DWG LAYOUT: 4 SAVED: 3/13/2013 4:11 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: C-LD2B-PDF-GMS PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/19/2013 2:22 PM BY: SMALL, BRIAN
XREFS: 5463AX01 IMAGES: PROJECTNAME: ---



LEGEND:

- PROPERTY LINE
- EXISTING CONCRETE PAD
- WETLAND
- VEGETATION
- 162 CONTOUR INDEX
- 160 CONTOUR INTERMEDIATE
- CHAINLINK FENCE
- SHEET PILE CONTAINMENT WALL
- 147–12 LOT NUMBER
- HISTORICAL ABOVE–GROUND TANK
- 22 OVERBURDEN THICKNESS CONTOUR LINE (NOTES 2 AND 3)
- EXTENT OF NAPL IN THE OVERBURDEN (SOIL THERMAL TREATMENT AREA)
- LIMITS OF ISTR TREATMENT AREA AND SURFACE COVER

SYMBOL	DRILL DEPTH	HEAT INTERVAL	BOOST INTERVAL	TARGET TREATMENT DEPTH
●	16	0–15	10–15	12
●	19	0–18	12–18	15
●	25	0–24	18–24	21

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G–7, G–8, G–9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. OVERBURDEN THICKNESS ELEVATION CONTOUR INTERVAL IS 2 FEET.
3. THIS FIGURE OVERLAYS CURRENT (NOVEMBER 2012) GROUND CONTOURS AND HISTORICAL BASE MAP FEATURES FROM DIVERSIFIED TECHNOLOGIES FOR BASE MAP.
4. ABSCOPE'S JANUARY 2013 AS–BUILT OVERBURDEN THICKNESS CONTOURS WERE DEVELOPED BY SUBTRACTING THE INTERPOLATED BEDROCK ELEVATION SURFACE FROM THE EXISTING GROUND SURFACE CONTOURS.

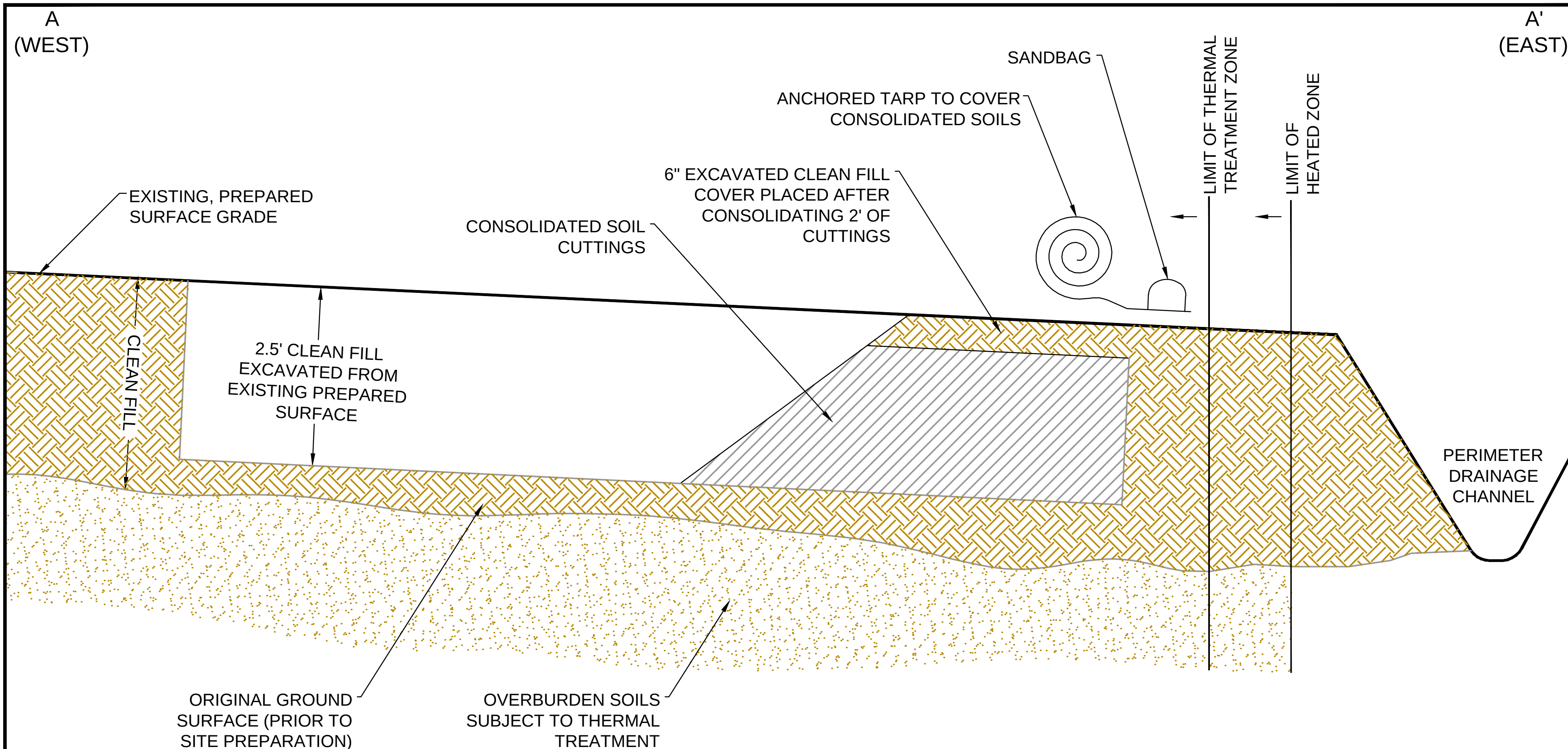
0 30' 60'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

OVERBURDEN THICKNESS CONTOUR MAP

ARCADIS

FIGURE
5



SUMMARY OF APPROACH

1. EXCAVATE CLEAN FILL WITHIN DESIGNATED AREA TO DEPTH OF ~2.5'. PLACE EXCAVATED SOILS IN DESIGNATED AREA FOR REUSE. PLACE CONSTRUCTION FENCE AROUND PERIMETER TO DEMARCATE AREA.

2. PLACE AND ANCHOR A TARP/COVER THAT CAN BE ROLLED OUT ONTO CONSOLIDATED SOILS AS NEEDED.

3. PLACE SOIL CUTTINGS AS GENERATED TO A THICKNESS OF 2'. BEGIN AT THE EAST END OF CONSOLIDATION AREA AND PROCEED WEST.

4. PLACE 6" CLEAN FILL ATOP CONSOLIDATED SOILS AS FILL PROGRESSES.

5. WHEN NEARLY ALL WELLS ARE INSTALLED, FILL ANY REMAINING VOIDS IN CONSOLIDATION AREA. COVER WITH EXCAVATED CLEAN MATERIAL, AND COMPACT.

6. INSTALL WELLS IN CONSOLIDATION AREA: ADDITIONAL CUTTINGS DISPOSED OFF SITE OR ANOTHER ONSITE LOCATION AS CONDITIONS ALLOW.

NOT TO SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
THERMAL WELLFIELD IMPLEMENTATION SUPPORT PLAN

SOIL CUTTING CONSOLIDATION AREA CONCEPTUAL DETAIL

ARCADIS

FIGURE
6

Attachments

Attachment A

Well Installations with Possible NAPL Standard Operating Procedure

[TerraTherm to Provide]

	WELL INSTALLATIONS, WITH POSSIBLE NAPL, AT THE SRSNE SUPERFUND SITE	Issued Date:	April 2013
		Revision:	5.2
		Approved:	
			John M. Bierschenk, President

PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to ensure that TerraTherm, Inc. (TerraTherm) follows a consistent program to install groundwater monitoring wells (MW), heater cans (HO), vapor extraction wells (VEW), temperature monitoring points (TMP) and pressure monitoring points (PMP) within the thermal wellfield at the SRSNE Superfund Site. This SOP specifically discusses procedures for installation of wells at the SRSNE Superfund Site where NAPL may be encountered during well installations. It is important to follow these established drilling methods including any health and safety protocols described in the site-specific Health and Safety Plan to the maximum extent feasible. It may be necessary to modify the methods described herein as field conditions become known.

The well installation procedures and designs described herein have been carefully developed to minimize the potential for NAPL to vertically migrate into bedrock during installation and construction of the heater cans and monitoring points associated with the in-situ thermal remediation system to the extent practicable.

DISCUSSION

The sonic drilling method will be used to install drill casing through the overburden soils and to core into bedrock, when encountered, for heater wells and temperature monitoring points. The specified bottom depths were selected based on available information of depth to bedrock across the site and the design objective of heating several feet into bedrock in order to ensure adequate heating of the bottom of the overburden soils throughout the NAPL treatment area.

Sonic drilling methods will also be used to install drill casing to the desired depths in the overburden soils to allow installation of the vapor extraction wells, groundwater monitoring wells, pressure monitoring points, and temperature monitoring points. Sonic drilling can be used to penetrate concrete (up to 8" thick) that may exist in the thermal well field beneath the ground surface.

- Sonic drilling provides significant protection against unintended NAPL migration during drilling and well installation due to the following:

- The sonic method results in a tight seal between the outside of the drill casing and the borehole wall. The sonic method has flexibility in advancing two concentric, smooth-walled casings. It is expected that the outer drill casing will be advanced only to the top-of-rock surface to isolate the overburden while the inner casing drills the required socket in the top of rock to facilitate heater-well installation into the upper portion of the bedrock.

