State Superfund Program

Remedial Investigation Work Plan

for

Off-Site Diamond Auto Service
Site No.: C152196A

71-73 Cleveland Avenue
Bay Shore
Suffolk County, New York

January 2015

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1.0 Introduction

The New York State Department of Environmental Conservation (NYSDEC), in cooperation with the New York State Department of Health (NYSDOH), is investigating off-site contamination from historical operations conducted at 71-73 Cleveland Avenue in Bay Shore, New York (herein referred to as the “site”). Off-site activities will be covered under site number C152196A. This work plan specifies the investigative methods proposed to accomplish the field investigations and sampling tasks required to evaluate off-site conditions so the appropriate remedial action can be selected. The remedial investigation (RI) will focus on defining the extents of off-site contamination in groundwater and soil vapor and potential threats to public health and the environment. Based on the findings of the RI, a feasibility study (FS) will be prepared that presents the remedial action objectives, compares remedial alternatives and identifies the appropriate remedial alternative. RI and FS activities are being performed under the Inactive Hazardous Waste Disposal Site Remedial Program, also known as the State Superfund (SSF) Program, to identify and characterize suspected inactive hazardous waste disposal sites and investigate and remediate inactive hazardous waste disposal sites which pose a significant threat to public health and/or the environment.

Information regarding on-site investigations and remedial activities is available under the Brownfield Cleanup Program for Diamond Auto Service site (site number C152196). The following link can be used to obtain current environmental and health assessments for on-site and off-site activities by entering the appropriate site number within the site code box.

http://www.dec.ny.gov/cfmx/extapps/derexternal/index.cfm?pageid=3

1.1 Site Location and Background

The Diamond Auto Service site is located at 71-73 Cleveland Avenue in Bay Shore, Suffolk County, New York, see Figure 1. The site is bounded by Cleveland Avenue to the west and buildings to the north, east and south. The site covers approximately 0.46 acres in a commercial and industrial area. The site is includes an 8,000 square foot single story building that was constructed in 1971. The remaining portions of the site are covered by asphalt. Site conditions are illustrated on Figure 2.

1.2 Historical Remedial Activities

The site was utilized by Multi-turn Manufacturing Corporation, Huntington Bronze Corporation and Precision Concepts Corporation (a sheet metal company). Historical operations included the use of a vapor degreaser, which used tetrachloroethene as the degreasing agent.

From 1998 to 2000, Suffolk County Department of Health Services reviewed remedial activities performed by the property owner to investigate and remediate soils within subsurface drainage structures. The reports identified tetrachloroethylene (PCE) and associated breakdown products within the environment. Groundwater was determined to be approximately six feet below ground surface and flows south. In June 1998 clean out of subsurface drainage structures LP-4 and SD-2 was performed. A vac-truck was used to remove 2 drums of soils from LP-4 and 6 drums from SD-2. Endpoint sample from SD-2 detected elevated concentrations of tetrachloroethene (PCE). In December 1998, supplemental removal action was conducted at SD-2, which removed approximately 22 tons of soil to a depth of 14 feet below ground surface. Groundwater concentrations at MW-2 decreased significantly following the removal of the contaminated soils, see Table 1.

Table 1
Groundwater Summary Results 1998 & 1999

Parameter	GW Std.	MW-1	MW-1	MW-2	MW-2	MW-3	MW-3	MW-4
Date	-	8/12/98	4/23/99	8/12/98	4/23/99	8/12/98	4/23/99	4/23/99
vinyl chloride	5	ND	ND	350	ND	ND	ND	1
1,1 DCE	5	ND	ND	25	ND	ND	ND	ND
t1,2 DCE	5	ND	ND	12	ND	ND	ND	ND
1,1 DCA	5	ND	ND	61	ND	ND	ND	ND
1,1,1 TCA	5	ND	ND	230	1	ND	ND	2
TCE	5	ND	ND	24	3	ND	3	23
toluene	5	ND	ND	600	ND	ND	ND	ND
PCE	5	ND	ND	72	17	ND	ND	150
ethyl benzene	5	ND	ND	69	ND	ND	ND	ND
total xylene	5	ND	ND	268	ND	ND	ND	ND
cis DCE	5	ND	ND	13,000	2	1	ND	220

Notes: units: micrograms per liter (ug/l)
ND – non-detect
DCE – dichlorothene
DCA – dichloroethane
TCA – trichloroethane
TCE – trichloroethene

In 2005, the site entered the Brownfield Cleanup Program. Remedial activities were performed to define contamination on-site and address contamination present on-site. Details of these activities are provided in the Final Engineering Report, dated November 2013. Investigation activities detected elevated concentrations of volatile organic compounds, particularly tetrachloroethene (PCE) and associated breakdown products trichloroethene (TCE), cis-1,2 dichloroethene (DCE) and vinyl chloride (VC), in groundwater and soil vapor samples. In 2007, remedial investigation activities detected volatile organic compounds in groundwater at concentrations below 10 ug/l and in soil vapor beneath the on-site building at over 600 micrograms per cubic meter. The primary action performed at the site was the installation of a sub-slab depressurization system and implementation of a site management plan. A passive sub-slab depressurization system was installed in March 2009 and subsequently upgraded to an active system in July 2013.