- Once the outer drill casing is seated into the top of the bedrock, the inside of the drill casing may be checked for the presence of NAPL before the inner core barrel is advanced into bedrock. If NAPL is present, it will be removed by *de maximis*/ARCADIS prior to advancing the inner core barrel.

- High temperature grout may be added, if necessary, to the drill casing prior to advancing the casing into bedrock to help seal off the overburden from the bedrock.

- Following installation of the heater can and/or temperature monitoring point at the bottom of the borehole, the annular space between the heater can and the borehole wall will be tremie pumped with high-temperature grout as the outer drill casing is removed.

- Following installation of the groundwater monitoring well, vapor extraction well, and pressure monitoring point to the bottom of the borehole, the annular space between the well and the borehole wall will be filled with sand pack and high-temperature grout, as per the design specifications, while the outer casing is removed.

- The sonic method results in minimal production of cuttings. Cuttings can be efficiently and safely handled since they are removed from the subsurface in a core barrel and directly deposited into a secure location (i.e., drum and/or soil bin), thereby minimizing handling, potential odors, and the volatilization of contaminants. The cuttings that show significant visible NAPL (not just small, isolated, disconnected "residual" NAPL blobs, but significant NAPL "pools") will be placed into a separate secure location from the non-saturated cuttings.

During the drilling activities, the air in the breathing zone will be monitored as per TerraTherm's Air Monitoring SOP-001-01.

APPLICATION

This SOP, although maybe not in its entirety, applies to most TerraTherm projects and the personnel responsible for well installation. It specifically addresses the possibility of encountering NAPL during well installations that extend into bedrock.

WELL INSTALLATION PROCEDURES

A standard 4 x 6 sonic drilling system is used to advance the borehole and install the heater cans, temperature monitoring points, or monitoring wells. The 4 x 6 system consists of a 4" core barrel (4.5" OD, 3.75" ID) and a 6" outer casing (5.5" OD, 4.75 ID). The core barrel fits snugly within the outer casing with approximately ~1/8" of clearance between the outside of the core barrel and the inside wall of the casing. Both the core barrel and outer casing are equipped with cutting shoes.

GROUNDWATER MONITORING WELL INSTALLATION: The following summarizes the approach for installing the monitoring wells at the SRSNE Superfund Site. Each groundwater monitoring well installed within the thermal treatment area will be drilled to the depth of the top of weathered bedrock, as determined based on soil sampling and logging at an adjacent heater-can location located within 5 feet of the monitoring well borehole. Each monitoring well will have a 2-ft long grouted sump at the bottom. Additional installation details and construction materials can be found in the Site drawing package.

- The 6" outer casing will core out the first 5 ft. of the hole. The outer casing is then retracted and emptied into a container at the surface.
- Once the outer casing is placed back into the hole, the inner 4" core barrel will be advanced down to the estimated depth of the top of rock, or until the driller interprets that bedrock has been encountered, if shallower.

Once the inner core barrel is advanced to the top of weathered rock as identified in the adjacent heater-can location, the outer casing will be advanced to the matching depth of the inner core barrel, and the inner core will then be extracted.

- High temperature grout will be injected by the tremie method into the borehole to fill approximately the bottom 2 feet of the borehole.
- Before the grout sets, the well materials will be quickly installed to the bottom of the borehole, with the sump surrounded by grout. A grout basket (optional) may be included at the base of the well screen, to help restrict grout from entering the screen prior to the grout curing.
- Once the monitoring well installation is at the designed depth, the filter pack is added and the drill casing is extracted with sonic vibration to help compact and settle the sand filter pack around the well.
- Once the screen has been backfilled to the designed depth, a high temperature grout will be tremie pumped to the surface.
- The bottom of the well casing will be immediately inspected for grout inside of the well using a bottom loading bailer.
    - If grout has entered the well, water will be added to flush the well and pump out excess grout.
- It is expected that the grout will settle. After settling grout will be added to top of the hole.
- After drilling operations, all equipment will be decontaminated as per the Decontamination Standard Procedure.

VAPOR EXTRACTION INSTALLATION: The following summarizes the approach for installing the vapor extraction wells at the SRSNE Superfund Site. Vapor extraction wells are shallow, installed to a depth of approximately 8 ft. bgs. They consist of 2" diameter, Schedule 80 carbon steel riser with 0.010-slot stainless steel screen. Additional installation details and construction materials can be found in the Site drawing package.

- The 6" outer casing will core out the first 5 ft. of the hole. The outer casing is retracted and emptied into a container at the surface.
- Once the outer drill casing is placed back into the hole, the inner 4" core barrel will be advanced to the installation depth (varies within treatment area).
- Once the inner core barrel reaches installation depth, the outer casing will then be advanced to the installation depth and the core barrel will be extracted.
- After the core has been extracted, the core barrel will be advanced in approximately 5-10 foot increments followed by the drill casing until installation depth is reached.
- The well material will be installed at the base of the borehole.
- Once the well is installed at depth, the filter pack is installed and the drill casing is extracted with sonic vibration to help compact and settle the sand filter pack around the well screen.
- Once the screen filter pack has been added to the designed depth, high temperature grout will then be added to surface.
- It is expected that the grout will settle. After settling, grout will be added to top off the hole.
- After drilling operations, all equipment will be decontaminated as per the Decontamination Standard Procedure.

TEMPERATURE MONITORING POINT (TMP) INSTALLATION: The following summarizes the approach for installing the temperature monitoring points at the SRSNE Superfund Site. Temperature monitoring points are installed to bedrock (i.e., depth will vary within well field). They consist of 1 ½" diameter, Schedule 40, carbon steel pipe. Additional installation details and construction materials can be found in the Site drawing package.

- The 6" outer casing will core out the first 5 ft. of the hole. The outer casing is retracted and emptied into a container at the surface.
- Once the outer drill casing is placed back into the hole, the inner 4" core barrel will be advanced to the installation depth (varies within treatment area).
- Once the inner core barrel reaches installation depth, the outer casing will then be advanced to the installation depth and the core barrel will be extracted.
- After the core has been extracted, the core barrel will be advanced in approximately 5-10 foot increments followed by the drill casing until installation depth is reached.

- The monitoring point material will be installed at the base of the borehole.
- Once the material is installed to depth, high temperature grout will then be tremie pumped to surface.
- It is expected that the grout will settle and be evident near the surface. After settling, grout will be added to top off the hole.

PRESSURE MONITORING POINT (PMP) INSTALLATION: The following summarizes the approach for installing the pressure monitoring points (PMP) at the SRSNE Superfund Site. PMPs are installed to a depth of approximately 7 or 12 ft. bgs, depending on their location within the wellfield. They consist of 2" diameter Schedule 40 carbon steel riser with 0.010-slot stainless steel screen. Additional installation details and construction materials can be found in the Site drawing package.

- The 6" outer casing will core out the first 5 ft. of the hole. The outer casing is retracted and emptied into a container at the surface.
- Once the outer drill casing is placed back into the hole, the inner 4" core barrel will be advanced to the installation depth (varies within treatment area).
- Once the inner core barrel reaches installation depth, the outer casing will then be advanced to the installation depth and the core barrel will be extracted.
- After the core has been extracted, the core barrel will be advanced in approximately 5-10 foot increments followed by the drill casing until installation depth is reached.
- The monitoring well material will be installed at the base of the borehole.
- Once the material is installed to depth, the filter pack is installed and the drill casing is extracted with sonic vibration to help compact and settle the sand filter pack around the well screen.
- Once the screen has been backfilled to the designed depth, high temperature grout will then be tremie pumped to surface.
- It is expected that the grout will settle and be evident near the surface. After settling, grout will be added to top off the hole.

HEATER ONLY (HO) INSTALLATION: The following summarizes the approach for installing the heater cans at the SRSNE Superfund Site. Materials of construction and installation details can be found in the Site drawing package.

- The 6" outer drill casing will core out the first 5 ft. of the hole. The outer casing is retracted and emptied into a container at the surface.
- Once the outer drill casing is placed back into the hole, the inner 4" core barrel will be advanced to the expected depth to bedrock, or until the driller interprets that bedrock has been encountered, if shallower.
- The outer casing will then be advanced to the same depth, and the core barrel will be extracted.
- The contents of the core barrel from shallow soil intervals (more than 5 feet above of the estimated bedrock depth) will be emptied into a bobcat bucket or similar, visually assessed and segregated based on NAPL presence (if any), and transported to the appropriate waste staging area(s). The soil samples obtained within 5 feet of the expected bedrock depth will be extracted, collected, and placed in bags, if possible, for logging and inspection. If the soil samples are too hot to place in bags, they will be placed in order on a suitable surface or container to allow them to cool for logging and inspection. The samples will be placed in a linear sequence such that the locations of the top and bottom of each "run" are known, and they will be labeled accordingly.
- The interpretation of when the core barrel reaches the top of the weathered bedrock will be made by ARCADIS.
- If the borehole has reached the expected bedrock depth, but bedrock has not yet been encountered, the core barrel will be advanced in increments of up to 5 feet and the core samples will be inspected for the presence of visible NAPL and the presence of weathered bedrock, if any. If the top of bedrock was not observed in the core sample, then the outer casing will be advanced to the same depth as the core barrel. This process will be repeated until the top of rock is encountered and confirmed by ARCADIS. The drill casing will then be advanced and "keyed" into the top of bedrock. Test drilling performed at the site indicated that this will most likely provide a tight seal with the rock surface. (Note: A tight seal was noted on all three test holes performed at the site.)