1.3 Physical Setting

Based on our review of the United States Geological Survey 7.5-Minute Quadrangle Maps, (Greenlawn, dated 1979), the elevation of the Site is approximately 60 feet above mean sea level. The topography of the immediate Site area was observed to be level, with a slight grade to the southeast. A copy of the topographic map is provided on Figure 1.

The surface geology of Long Island consists of glacial outwash. The soils encountered during the previous investigations consisted of predominately tan medium to fine grained sands with varying amounts of silt, coarse grained sand and gravel. Groundwater is approximately 4 feet below ground surface (bgs) and flows south. Groundwater within the glacial outwash is part of the Upper Glacial aquifer, which extends to an approximate depth of 150 feet bgs near the site. The Magothy aquifer underlies the Upper Glacial aquifer and extends from 150 feet to 850 feet bgs near the site. The Magothy aquifer is comprised of interbedded sand and clay.

2.0 Remedial Investigation Field Activities

The primary objective of this RI is to delineate the extent of groundwater and soil vapor contamination that has migrated off-site. This will be accomplished through the installation of temporary wells, permanent wells and soil vapor intrusion evaluations. The following sections will provide the descriptions and rationales for the various field activities to address the RI objectives. Figure 3 illustrates the locations of the proposed activities to be completed under this RI. A summary of the planned sampling and analyses are presented in Table 2. All sampling and investigation activities shall be performed in accordance with the NYSDEC regulations and guidance documents. The anticipated field activities will follow the site Health and Safety Plan (HASP). Field work is anticipated to begin in March 2015.

TABLE 2
Sample Summary
Volatile Organic Compound Analysis

Task	Groundwater Profile Points	Groundwater Monitoring Well Sampling	Soil Vapor Structure Sampling
Groundwater Profiles (GP)	28		
Monitoring Wells (MW)		4	
Indoor Air (IA)			7
Sub-slab Soil Vapor (SS)			7
Ambient Air (AA)			1
QA/QC			
Trip Blanks	4	1	
Field Blanks	4	1	
Duplicates	2	1	1
MS/MSD	2	1	
Totals	52	11	14

Notes:
1. All samples will be analyzed by a NYSDOH Environmental Laboratory Approval Program (ELAP) certified laboratory.
2. Analytical data shall be reported by the laboratory in a NYSDEC Analytical Services Protocol Category B data deliverable format.
3. Groundwater samples will be analyzed for VOC by EPA Method 8260, bottles will be 2 40 ml glass vials with Teflon lined septa and HCL preservation. Maximum hold time is 7 days. Laboratory method detection limits is 2 micrograms per liter for chlorinated volatile organic compounds.
4. Air samples will be analyzed for VOC by EPA Method TO-15.
5. Sample results shall be provided within the standard turnaround time (30 days).
6. Matrix spike/matrix spike duplicate (MS/MSD) and duplicates will be done 1/20 samples.
7. Trip blanks will be done one per cooler shipment to the laboratory and will be in the sample cooler at all times.
8. Field blanks will consist of the analysis of laboratory provided water that contacted sampling equipment.
9. Samples must be stored on ice at 4 degrees Celsius.
10. Unique sample identification for each sample (e.g. GP#-depth-date, MW#-depth-date, SS#-date, IA#-date, AA#-date).

2.1 Utility Mark-outs and Off-site Access

Prior to mobilization, the necessary permits shall be obtained, utilities shall be marked out and property owners shall be contacted. A utility mark-out verification reference number for the site will be obtained. Proposed explorations shall be located a safe distance from utility mark-outs. Hand clearing each location, via hand auger, will be considered based on utility mark-outs.

2.2 Groundwater Profile Points

Four groundwater profile points will be completed to evaluate groundwater quality at or down-gradient of the site, see Figure 3. Temporary sampling points via direct push techniques using slotted rods will be performed to obtain discrete groundwater samples every 10 feet, starting at approximately 10 feet bgs and finishing at 70 feet bgs. A peristaltic pump or inertia pump will be used to purge groundwater from each sample interval. New tubing shall be used between each sample interval. Groundwater samples shall be collected after three tubing volumes or turbidity is below 50 NTUs. Groundwater parameters (e.g. turbidity, pH, temperature, conductivity, dissolved oxygen and redox) will be obtained prior to sampling.

After collecting the last sample at 70 feet bgs, the borehole shall be grouted (grout mixture: 94 pounds cement, 4 pounds powdered bentonite and 8 gallons potable water).

Table 2 presents a summary of sampling and analyses for this phase of the RI. Groundwater samples will be analyzed for Volatile Organic Compounds (VOCs) via USEPA Method 8260B by a NYSDOH ELAP certified lab. Two duplicate groundwater samples, four field blanks, two trip blanks and two MS/MSD are anticipated for Quality Assurance/Quality Control (QA/QC) purposes. Table 2 summarizes all proposed water samples for laboratory analysis. Data from this sampling event will determine the extent of groundwater contamination and be used to determine the screen intervals for the permanent monitoring wells.

Purge water derived from well development and well sampling, will be discharged directly to the ground, unless a sheen is present or there are elevated PID readings. If PID readings are elevated or there is a sheen present, purge water will be containerized in 55-gallon drums for characterization prior to off-site disposal. Each borehole shall be grouted to ground surface prior to mobilizing to the next groundwater profile point.

2.3 Monitoring Well Installation

Following completion of the down-gradient profile points located along South Fehr Way, three monitoring wells shall be installed (one at each groundwater profile point location) utilizing direct push techniques. Each monitoring well shall be screened at the interval with the highest chlorinated VOC detection or at the top of the groundwater table. Ten feet of 3/4-inch diameter prepacked 0.010-inch slotted, schedule 40 PVC well screen shall be installed. Schedule 40 PVC riser shall be connected to the well screen and extended to ground surface. Aggregate should be placed within the borehole to extend the filter pack 2 feet above the top of the screen. Prior to placement of bentonite-cement grout to 1 foot bgs (grout mixture: 94 pounds cement, 4 pounds powdered bentonite and 8 gallons potable water) a bentonite seal approximately 2 feet thick will be placed above the filter pack. Each monitoring well shall be capped with a water tight plug and protected by a flushmount set within a concrete pad (2 feet by 2 feet by 0.5 feet). Additional details regarding construction of the monitoring wells is available in Appendix A.

Well development procedures will begin after completion of the monitoring wells. Development of monitoring wells will include continued groundwater pumping and surging until well water is as free of sediment as practical. Purge water derived from well development and well sampling, will be discharged directly to the ground, unless a sheen is present or there are elevated PID readings. If PID readings are elevated or there is a sheen present, purge water will be containerized in 55-gallon drums for characterization prior to off-site disposal.

2.4 Surveying

The locations of the groundwater profile points and the monitoring wells shall be surveyed to determine the horizontal coordinates using a trimble unit. The elevations of the top of the well casings will be surveyed to a site datum to the nearest 0.01 of a foot. The existing wells shall be used as the datum. Following surveying activities a round of groundwater elevations will be recorded to confirm groundwater flow direction.

2.5 Groundwater Sampling

After the new monitoring wells are installed, one round of groundwater sampling will be completed. Groundwater sampling will be conducted at the three new wells and the one on-site well, identified as MW-4. Groundwater sampling will be conducted a minimum of 14 days after completion of all new monitoring well development procedures. Prior to all purging and sampling activities, a round of groundwater elevation measurements shall be taken from the wells to determine the direction of groundwater flow. Environmental Protection Agency (EPA) Region 2 low flow purge and field screening techniques will be utilized prior to collecting the groundwater samples at all the monitoring wells. A copy of the EPA Region 2 low flow sampling procedure and a field form is included in Appendix B.

Table 2 presents a summary of sampling and analyses for this RI. Groundwater samples will be analyzed for VOCs via USEPA Method 8260B by a NYSDOH ELAP certified lab. One duplicate groundwater sample, one field blank, one trip blank and one MS/MSD must be taken for QA/QC purposes. Table 2 summarizes all proposed water samples for laboratory analysis. Data from this sampling event will confirm findings from the groundwater profile points and permit future sampling events.

2.6 Equipment Decontamination

All down-hole drilling equipment will be decontaminated prior to its arrival at the site and between each use. All reusable sampling equipment will be decontaminated with a three step washing process that consists of a tap water rinse, an alconox and tap water wash, followed by a tap water rinse.

Groundwater sampling pumps used for sample collection will be decontaminated between sample collection by passing the detergent and water mixture through the pump, followed by fresh water rinse.

If visual contamination remains, new sampling equipment will be obtained or decontaminated procedures will be modified.

2.7 Structure Sampling

Contact seven off-site property owners to conduct soil vapor intrusion evaluations during the heating season. Each evaluation will include completion of the NYSDOH indoor air quality questionnaire and building inventory form, see Appendix C, and the collection of an indoor air and sub-slab soil vapor samples. Field activities shall be conducted in accordance with New York State Department of Health Guidance for Evaluating Soil Vapor Intrusion in the State of New York. Indoor air canisters shall be located within occupied spaces and set at a height of approximately 4 feet. Sub-slab soil vapor points shall be constructed by drilling a 3/8-inch hole through the floor and inserting ¼-inch diameter chemical resistant tubing approximately 2-inches below the base of the floor. The tubing will be sealed to the floor by using modeling clay covered by bees wax at the top of the floor. A syringe or air pump will be used to purge three tubing volumes at each sub-slab vapor point. Purge and sample rates will be less than 200 milliliter/minute (ml/min). Purged air will be screened with a photoionization detector. Immediately after purging, the tubing shall be connected to the canister. An additional sample will be collect of the ambient air during this sampling program at an up wind location. Canisters will be laboratory-certified clean summa® canister equipped with a 24 hour regulator. Vacuum readings from the regulators will be obtained when activated, 15 minutes after activation and prior to collection at ~24 hours. After completion of the sampling program, hydraulic cement will be placed within the sub-slab soil vapor points to seal the holes.