- ARCADIS and/or *de maximis* will inspect the sample materials obtained from the bottom portion of the overburden (within approximately 3 to 5 ft. of the top of weathered bedrock) for the presence of visible NAPL.
- NAPL will be interpreted as present if observed with the unaided eye.
    - o If NAPL is observed in the sample, ARCADIS and/or *de maximis* will check the bottom of the borehole for the presence of NAPL and remove the NAPL, if present, using a peristaltic pump with a check valve (preferred) or bottom-loading bailer. The NAPL will be placed into a sealable container (e.g. 55 gallon drum).
    - o After removing the NAPL (if any) from the bottom of the borehole, high temperature grout will be injected into the bottom of the borehole.

- If NAPL is not observed in the sample, the driller will check the bottom of the borehole for the presence of water using a water-level indicator.
    - o If the borehole is dry, drilling will proceed as described below.
    - o If water is present in the borehole, high temperature grout will be injected into the bottom 3 ft. of the borehole, and drilling will proceed as discussed below.
- After the above actions have taken place, the core barrel will be advanced into bedrock to the desired depth. Typically only one core run will be required to reach the target depth, but depending on the amount of rock coring required for the boring this may be accomplished in several steps. After each bedrock core run, the contents of the core barrel(s) will be extracted and collected for logging and inspection by others.

IF BEDROCK IS NOT ENCOUNTERED: If the design depth of the heater has been achieved but bedrock has not, the following will take place.

- o The core barrel will be advanced in increments of up to 5 feet and the core samples will be inspected for the presence of visible NAPL and the presence of weathered bedrock, if any.
- o Log designed depth and actual depth on the heater can construction log.
- o Either use longer heater can or weld extension onto heater can.

- Once the final core has been extracted, ARCADIS and/or *de maximis* will check the bottom of the borehole for the presence of NAPL and remove the NAPL, if present, using a peristaltic pump with a check valve (preferred) or bottom-loading bailer. The NAPL will be placed into a sealable container (e.g. 55 gallon drum).
- After removing the NAPL (if any) from the bottom of the borehole, high temperature grout will be injected into the bottom of the borehole via tremie pipe and the heater can will then be installed.
    - o Once the heater can is installed, the high temperature grout will be topped off in the annulus between the heater can and the borehole wall.
- It is expected that the grout will settle and be evident at the surface. Grout will be added to top off the hole as needed.
- After drilling operations, all equipment will be decontaminated as per the Decontamination Standard Procedure.

HEATER ONLY HANDLING: Heater cans consist of 3" diameter Schedule 80 carbon steel at 18, 21, 27, & 31 ft. lengths and weigh between 180-270 lbs., depending on their length. Because of their weight, these cans require additional care during installation to ensure the safety of the workers installing them as well as the safety of others onsite. The preferred method for handling the heater cans is presented below; however, individual locations may dictate variances in the installation method.

- Personnel not required for Heater Can installation will stand clear of the area and remain outside the footprint consistent with the length of the Heater Can (i.e. stand at least 35' away for a 30' Heater Can).
- A strap will be installed around the bottom of the can in a double choker configuration and attached to the winch located at the top of the drill rig mast. The winch will pick up the bottom of the can and it will be guided into place in the rod handler.
- Once the rod handler clamps the can, the sling will be relocated around the top of the can and re-attached to the winch.

- The rod handler will then lift the can up in the air as the slack on the winch line is taken in. When the can is above the hole, the rod handler will release the can and the can will be lowered into the hole slowly with the winch.

If site conditions don't allow for the can to be handled with the rod handler, the can will be installed by lifting the can with the winch on the rig or a fork lift.

DOCUMENTATION

The Site Supervisor, or his designee, will document the installation of the heater can wells, groundwater wells, and monitoring wells in either the attached Heater Can Installation Construction Log and Well Construction Detail. The information required includes:

- Start and finish time(s)
- Depth of well installation/depth to bedrock
- Amount of water used, if any, during drilling
- Amount of grout used
- NAPL observed in soil, particularly in bottom 5-ft of overburden, but also in shallower soil (if any)
- Note volume of NAPL collected (if applicable)
- Note any deviations from the SOP and/or any characteristics specific to that well

RESPONSIBILITIES

The Site Supervisor, or his designee, will conduct periodic inspections of the installation procedures established by this SOP. The purpose of the inspection is to verify that the procedures and the requirements of the SOP are being followed. Any deviations or inadequacies that are identified during the inspection will be immediately corrected.

ATTACHMENTS

SRSNE Superfund Site Well Construction Details

Well Construction Detail

Five Star High Temp Grout Specs

TERRATHERM

SRSNE SUPERFUND SITE
WELL CONSTRUCTION DETAILS

DATE		
WELL ID		
BEDROCK DESIGN DEPTH	15 18 21	FT
DRILLER		
START TIME		
BEDROCK ENCOUNTERED AT		FT
NAPL PRESENT	YES NO	
START PUMPING NAPL		TIME
FINISH PUMPING NAPL		TIME
COMPLETION DEPTH		FT
FINISH TIME		

NOTES

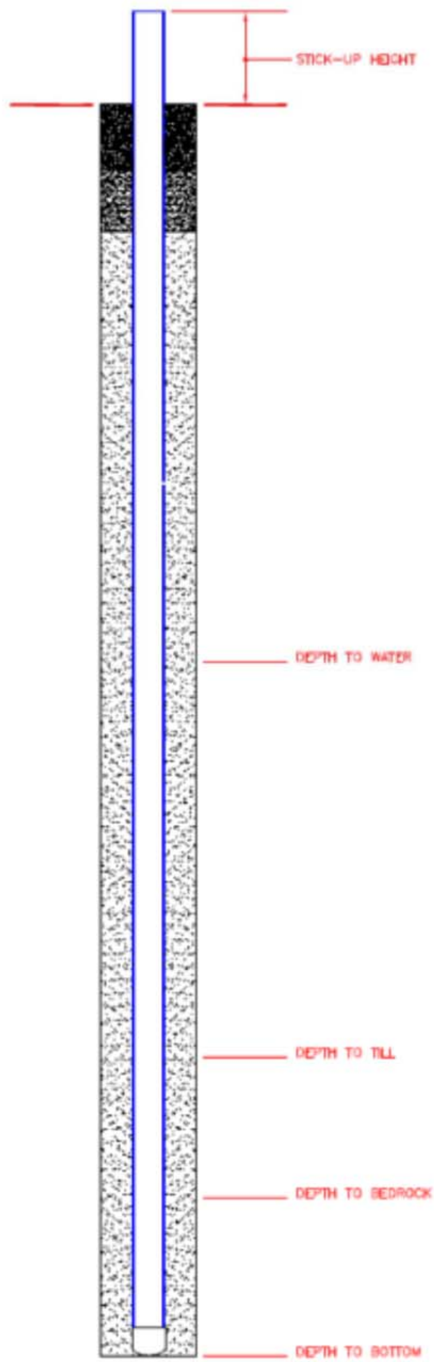
TERRATHERM TEAM ______

ARCADIS/*de maximis* ______

STANDBY YES NO

TOTAL STANDBY ______ MIN

APPROVED BY ______



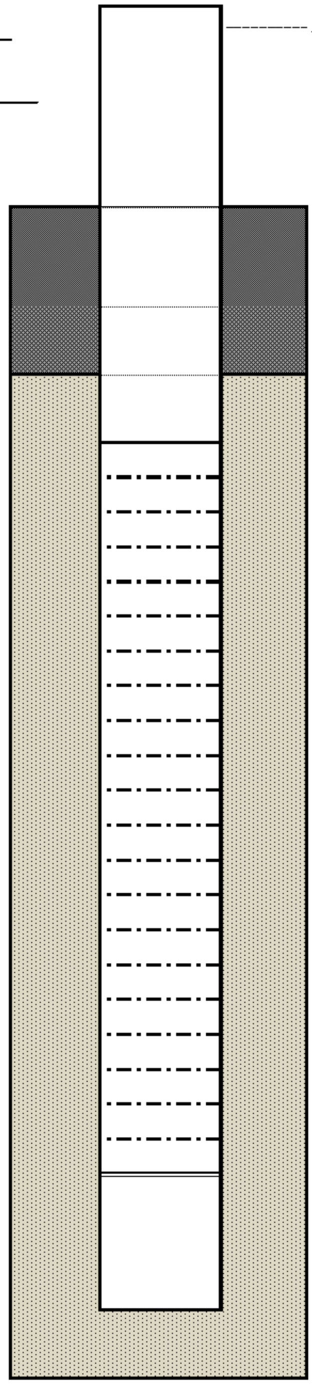
TerraTherm Inc | **Well Construction Detail**

Site Location: ____________________ **Date:** ____________________

Job #: ____________________ **Name:** ____________________

Well Diamete ____________________ *Stick Up Height:* ____________________

Well #: ____________________



Ground Surface 0.0'------------ ----- **Cement/Bentonite Seal**

Casing Material
(circle one)
Carbon Steel
Stainless Steel
Fiberglass
Other

----- **Fine Sand or Bentonite Chips**

Top of Filter Pack ____________________

Top of Screen ____________________

Screen Material
(circle one)
Stainless Steel
Fiberglass
Other

Filter Pack Size ____________________

Borehole Diameter ____________________

Slot Size
(circle one)
0.005
0.01
0.015
0.02

Installation Method
(circle one)
Sonic
Auger
DPT
Other

Schedule 40 80

Bottom of Screen ____________________

Sump *Y* *N*

Sump Length ____________________

Bottom of Well ____________________

Bottom of Borehole ____________________

PRODUCT DESCRIPTION FOR HIGH TEMPERATURE GROUT (*note that this product may not be available at the time of wellfield installation and a similar high temperature grout will be used).*

Five Star® HTR Grout is a unique cement based grout for supporting equipment and structural base plates in high temperature environments. Five Star HTR Grout can be poured into place, gains strength rapidly and can be exposed to 1000°F (538°C) in 24 hours and up to 2400°F (1316°C) after a 7-day curing procedure. Five Star HTR Grout exhibits positive expansion when tested in accordance with ASTM C 827.