Table 2 presents a summary of sampling and analyses for this RI. Samples will be analyzed for VOCs via USEPA Method TO-15 by a NYSDOH ELAP certified lab. One duplicate sample will be collected for QA/QC purposes.

2.8 Data Validation and Electronic Data Deliverables

Laboratory data will be reviewed by a NYSDEC data reviewer and a data quality report will be prepared. Category B data deliverables and NYSDEC electronic data deliverables (EDD) will be provided by the laboratories. An EDD submission to NYSDEC will be performed.

3.0 Remedial Investigation Report

Following the implementation and completion of all activities included in this work plan, a Remedial Investigation Report (RIR) will be prepared. The report will include the following elements at a minimum:

- A description of all investigative activities performed;
- Conclusions drawn from the data analysis; and
- Assessment of human health and environmental conditions.

4.0 References

6 NYCRR Parts 375 *Environmental Remediation Programs*, December 14, 2006.

Conroy Environmental Consultants, Inc., *Brownfield Cleanup Program Application*, July 21, 2004.

Division of Environmental Remediation (DER-10) *Technical Guidance for Site Investigation and Remediation*, May 3, 2010.

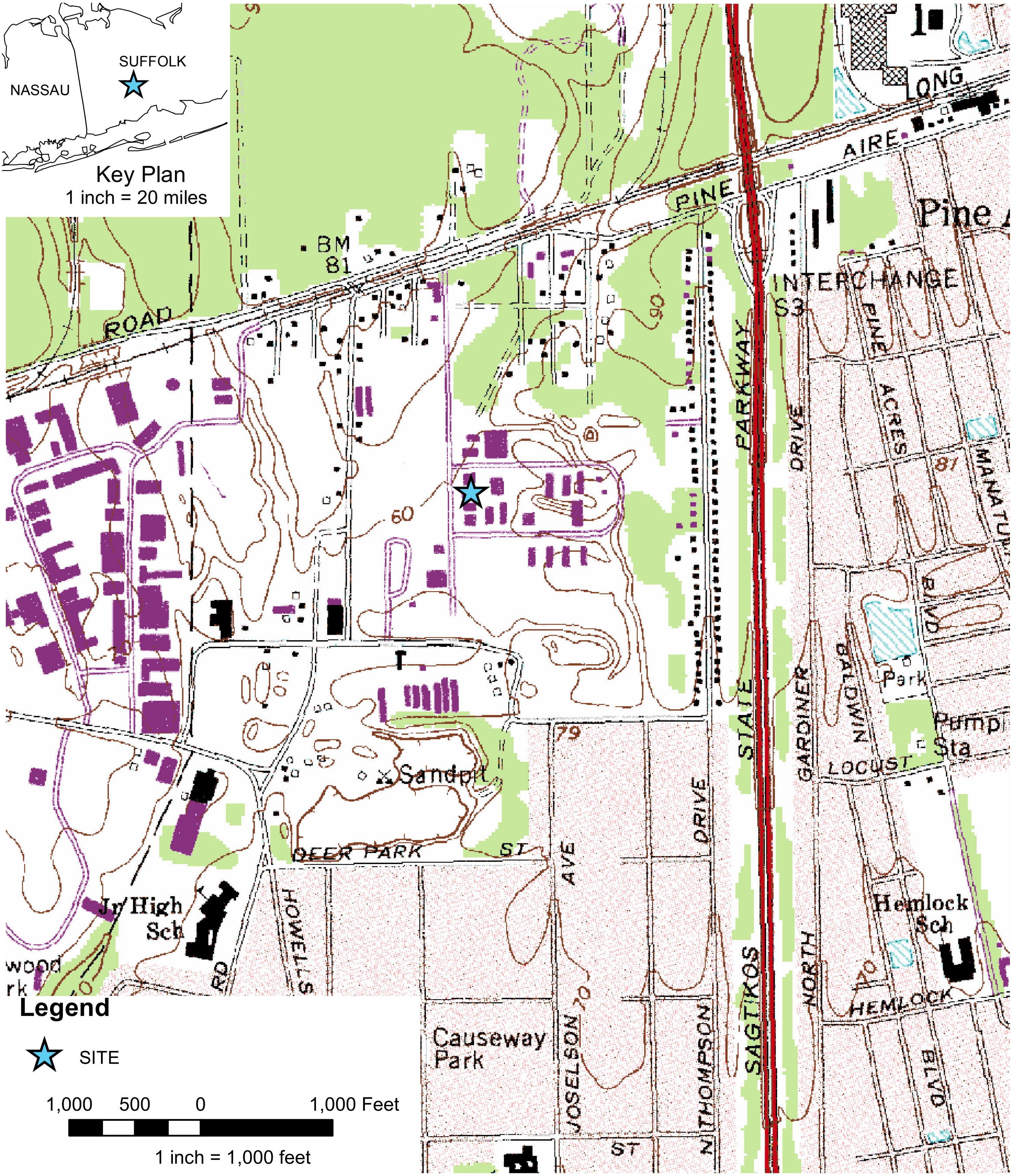
J.R. Holzmacher, *Diamond Auto Service, Inc. Remedial Investigation Report*, December 9, 2009.