TYPICAL PLACEMENT GUIDELINES *Installation details may vary depending on field conditions*

1. SURFACE PREPARATION: All surfaces in contact with Five Star® HTR Grout shall be free of oil, grease, laitance and other contaminants. Concrete must be clean, sound and roughened to ensure a good bond. Soak concrete surfaces for 8 to 24 hours prior to application with liberal quantities of potable water, leaving the concrete saturated and free of standing water.

2. FORMWORK: Formwork shall be constructed of rigid non-absorbent materials, securely anchored, liquid-tight and strong enough to resist forces developed during grout placement. The clearance between formwork and baseplate shall be sufficient to allow for a headbox. The clearance for remaining sides shall be one to two inches (25 - 50 mm). Areas where bond is not desired must be treated with form oil, paste wax or similar material. Isolation joints may be necessary depending on pour dimensions. Contact Five Star Engineering and Technical Service Center for further information.

3. MIXING: Mix Five Star HTR Grout thoroughly for four to five minutes to a uniform consistency with a mortar mixer (stationary barrel with moving blades). A drill and paddle mixer is acceptable for single bag mixes. For optimum performance, condition between 60°F and 80°F (16°C and 27°C). Mix Five Star HTR Grout with 3 to 3 1/2 quarts potable water per 50 lb. bag. Working time is approximately 20 minutes at 70°F (21°C). Follow printed instructions on the package. Always add mixing water first to mixer followed by grout.

4. METHODS OF PLACEMENT: Five Star HTR Grout may be poured into place. Minimum placement thickness for Five Star HTR Grout is one inch (25 mm). For pours over three inches in depth Five Star HTR Grout should be extended with a clean damp coarse aggregate meeting the requirements of ASTM C 33. NOTE: Coarse aggregate must be suitable for high temperature exposure. Refer to the Five Star Technical Bulletin "Cement Grout Aggregate Extension" for guidelines.

5. POST-PLACEMENT PROCEDURES: Five Star HTR Grout shall be wet cured for a minimum of 30 minutes. Approximately three hours after placement, material can be brought up to an operating temperature of 1000°F (538°C). For operating temperatures up to 2400°F (1316°C), wet cure for 3 days followed by dry cure for 4 days. Then slowly apply heat up to 2400°F (1316°C).

NOTE: PRIOR TO APPLICATION, READ ALL PRODUCT PACKAGING THOROUGHLY. For more detailed placement procedures, refer to Design-A-Spec™ installation guidelines or call the Five Star Engineering and Technical Service Center at (800) 243-2206.

CONSIDERATIONS: If temperatures of equipment and surfaces are not between 40°F and 90°F (4°C and 32°C) at time of placement, refer to Design-A-Spec™ for cold and hot weather grouting procedures, or call the Five Star Engineering and Technical Service Center at (800) 243-2206. Substrate shall be free of frost and ice. Grout shall be protected from freezing until it reaches 1000 psi (6.9 MPa). Never exceed the maximum water content stated on the bag. Construction practices dictate concrete foundation should achieve its design strength before grouting.

Attachment B

DNAPL Monitoring and Removal Procedure Standard Operating Procedure

Infrastructure · Water · Environment · Buildings

Imagine the result

DNAPL Monitoring and Removal Procedure

Rev. #: 0

Rev Date: February 19, 2013

Approval Signatures

Prepared by: ______________________ Date: 2/19/13
David A. Cornell, P.G.

Reviewed by: ______________________ Date: 2/19/13
Michael J. Gefell (Technical Expert)

I. Scope and Application

This document was prepared as a guide for the monitoring and removal (where identified) of dense, non-aqueous phase liquid (DNAPL) during the drilling and installation of heater wells and new monitoring wells within the thermal treatment zone at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. If DNAPL is encountered during drilling, this SOP provides the procedures to remove DNAPL from the boreholes in a safe and efficient manner while reducing, to the extent practicable, the potential impacts and time delays during the well installation process.

II. Personnel Qualifications

DNAPL monitoring and removal activities will be performed by persons who have been trained in DNAPL handling under the guidance of an experienced field geologist, engineer, or technician.

III. Equipment List

The following materials will be available for DNAPL removal during heater well installation activities:

- Health and Safety Plan (HASP);
- personal protective equipment (PPE), as required by the HASP;
- photo-ionization detector (PID) or flame ionization detector (FID) for Health and Safety monitoring;
- peristaltic pump (Solinst Model 410, or equivalent);
- Whale® submersible pump;
- polyethylene tubing (for use with peristaltic and/or Whale® pump);
- weighted bottom-loading bailers (Teflon, polyethylene or stainless steel);
- string/rope for lowering bailers into boreholes;
- buckets with appropriate lids (for transporting recovered DNAPL to drums);

- 55-gallon metal drum(s) for storage of recovered DNAPL;
- disposable absorbent towels;
- plastic sheeting;
- non-phosphate detergent;
- cleaning brushes;
- potable water; and
- field notebook(s).

IV. Cautions

Downward Mobilization

DNAPL can migrate downward during drilling and well installation processes, or via the sand pack or screen of a monitoring well. This caution is applicable to all DNAPL sites, but may be especially important at solvent sites, where DNAPL has relatively high density and low viscosity. Rapid detection and removal of DNAPL from boreholes where DNAPL accumulates can reduce the potential for downward DNAPL migration.

DNAPL Handling

Handle and store DNAPL with care to avoid spills. Use absorbent materials when handling equipment that contains or has been coated with DNAPL.

Shipping

Shipping determination must be performed (by DOT-trained personnel) for all DNAPL drums or other potentially hazardous materials that are to be shipped.

V. Health and Safety Considerations

Field activities associated with this DNAPL Monitoring and Removal SOP will be performed in accordance with the site-specific HASP (ARCADIS 2010), a copy of which will be present on site during all field activities.

VI. Procedure

Heater wells and new monitoring wells will be installed within the thermal treatment zone to prepare the site for the in-situ thermal treatment process. These wells will be installed by the thermal treatment vendor using established drilling and installation procedures. The boreholes for these wells will be drilled into or to bedrock. As each borehole approaches or reaches the target depth, the drillers will notify the field team of the need to initiate the DNAPL assessment and (if needed) removal procedures.

These procedures apply:

1. At heater well and monitoring well boreholes, upon reaching the top of rock, if the soil within the bottom 3 to 5 feet of the overburden contains visible DNAPL.

   The supervising scientist or engineer (from ARCADIS or ***de maximis***) will inspect the rotasonic core sample obtained from the bottom portion of the overburden (within approximately 3 to 5 feet of the bedrock surface) for the presence of visible non-aqueous phase liquids (NAPL). NAPL will be interpreted as present if NAPL is observed with the unaided eye (without shake test, sheen test and/or hydrophobic dye.

   [If it is determined that visible NAPL is present in the soils within the bottom portion of the overburden, the bottom of the borehole will be pumped or bailed to removed accumulated NAPL (if any), and then the driller will inject heat-resistant grout into the bottom portion of the outer casing prior to advancing the inner core barrel into the bedrock.]

2. At all heater well boreholes after drilling the socket into the top of bedrock (but before grouting each heater well in place).

Field staff will coordinate with the driller so that the bottom of the borehole can be checked for the presence of DNAPL in a timely manner subject to the criteria listed above.

Interface probes will <u>not</u> be used to check for DNAPL, since they have been found to be unreliable with the site-specific DNAPL. Instead, a peristaltic pump (preferred -- Solinst Model 410, or equivalent), Whale® pump equipped with a suitable length of polyethylene tubing, or a weighted bottom loading bailer will be used to check for and remove any accumulated DNAPL from the boreholes.

The procedure for monitoring and removal of DNAPL by peristaltic pump or Whale® pump is as follows:

1. Don appropriate PPE (as required by the HASP).

2. To ensure the peristaltic pump tubing intake reaches the bottom of the borehole, the bottom of the tubing can be attached to a length of rigid polyvinyl chloride (PVC) or metal pipe using hose clamps, zip ties or duct tape, prior to being placed down the hole.

3. When using a peristaltic pump, the bottom of the tubing will be cut at a 45-degree angle, to reduce the chances of plugging, prior to lowering it into the drill casing.

4. Lower the peristaltic pump tubing or the Whale® pump into the drill casing until it reaches the bottom of the borehole.

5. Once the peristaltic pump tubing (if used) is at the bottom of the borehole, connect the down-hole tubing to the silicone tubing that runs through the peristaltic pump body and attaches to a discharge tubing.

6. Connect pump to the power supply and start pumping at a moderate flow rate. Direct the pump discharge into a graduated container or bucket.

7. Pump until groundwater and/or DNAPL is observed discharging from the pump. Site-specific DNAPL has a dark-brown color, pungent odor, and produces a visible sheen at the surface of water.

8. Continue pumping until DNAPL is no longer observed discharging from the pump.

9. **If** there is no evidence of DNAPL in the return water after pumping for a minimum of one minute, then the location will be considered to have no recoverable amount DNAPL at the present time.

10. If the pump tubing or pump becomes plugged due to sediment/soil, raise the pump tubing or pump above the bottom of the borehole and slowly lower it during pumping.

11. After DNAPL has been removed to the extent practicable, stop the pump and verify that the drilling crew is prepared to go to the next step in the drilling or well construction process. The DNAPL removal equipment will be left in place if the drilling crew is not prepared to move forward. When the drilling crew is prepared to

go to the next step in the drilling or well construction process, repeat the removal process to confirm that DNAPL has been removed from the borehole to the extent practicable.

12. Remove the equipment from borehole.

13. If peristaltic pump was used and the tubing was attached to a length of PVC or metal pipe, disconnect the tubing from the pipe; wipe the outside of the pipe with disposable absorbent towels to remove any visible DNAPL. If visible DNAPL was removed from the borehole and/or observed on the pipe, the bottom section (up to 5 feet) of the pipe will be decontaminated by scrubbing and brushing with detergent solution, followed by potable water rinse. The pipe can then be reused at subsequent locations.

14. Dispose of the down-hole section of pump tubing (either peristaltic or Whale® pump tubing).

15. Record the volume of recovered DNAPL; then transfer the DNAPL to a covered bucket or trailer-mounted carboy and transport to a properly labeled on-site staging vessel (i.e., DOT drum) for future characterization and off-site disposal. Any water produced during the pumping activities will be separated (decanted) from the DNAPL and placed in a separate storage vessel for subsequent treatment at the on-site groundwater treatment system. Likewise, any water removed from a thermal well location, even if there is no evidence of NAPL, will be treated in the on-site groundwater treatment system. Only NAPL will be disposed off-site.

16. Discard all disposable investigation derived waste (IDW) (i.e., down-hole pump tubing, duct tape, bailer string, absorbent towels or any other contaminated disposable supplies generated during the DNAPL removal process) and PPE in accordance with Section VII and site-specific protocols.

Peristaltic pump is the default and preferred method for DNAPL monitoring and removal. Whale® pump is the second option in order of preference.

If neither a peristaltic nor Whale® pump is successful at removing DNAPL, a weighted bottom-loading bailer (Teflon, polyethylene, PVC or stainless steel) will be used as follows:

1. Don appropriate PPE (as required by the HASP).

2. Remove the bailer from the plastic wrapper (if applicable) and attach a string or rope to the top of the bailer.

3. Gently lower the bailer though the drill casing to the bottom of the borehole.

4. Gently "bounce" the bailer several times on the bottom of the borehole.

5. Retrieve the bailer from the drill casing.

6. Decant the contents of the bailer into a graduated cylinder or bucket for measurement

7. Repeat until the DNAPL is no longer produced from the borehole. When the drilling crew is prepared to go to the next step in the drilling or well construction process, repeat Steps 3 though 6 until DNAPL has been removed from the borehole to the extent practicable.

8. Record the volume of recovered DNAPL; then transfer the DNAPL to a covered bucket or trailer-mounted carboy and transport to a properly labeled on-site staging vessel (i.e., DOT drum) for future characterization and off-site disposal. As previously described, any water produced during the bailing activities will be separated (decanted) from the DNAPL and placed in a separate storage vessel for subsequent treatment at the on-site groundwater treatment system. Likewise, any water removed from a thermal well location, even if there is no evidence of NAPL, will be treated in the on-site groundwater treatment system. Only NAPL will be disposed off-site.

9. Discard all disposable investigation derived waste (IDW) and PPE in accordance with Section VII and site-specific protocols.

VII. Waste Management

Materials generated during DNAPL monitoring and removal activities, including disposable equipment (e.g., absorbent pads, bailers, rope, etc.) and DNAPL, will be containerized in labeled containers or drums for subsequent disposal. Solids, such as disposable absorbent towels, used pump tubing, and gloves will be placed in to drums separate from those containing liquids. DNAPL from all locations will be containerized in DOT drums. The locations and volumes of recovered DNAPL will be recorded in the field notebook.

VIII. Data Recording and Management

Any occurrence of DNAPL encountered during heater well or monitoring well installation will be documented in an appropriate field notebook in terms of the drilling location (boring or well identification), volume of DNAPL recovered, volume of water removed, and depth of boring below ground surface at the time of DNAPL recovery. In addition, it will be noted whether the bottom of the borehole is at the top of bedrock or is a socket drilled into the bedrock.

IX. Quality Assurance

The field staff will coordinate with the driller such that DNAPL removal is performed as soon as practicable after reaching the top of bedrock at each thermal well or monitoring well borehole, and after drilling a socket into the top of bedrock at each thermal well borehole. Following the removal of DNAPL, if any, the next step in the drilling and well-construction process should commence as soon as practicable. If a significant period of time has elapsed after DNAPL removal and the next step has not commenced, then the borehole should be re-checked for DNAPL and DNAPL removed, as necessary, prior to resuming the thermal well or monitoring well installation activities.

X. References

ARCADIS, 2010. *Health and Safety Plan – SRSNE Site Group, Remedial Design Project Operations - Plan Attachment D*, November 2012.

Attachment C

Well Log Form

Heater Can Installation Construction Log

WELL CONSTRUCTION DETAIL

Project Name	____________________
Date	____________________
Well ID	____________________
Drilling Company	____________________
Driller	____________________
Start Time	____________________
Finish Time	____________________
Amt. Water Used	____________________
Amt. Grout	____________________
NAPL Present? Amt?	____________________
Depth/Location of NAPL	____________________
NAPL Removed by:	____________________

Misc. Notes:

____

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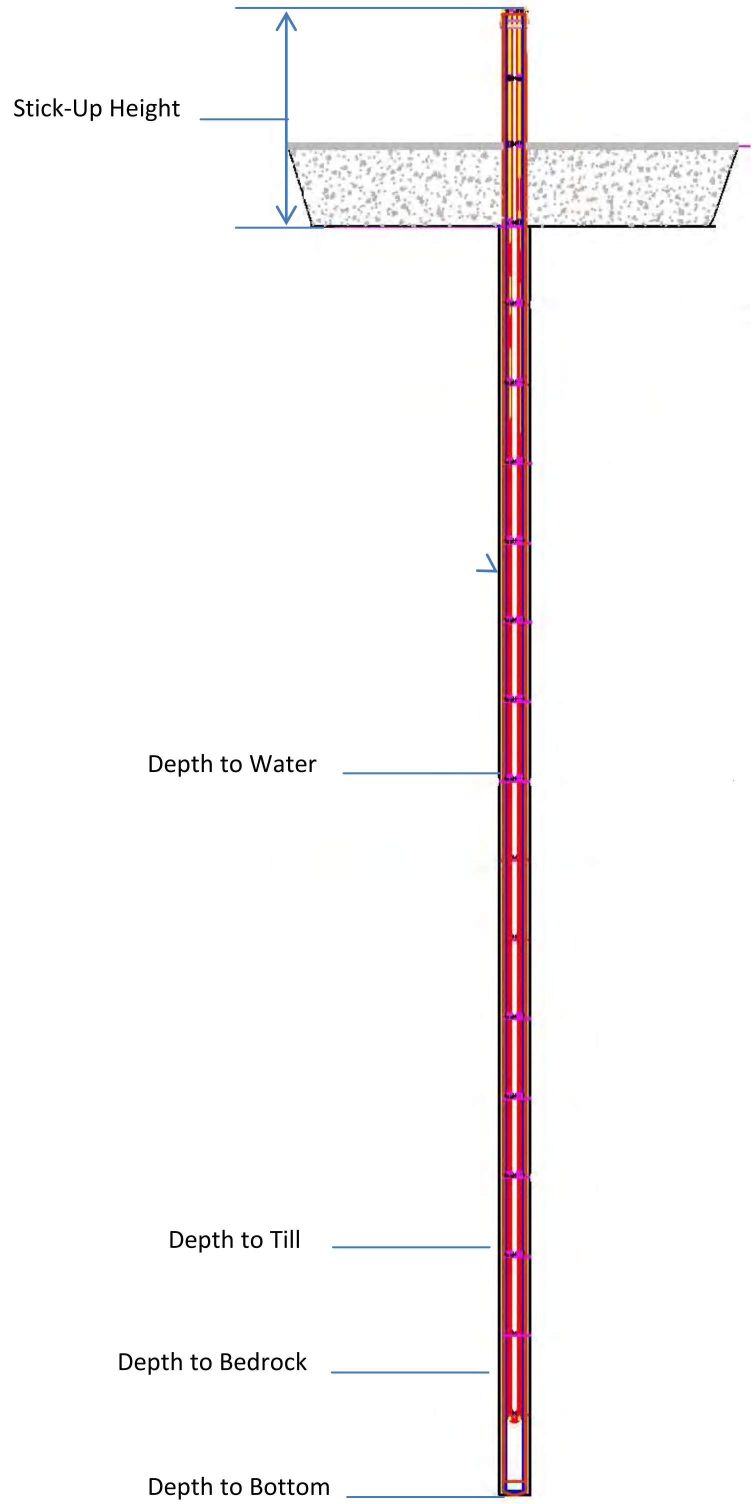

TERRATHERM INC.