J.R. Holzmacher, *Diamond Auto Service, Inc. Site Management Plan*, August 2013.

J.R. Holzmacher, *Diamond Auto Service, Inc. Final Engineering Report*, November 2013.

P.W. Grosser Consulting Engineer & Hydrogeologist, P.C., *Investigation Report for 71-73 Cleveland Avenue*, September 1998.

P.W. Grosser Consulting Engineer & Hydrogeologist, P.C., *Remediation Report for 71-73 Cleveland Avenue*, August 1999.



Source Data: Aerial - 2004 Color 30cm Resolution

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Figure 1
Site Location Map
Diamond Auto Service
Bay Shore, Suffolk County, New York

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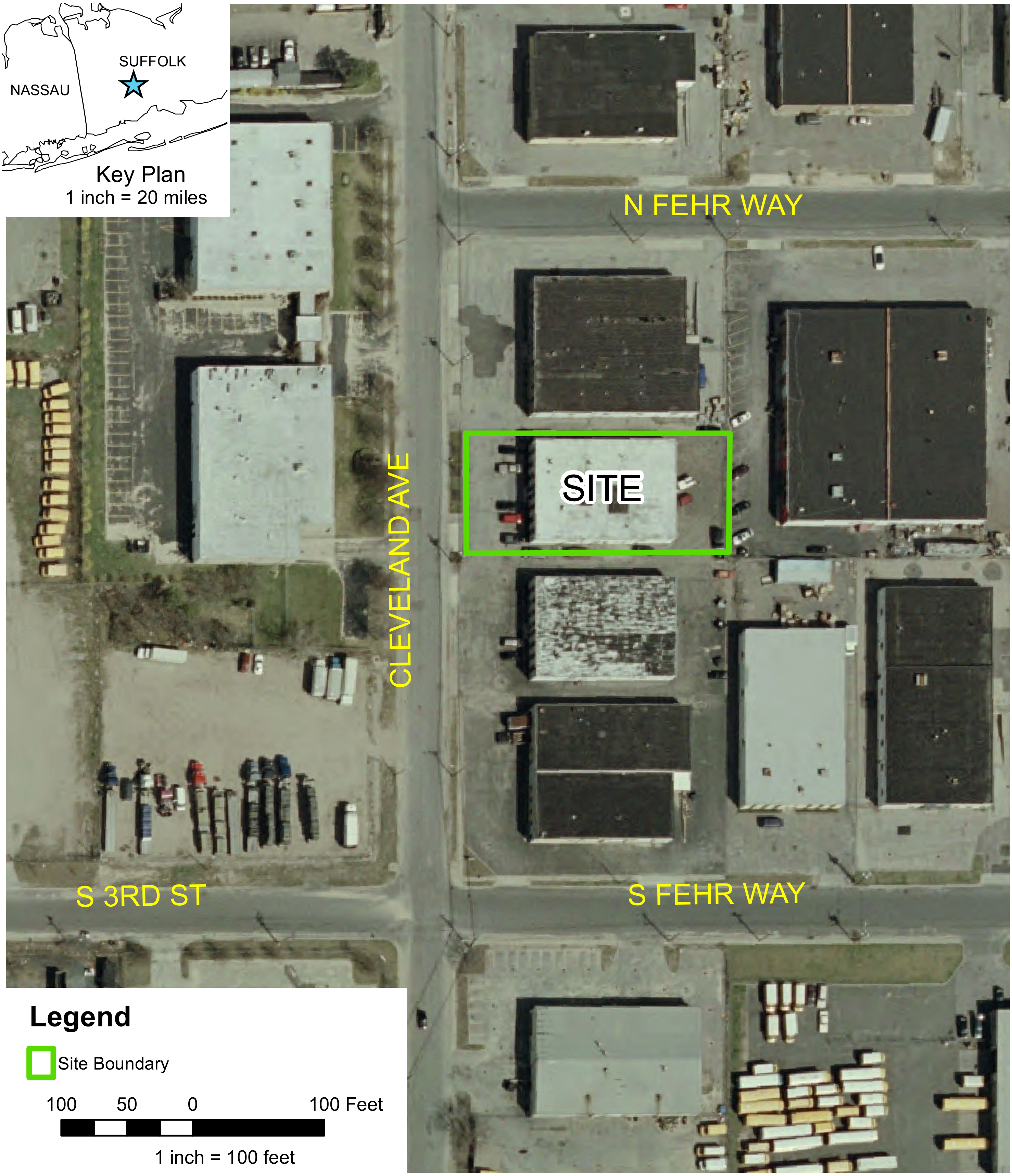