WELL CONSTRUCTION DETAIL

DATE	DRAWN BY	SIZE A	DWG NAME TT–TYPICAL WELL CONSTRUCTION DETAIL	REV 0
		SCALE NTS	DWG	SHEET 1 OF 1

ARCADIS

Attachment D

Air Monitoring Form

ARCADIS

Air Monitoring Form

PID Model: ______________________

Multi-Gas Model: ______________________

CIT Model: ______________________

Dust Mon. Model: ______________________

Monitor Frequency: ______________________

Air Monitoring Results

Date	Time	PID (units)	O_2 (%)	LEL (% LEL)	CO (ppm)	H_2S (ppm)	CIT (ppm)	Dusts (mg/m^3)	Location

PID	Photoionization Detector	ppm	Part per million
LEL	Lower Explosive Limit	%	Percent
O_2	Oxygen	mg/m^3	Miligram per cubic meter
CIT	Colorimetric Indicator Tube		

ARCADIS

Attachment E

Calculations of Air Monitoring Action Levels

VOC ACTION LEVEL CALCULATIONS

The State of Connecticut Hazard Limiting Values (HLVs) located in Section 22a-174-29 “Hazardous Air Pollutants” regulation for each of the VOCs/SVOCs were used to calculate the perimeter PID ambient air action level using a PID equipped with a 10.6 eV lamp calibrated to isobutylene. HLVs for VOCs/SVOCs are presented as a 30-minute and/or 8-hour value.

Action levels for VOCs/SVOCs were based on the concentrations of the specific constituents found in the soil located on site. Dividing the HLVs by the mole fraction of that constituent in the soil, the PID measurement required to exceed the HLV is determined. The following formula can be used to calculate the maximum PID measurement to maintain VOCs/SVOCs in air below their respective HLV:

> Maximum PID measurement to maintain VOCs/SVOCs in air below their respective HLV = [HLV (ppm) / (mole fraction in Soil)(PID Correction factor)

Using the HLVs established by the State of Connecticut, taking into account the PID correction factors provided by the manufacturer for a 10.6 eV lamp, and incorporating the maximum contaminant concentrations on Site, both 8-hour and 30-minute average action levels can be calculated (see Tables 1A and 1B presenting the State of Connecticut HLVs and illustrating calculations for both values below). The VOCs/SVOCs having the lowest and most conservative 8-hour average action level was bromoform with a value of 0.4 ppm. The VOCs/SVOCs having the lowest and most conservative 30-minute average action level was chloroform with a value of 2.0 ppm.

Based on the aforementioned calculations the fence line 8-hour TWA PID action level will be 0.4 ppm and the 30-minute action level will be 2.0 ppm.

TOTAL DUST ACTION LEVEL CALCULATIONS

Action levels for total airborne dust were based on the maximum concentrations of the specific metal constituents found in the soil on site. Taking the 8-hour and 30-minute State of Connecticut Hazard Limiting Values (HLVs) for these metals, multiplying them by 10^6 mg/kg and dividing them by the highest concentration level in the soil, the level of total dust required to exceed the HLV is determined. The following formula can be used to calculate an airborne dust (AD) concentration to maintain ambient metals in air levels below the HLV:

Minimum airborne total dust level required to reach the HLV for a specific metals contaminant = (HLV (mg/m^3) X 10^6 mg/kg) / Concentration in Soil (mg/kg)

Following calculation, the metal having the lowest and most conservative 8-hour average action level was cadmium with a value of 2.19 mg/m^3. The metal having the lowest and most conservative 30-minute average action level was also cadmium with a value of 10.93 mg/m^3 (see Tables 2A and 2B below illustrating calculations for both values).

In addition to State determined HLVs, the United States Environmental Protection Agency (USEPA) has an overall 24-hour average ambient air quality standard of 0.15 mg/m^3. Multiplying this value by 3 would equate to an 8-hour TWA limit of 0.45 mg/m^3 for the Site while exercising an 8-hour work shift. Since the USEPA established 8-hour limit is significantly lower than the calculated 8-hour TWA action level based on site-specific data, the value of 0.45 mg/m^3 will be established for the 8-hour TWA particulate threshold. From above, the 30-minute fence line action level was calculated to be 10.93 mg/m^3. However, if sustained for 30 minutes, this is less stringent than the 8-hour TWA action level. By multiplying the 8-hour TWA threshold of 0.45 mg/m^3 by 16 (16 30-minute periods in an 8 hour cycle) a value of 7 mg/m^3 for the 30-minute action level will provide compliance with the 8-hour TWA.

Based on the aforementioned calculations the fence line 8-hour TWA dust action level will be 0.45 mg/m^3 and the 30-minute action level will be 7 mg/m^3.

Table 1A: VOC 8-Hour TWA Action Level Data

VOC/SVOC	Maximum Concentration (ug/kg)	8-Hour TWA HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
1,1,1-Trichloroethane	1000000	NL	0.0220	NA	NL	NA
1,1,2,2-Tetrachloroethane	440000	NL	0.0097	NA	NL	NA
1,1,2-Trichloroethane	440000	NL	0.0097	NA	NL	NA
1,1-Dichloroethane	440000	NL	0.0097	NA	NL	NA
1,1-Dichloroethene	440000	NL	0.0097	NA	0.9	NA
1,2,4-Trichlorobenzene	3000	NL	0.0001	NA	NL	NA
1,2-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,2-Dichloroethane	440000	NL	0.0097	NA	0.8	NA
1,2-Dichloroethene, Total	1400000	NL	0.0308	NA	0.8	NA
1,2-Dichloropropane	440000	NL	0.0097	NA	NL	NA
1,3-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,4-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,4-Dioxane	50000	NL	0.0011	NA	1.1	NA
2,2'-oxybis(dichloropropane)	3000	NL	0.0001	NA	NL	NA
2,4,5-Trichlorophenol	14000	NL	0.0003	NA	NL	NA
2,4,6-Trichlorophenol	3000	NL	0.0001	NA	NL	NA
2,4-Dichlorophenol	3000	NL	0.0001	NA	NL	NA
2,4-Dimethylphenol	3000	NL	0.0001	NA	NL	NA
2,4-Dinitrophenol	14000	NL	0.0003	NA	NL	NA
2,4-Dinitrotoluene	3000	NL	0.0001	NA	NL	NA
2,6-Dinitrotoluene	3000	NL	0.0001	NA	NL	NA
2-Butanone (MEK)	440000	4	0.0097	412.63	0.9	NA
2-Chloroethylvinyl ether	2000	NL	0.0000	NA	NL	NA
2-Chloronaphthalene	3000	NL	0.0001	NA	NL	NA
2-Chlorophenol	3000	NL	0.0001	NA	NL	NA
2-Hexanone	440000	NL	0.0097	NA	NL	NA
2-Methylnaphthalene	2000	NL	0.0000	NA	NL	NA

Table 1A: VOC 8-Hour TWA Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	8-Hour TWA HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
2-Methylphenol	3000	NL	0.0001	NA	NL	NA
2-Nitroaniline	14000	NL	0.0003	NA	NL	NA
2-Nitrophenol	3000	NL	0.0001	NA	NL	NA
3,3'-Dichlorobenzidine	5900	NL	0.0001	NA	NL	NA
3-Nitroaniline	14000	NL	0.0003	NA	NL	NA
4,6-Dinitro-2-methylphenol	14000	NL	0.0003	NA	NL	NA
4-Bromophenyl phenyl ether	3000	NL	0.0001	NA	NL	NA
4-Chloro-3-methylphenol	3000	NL	0.0001	NA	NL	NA
4-Chloroaniline	3000	NL	0.0001	NA	NL	NA
4-Chlorophenyl phenyl ether	3000	NL	0.0001	NA	NL	NA
4-Methyl-2-pentanone (MIBK)	490000	1	0.0108	92.63	1	92.6
4-Methylphenol	3000	NL	0.0001	NA	NL	NA
4-Nitroaniline	14000	NL	0.0003	NA	NL	NA
4-Nitrophenol	14000	NL	0.0003	NA	NL	NA
Acenaphthene	3000	NL	0.0001	NA	NL	NA
Acenaphthylene	3000	NL	0.0001	NA	NL	NA
Acetone	440000	5	0.0097	515.78	1.1	468.9
Acrolein	20000	0.002	0.0004	4.54	3.9	1.2
Acrylonitrile	20000	0.01	0.0004	22.69	NL	NA
Aldrin	140	NL	0.0000	NA	NL	NA
alpha-BHC	140	NL	0.0000	NA	NL	NA
alpha-Chlordane	1400	NL	0.0000	NA	NL	NA
Benzene	440000	0.05	0.0097	5.16	0.5	10.3
Benzyl alcohol	3000	NL	0.0001	NA	NL	NA
beta-BHC	140	NL	0.0000	NA	NL	NA
bis(2-Chloroethoxy)methane	3000	NL	0.0001	NA	NL	NA
bis(2-Chloroethyl)ether	3000	NL	0.0001	NA	NL	NA
Bis(2-ethylhexyl) phthalate	56000	NL	0.0012	NA	NL	NA
Bromoform	440000	0.01	0.0097	1.03	2.5	0.4