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Figure 2
Site Plan
Diamond Auto Service
Bay Shore, Suffolk County, New York

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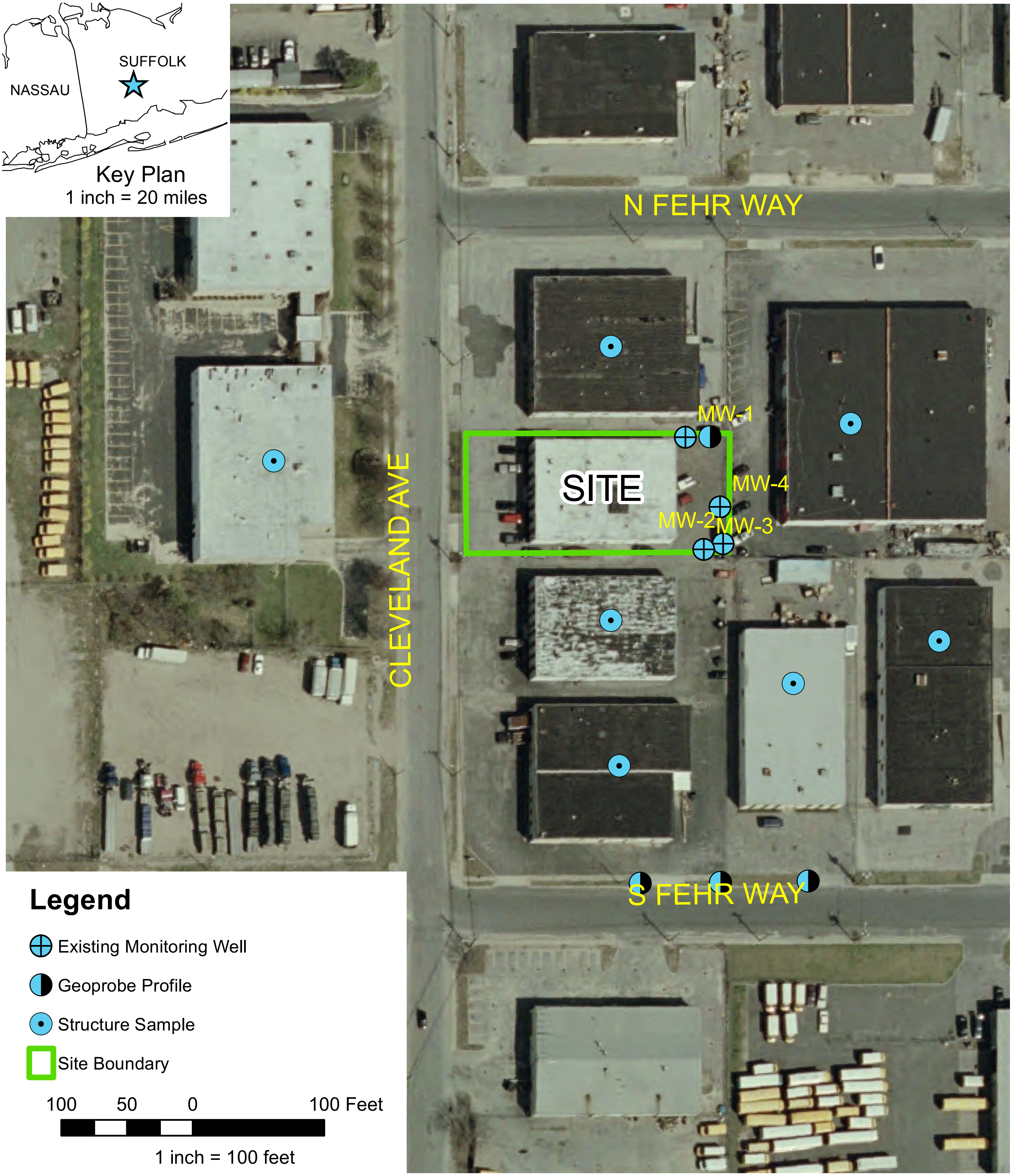

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Figure 3
Sampling Plan
Diamond Auto Service
Bay Shore, Suffolk County, New York