Table 1A: VOC 8-Hour TWA Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	8-Hour TWA HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
Bromomethane	440000	NL	0.0097	NA	NL	NA
Butyl benzyl phthalate	10000	NL	0.0002	NA	NL	NA
Carbon disulfide	440000	0.02	0.0097	2.06	1.2	1.7
Carbon tetrachloride	440000	0.05	0.0097	5.16	NL	NA
Chlorobenzene	440000	1.5	0.0097	154.74	0.4	386.8
Chlorodibromomethane	440000	NL	0.0097	NA	NL	NA
Chloroethane	440000	NL	0.0097	NA	NL	NA
Chloroform	440000	0.05	0.0097	5.16	NL	NA
Chloromethane	440000	NL	0.0097	NA	NL	NA
Chrysene	3000	NL	0.0001	NA	NL	NA
cis-1,2-Dichloroethene	5	NL	0.0000	NA	0.8	NA
cis-1,3-Dichloropropene	440000	NL	0.0097	NA	NL	NA
delta-BHC	140	NL	0.0000	NA	NL	NA
Dibenz(a,h)anthracene	3000	NL	0.0001	NA	NL	NA
Dibenzofuran	3000	NL	0.0001	NA	NL	NA
Dichlorobromomethane	440000	NL	0.0097	NA	NL	NA
Dieldrin	270	NL	0.0000	NA	NL	NA
Diethyl phthalate	3000	NL	0.0001	NA	NL	NA
Dimethyl phthalate	3000	NL	0.0001	NA	NL	NA
Di-n-butyl phthalate	5900	NL	0.0001	NA	NL	NA
Di-n-octyl phthalate	2600	NL	0.0001	NA	NL	NA
Endosulfan I	140	NL	0.0000	NA	NL	NA
Endosulfan II	270	NL	0.0000	NA	NL	NA
Endosulfan sulfate	270	NL	0.0000	NA	NL	NA
Endrin	270	NL	0.0000	NA	NL	NA
Endrin ketone	270	NL	0.0000	NA	NL	NA
Ethylbenzene	3800000	20	0.0837	238.89	0.5	477.8
Fluoranthene	3000	NL	0.0001	NA	NL	NA
Fluorene	3000	NL	0.0001	NA	NL	NA

Table 1A: VOC 8-Hour TWA Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	8-Hour TWA HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
gamma-BHC (Lindane)	140	NL	0.0000	NA	NL	NA
gamma-Chlordane	1400	NL	0.0000	NA	NL	NA
Heptachlor	140	NL	0.0000	NA	NL	NA
Heptachlor epoxide	140	NL	0.0000	NA	NL	NA
Hexachlorobenzene	3000	NL	0.0001	NA	NL	NA
Hexachlorobutadiene	3000	NL	0.0001	NA	NL	NA
Hexachlorocyclopentadiene	3000	NL	0.0001	NA	NL	NA
Hexachloroethane	3000	NL	0.0001	NA	NL	NA
Indeno[1,2,3-cd]pyrene	3000	NL	0.0001	NA	NL	NA
Isophorone	3000	0.1	0.0001	1512.97	NL	NA
Isopropanol	230000	8	0.0051	1578.75	6	263.1
M,P-Xylene	5	NL	0.0000	NA	0.5	NA
Methoxychlor	1400	NL	0.0000	NA	NL	NA
Methylene chloride	440000	2	0.0097	206.31	NL	NA
Naphthalene	3300	0.2	0.0001	2750.85	0.4	6877.1
Nitrobenzene	3000	0.02	0.0001	302.59	1.9	159.3
N-Nitrosodimethylamine	380	NL	0.0000	NA	NL	NA
N-Nitrosodi-n-propylamine	3000	NL	0.0001	NA	NL	NA
N-Nitrosodiphenylamine	3000	NL	0.0001	NA	NL	NA
O-Xylene	5	NL	0.0000	NA	0.5	NA
Pentachlorophenol	14000	NL	0.0003	NA	NL	NA
Phenanthrene	1500	NL	0.0000	NA	NL	NA
Phenol	3000	0.1	0.0001	1512.97	1	1513.0
Pyrene	3000	NL	0.0001	NA	NL	NA
Styrene	2500000	1	0.0551	18.16	0.4	45.4
Tetrachloroethene	1600000	NL	0.0353	NA	NL	NA
Toluene	8600000	2	0.1895	10.56	0.51	20.7
Toxaphene	2700	NL	0.0001	NA	NL	NA

Table 1A: VOC 8-Hour TWA Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	8-Hour TWA HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
trans-1,2-Dichloroethene	5	NL	0.0000	NA	0.5	NA
trans-1,3-Dichloropropene	440000	NL	0.0097	NA	NL	NA
Trichloroethene	7200000	NL	0.1586	NA	0.5	NA
Trichlorofluoromethane	2000	NL	0.0000	NA	NL	NA
Vinyl acetate	270000	NL	0.0059	NA	1.2	NA
Vinyl chloride	350000	0.025	0.0077	3.24	2	1.6
Xylenes, Total	7400000	2	0.1630	12.27	0.6	20.4

Notes:
TWA = time weighted average
VOCs = volatile organic compounds
SVOCs = semi-volatile compounds
ug = microgram
kg = kilogram
ppm = parts per million
NL = not listed
NA = not applicable

Table 1B: VOC 30-Minute Action Level Data

VOC/SVOC	Maximum Concentration (ug/kg)	30-minute HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
1,1,1-Trichloroethane	1000000	NL	0.0220	NA	NL	NA
1,1,2,2-Tetrachloroethane	440000	NL	0.0097	NA	NL	NA
1,1,2-Trichloroethane	440000	NL	0.0097	NA	NL	NA
1,1-Dichloroethane	440000	NL	0.0097	NA	NL	NA
1,1-Dichloroethene	440000	NL	0.0097	NA	0.9	NA
1,2,4-Trichlorobenzene	3000	NL	0.0001	NA	NL	NA
1,2-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,2-Dichloroethane	440000	NL	0.0097	NA	0.8	NA
1,2-Dichloroethene, Total	1400000	NL	0.0308	NA	0.8	NA
1,2-Dichloropropane	440000	NL	0.0097	NA	NL	NA
1,3-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,4-Dichlorobenzene	3000	NL	0.0001	NA	0.47	NA
1,4-Dioxane	50000	NL	0.0011	NA	1.1	NA
2,2'-oxybis(dichloropropane)	3000	NL	0.0001	NA	NL	NA
2,4,5-Trichlorophenol	14000	NL	0.0003	NA	NL	NA
2,4,6-Trichlorophenol	3000	NL	0.0001	NA	NL	NA
2,4-Dichlorophenol	3000	NL	0.0001	NA	NL	NA
2,4-Dimethylphenol	3000	NL	0.0001	NA	NL	NA
2,4-Dinitrophenol	14000	NL	0.0003	NA	NL	NA
2,4-Dinitrotoluene	3000	NL	0.0001	NA	NL	NA
2,6-Dinitrotoluene	3000	NL	0.0001	NA	NL	NA
2-Butanone (MEK)	440000	20	0.0097	NA	0.9	NA
2-Chloroethylvinyl ether	2000	NL	0.0000	NA	NL	NA
2-Chloronaphthalene	3000	NL	0.0001	NA	NL	NA
2-Chlorophenol	3000	NL	0.0001	NA	NL	NA
2-Hexanone	440000	NL	0.0097	NA	NL	NA
2-Methylnaphthalene	2000	NL	0.0000	NA	NL	NA
2-Methylphenol	3000	NL	0.0001	NA	NL	NA
2-Nitroaniline	14000	NL	0.0003	NA	NL	NA