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Appendix A

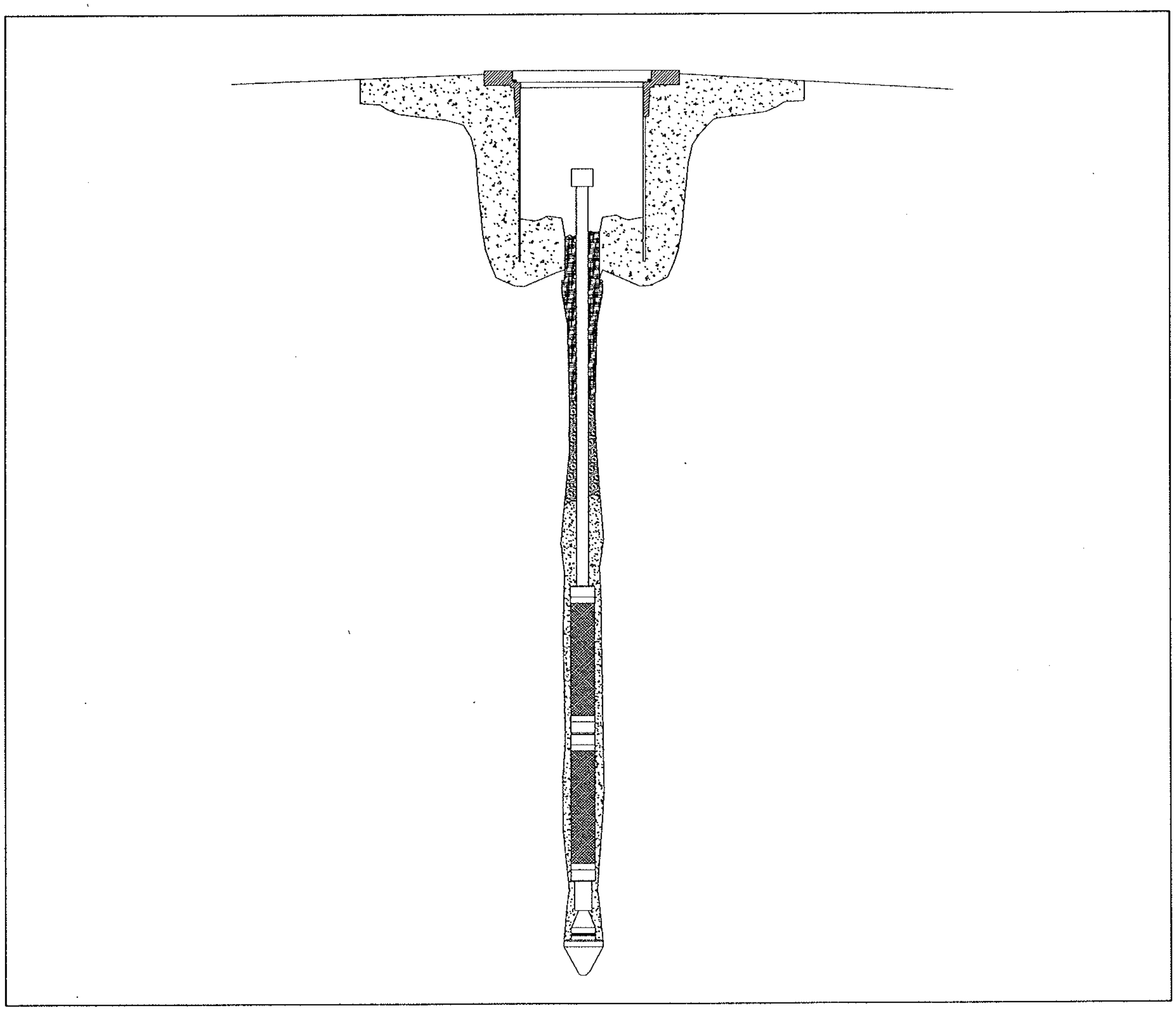
GEOPROBE® 0.5-IN. X 1.4-IN. OD AND 0.75-IN. X 1.4-IN. OD PREPACKED SCREEN MONITORING WELLS

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 962000

PREPARED: September, 1996

REVISED: January, 2011



GEOPROBE® PREPACKED SCREEN MONITORING WELL

Geoprobe Systems®

Geoprobe® and Geoprobe Systems®, Macro-Core® and Direct Image® are Registered Trademarks of Kejr, Inc., Salina, Kansas

Geoprobe® Prepacked Screens are manufactured under U.S. Patent No. 7,735,553B2.

1.0 OBJECTIVE

The objective of this procedure is to install a permanent, small-diameter groundwater monitoring well that can be used to collect water quality samples, conduct hydrologic and pressure measurements, or perform any other sampling event that does not require large amounts of water over a short period of time (e.g. flow rate > 1 liter/minute). These methods meet or exceed the specifications discussed for direct push installation of permanent monitoring wells with prepacked screens in the U.S. Environmental Protection Agency's guidance document, *Expedited Site Assessment Tools For Underground Storage Tank Sites*, (EPA, 1997) and ASTM Standards *D 6724* (ASTM, 2002) and *D 6725* (ASTM, 2002).