Table 1B: VOC 30-Minute Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	30-minute HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
2-Nitrophenol	3000	NL	0.0001	NA	NL	NA
3,3'-Dichlorobenzidine	5900	NL	0.0001	NA	NL	NA
3-Nitroaniline	14000	NL	0.0003	NA	NL	NA
4,6-Dinitro-2-methylphenol	14000	NL	0.0003	NA	NL	NA
4-Bromophenyl phenyl ether	3000	NL	0.0001	NA	NL	NA
4-Chloro-3-methylphenol	3000	NL	0.0001	NA	NL	NA
4-Chloroaniline	3000	NL	0.0001	NA	NL	NA
4-Chlorophenyl phenyl ether	3000	NL	0.0001	NA	NL	NA
4-Methyl-2-pentanone (MIBK)	490000	5	0.0108	463.15	1	463
4-Methylphenol	3000	NL	0.0001	NA	NL	NA
4-Nitroaniline	14000	NL	0.0003	NA	NL	NA
4-Nitrophenol	14000	NL	0.0003	NA	NL	NA
Acenaphthene	3000	NL	0.0001	NA	NL	NA
Acenaphthylene	3000	NL	0.0001	NA	NL	NA
Acetone	440000	25	0.0097	2578.92	1.1	2344
Acrolein	20000	0.01	0.0004	22.69	3.9	6
Acrylonitrile	20000	0.05	0.0004	113.47	NL	NA
Aldrin	140	NL	0.0000	NA	NL	NA
alpha-BHC	140	NL	0.0000	NA	NL	NA
alpha-Chlordane	1400	NL	0.0000	NA	NL	NA
Benzene	440000	0.25	0.0097	25.79	0.5	52
Benzyl alcohol	3000	NL	0.0001	NA	NL	NA
beta-BHC	140	NL	0.0000	NA	NL	NA
bis(2-Chloroethoxy)methane	3000	NL	0.0001	NA	NL	NA
bis(2-Chloroethyl)ether	3000	NL	0.0001	NA	NL	NA
Bis(2-ethylhexyl) phthalate	56000	NL	0.0012	NA	NL	NA
Bromoform	440000	0.05	0.0097	5.16	2.5	2
Bromomethane	440000	NL	0.0097	NA	NL	NA
Butyl benzyl phthalate	10000	NL	0.0002	NA	NL	NA
Carbon disulfide	440000	0.1	0.0097	10.32	1.2	9

Table 1B: VOC 30-Minute Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	30-minute HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
Carbon tetrachloride	440000	0.25	0.0097	25.79	NL	NA
Chlorobenzene	440000	7.5	0.0097	773.68	0.4	1934
Chlorodibromomethane	440000	NL	0.0097	NA	NL	NA
Chloroethane	440000	10	0.0097	1031.57	NL	NA
Chloroform	440000	0.25	0.0097	25.79	NL	NA
Chloromethane	440000	NL	0.0097	NA	NL	NA
Chrysene	3000	NL	0.0001	NA	NL	NA
cis-1,2-Dichloroethene	5	NL	0.0000	NA	0.8	NA
cis-1,3-Dichloropropene	440000	NL	0.0097	NA	NL	NA
delta-BHC	140	NL	0.0000	NA	NL	NA
Dibenz(a,h)anthracene	3000	NL	0.0001	NA	NL	NA
Dibenzofuran	3000	NL	0.0001	NA	NL	NA
Dichlorobromomethane	440000	NL	0.0097	NA	NL	NA
Dieldrin	270	NL	0.0000	NA	NL	NA
Diethyl phthalate	3000	NL	0.0001	NA	NL	NA
Dimethyl phthalate	3000	NL	0.0001	NA	NL	NA
Di-n-butyl phthalate	5900	NL	0.0001	NA	NL	NA
Di-n-octyl phthalate	2600	NL	0.0001	NA	NL	NA
Endosulfan I	140	NL	0.0000	NA	NL	NA
Endosulfan II	270	NL	0.0000	NA	NL	NA
Endosulfan sulfate	270	NL	0.0000	NA	NL	NA
Endrin	270	NL	0.0000	NA	NL	NA
Endrin ketone	270	NL	0.0000	NA	NL	NA
Ethylbenzene	3800000	20	0.0837	238.89	0.5	478
Fluoranthene	3000	NL	0.0001	NA	NL	NA
Fluorene	3000	NL	0.0001	NA	NL	NA
gamma-BHC (Lindane)	140	NL	0.0000	NA	NL	NA
gamma-Chlordane	1400	NL	0.0000	NA	NL	NA
Heptachlor	140	NL	0.0000	NA	NL	NA
Heptachlor epoxide	140	NL	0.0000	NA	NL	NA

Table 1B: VOC 30-Minute Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	30-minute HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
Hexachlorobenzene	3000	NL	0.0001	NA	NL	NA
Hexachlorobutadiene	3000	NL	0.0001	NA	NL	NA
Hexachlorocyclopentadiene	3000	NL	0.0001	NA	NL	NA
Hexachloroethane	3000	NL	0.0001	NA	NL	NA
Indeno[1,2,3-cd]pyrene	3000	NL	0.0001	NA	NL	NA
Isophorone	3000	0.5	0.0001	7564.83	NL	NA
Isopropanol	230000	40	0.0051	7893.73	6	1316
M,P-Xylene	5	NL	0.0000	NA	0.5	NA
Methoxychlor	1400	NL	0.0000	NA	NL	NA
Methylene chloride	440000	10	0.0097	1031.57	NL	NA
Naphthalene	3300	1	0.0001	13754.23	0.4	34386
Nitrobenzene	3000	0.1	0.0001	1512.97	1.9	796
N-Nitrosodimethylamine	380	NL	0.0000	NA	NL	NA
N-Nitrosodi-n-propylamine	3000	NL	0.0001	NA	NL	NA
N-Nitrosodiphenylamine	3000	NL	0.0001	NA	NL	NA
O-Xylene	5	NL	0.0000	NA	0.5	NA
Pentachlorophenol	14000	NL	0.0003	NA	NL	NA
Phenanthrene	1500	NL	0.0000	NA	NL	NA
Phenol	3000	0.5	0.0001	7564.83	1	7565
Pyrene	3000	NL	0.0001	NA	NL	NA
Styrene	2500000	5	0.0551	90.78	0.4	227
Tetrachloroethene	1600000	NL	0.0353	NA	NL	NA
Toluene	8600000	10	0.1895	52.78	0.51	103
Toxaphene	2700	NL	0.0001	NA	NL	NA
trans-1,2-Dichloroethene	5	NL	0.0000	NA	0.5	NA
trans-1,3-Dichloropropene	440000	NL	0.0097	NA	NL	NA

Table 1B: VOC 30-Minute Action Level Data (Cont'd)

VOC/SVOC	Maximum Concentration (ug/kg)	30-minute HLV (ppm)	Mole Fraction	HLV/Mole Fraction	PID Correction Factor	Action Level (ppm)
Trichloroethene	7200000	NL	0.1586	NA	0.5	NA
Trichlorofluoromethane	2000	NL	0.0000	NA	NL	NA
Vinyl acetate	270000	NL	0.0059	NA	1.2	NA
Vinyl chloride	350000	0.125	0.0077	16.21	2	8
Xylenes	7400000	10	0.1630	61.34	0.6	102
Total ug of all VOC/SVOC per unit of soil	45388971	NL	NL	NA	NL	NA

Notes:
TWA = time weighted average
VOCs = volatile organic compounds
SVOCs = semi-volatile compounds
ug = microgram
kg = kilogram
ppm = parts per million
NL = not listed
NA = not applicable

Table 2A: Particulate 30-Minute Action Level Data

Metal	Metals Concentration (mg/kg)	HLV 30-Minute Value (mg/m^3)	Airborne Dust Concentration To Maintain Ambient Level Below The HLV 30-Minute Value (mg/m^3)
Aluminum	10700.0	1	93.46
Antimony	12.0	0.05	4166.67
Arsenic	3.3	0.00025	75.76
Barium	615.0	0.05	81.30
Beryllium	1.0	0.00005	50.00
Cadmium	183.0	0.002	10.93
Chromium	183.0	0.0125	68.31
Cobalt	9.9	0.01	1010.10
Copper	60.1	0.1	1663.89
Lead	873.0	0.015	17.18
Iron	13700.0	0.5	36.50
Magnesium	5330.0	1	187.62
Manganese	440.0	0.1	227.27
Mercury	0.1	0.001	10000.00
Nickel	19.9	0.0015	75.38
Selenium	37.3	0.02	536.19
Silver	2.0	0.001	500.00
Thallium	2.0	0.01	5000.00
Vanadium	30.9	0.005	161.81
Zinc	155.0	0.5	3225.81

Notes:
TWA = time weighted average
mg = milligram
kg = kilogram
m^3 = cubic meters
NL = not listed
NA = not applicable

Table 2B: Particulate 8-Hour TWA Action Level

Metal	Metals Concentration (mg/kg)	HLV 8-Hour TWA Value (mg/m^3)	Airborne Dust (AD) Concentration To Maintain Ambient Level Below the HLV 8-Hour TWA Value (mg/m^3)
Aluminum	10700.0	0.2	18.69
Antimony	12.0	0.01	833.33
Arsenic	3.3	0.00005	15.15
Barium	615.0	0.01	16.26
Beryllium	1.0	0.00001	10.00
Cadmium	183.0	0.0004	2.19
Chromium	183.0	0.0025	13.66
Cobalt	9.9	0.001	101.01
Copper	60.1	0.02	332.78
Lead	873.0	0.003	3.44
Iron	13700.0	0.1	7.30
Magnesium	5330.0	0.2	37.52
Manganese	440.0	0.02	45.45
Mercury	0.1	0.0002	2000.00
Nickel	19.9	0.0003	15.08
Selenium	37.3	0.004	107.24
Silver	2.0	0.0002	100.00
Thallium	2.0	0.002	1000.00
Vanadium	30.9	0.001	32.36
Zinc	155.0	0.1	645.16

Notes:
TWA = time weighted average
mg = milligram
kg = kilogram
m^3 = cubic meters
NL = not listed
NA = not applicable