2.0 BACKGROUND

2.1 Definitions

Geoprobe® Direct Push Machine: A vehicle-mounted, hydraulically-powered machine that uses static force and percussion to advance small-diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling, soil conductivity and contaminant logging, grouting, materials injection, and to install small-diameter permanent monitoring wells or temporary piezometers.
**Geoprobe® is a registered trademark of Kejr, Inc., Salina, Kansas.*

0.5-inch x 1.4-inch OD Prepacked Well Screen (0.5-inch prepack): An assembly consisting of a slotted PVC pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 0.5-inch Schedule 80 PVC pipe with 0.01-inch (0.25 mm) slots. Stainless steel wire mesh with a pore size of 0.011 inches (0.28 mm) makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe® 0.5-inch x 1.4-inch prepacks are available in 3-foot and 5-foot sections and have an outside diameter of 1.4 inches (36 mm) and a nominal inside diameter of 0.5 inches (13 mm).

0.75-inch x 1.4-inch OD Prepacked Well Screen (0.75-inch prepack): An assembly consisting of a slotted PVC pipe surrounded by environmental grade sand contained within a stainless steel wire mesh cylinder. The inner component of the prepacked screen is a flush-threaded, 0.75-inch Schedule 40 PVC pipe with 0.01-inch (0.25 mm) slots. Stainless steel wire mesh with a pore size of 0.011 inches (0.28 mm) makes up the outer component of the prepack. The space between the inner slotted pipe and outer wire mesh is filled with 20/40 mesh silica sand. Geoprobe® 0.75-inch x 1.4-inch prepacks are available in 3-foot and 5-foot sections and have an outside diameter of 1.4 inches (36 mm) and a nominal inside diameter of 0.75 inches (19 mm).

2.2 Discussion

Conventional monitoring wells are typically constructed through hollow stem augers by lowering slotted PVC pipe (screen) to depth on the leading end of a string of threaded PVC riser pipe. A filter pack is then installed by pouring clean sand of known particle size through the tool string annulus until the slotted section of the PVC pipe is sufficiently covered.

Installing the entire filter pack through the tool string annulus becomes a delicate and time-consuming process when performed with small-diameter direct push tooling. Sand must be poured very slowly in order to avoid bridging between the riser pipe and probe rod. When bridging does occur, considerable time can be lost in attempting to dislodge the sand or possibly pulling the tool string and starting over.

Prepacked screens greatly decrease the volume of loose sand required for well installation as each screen assembly includes the necessary sand filter pack. Sand must still be delivered through the casing annulus to provide a minimum 2-foot grout barrier, but this volume is significantly less than for the entire screened interval.

The procedures outlined in this document describe construction of a permanent groundwater monitoring well using Geoprobe® 2.25-inch (57 mm) outside diameter (OD) probe rods and 1.4-inch OD prepacked screens. Geoprobe® 1.4-inch prepacks are available with either nominal 0.5-inch schedule 80 or 0.75-inch schedule 40 PVC components. Further options include running lengths of 3 and 5 feet for both 0.5- and 0.75-inch prepacks.

Installation of a prepack monitoring well begins by advancing 2.25-inch (57 mm) outside diameter (OD) probe rods to depth with a Geoprobe® direct push machine. Prepacked screen(s) are then assembled and installed through the 1.5-inch (38 mm) inside diameter (ID) of the probe rods using corresponding 0.5-inch schedule 80 or 0.75-inch schedule 40 PVC riser (Fig. 2.1-A).

The prepack tool string is attached to an expendable anchor point with a locking connector that is threaded to the bottom of the leading screen. Once the connector is locked onto the anchor point, the rod string is slowly retracted until the lower end of the rods is approximately 3 feet above the top prepack. Threaded bottom plug with an expendable point is another way to set the well.

Regulations generally require a minimum 2-foot grout barrier above the top prepack (Fig. 2.1-B) to avoid contaminating the well screens with bentonite or cement during installation. In some instances, natural formation collapse will provide the required barrier. If the formation is stable and does not collapse around the riser as the rod string is retracted, environmental grade 20/40 mesh sand may be installed through the probe rods to provide the minimum 2-foot grout barrier.

Granular bentonite or bentonite slurry is then installed in the annulus to form a well seal (Fig. 2.1-B). A high-pressure grout pump (Geoprobe® Model GP300 or GP350) may be used to tremie high-solids bentonite slurry or neat cement grout to fill the well annulus as the probe rods are retracted (Fig. 2.1-B). The grout mixture must be installed with a tremie tube from the bottom up to accomplish a tight seal without voids to meet regulatory requirements.

In certain formation conditions, the prepacked screens may bind inside the probe rods as the rods are retracted. This is most common in sandy formations sometimes called flowing or heaving sands. This binding can generally be overcome by lowering extension rods down the inside of the well riser and gently, but firmly, tapping the extension rods against the base of the well as the rods are slowly retracted. If the binding persists, clean tap water or distilled water may be poured down the annulus of the rods to increase the hydraulic head inside the well. This, combined with the use of the extension rods, will free up the prepacked screen and allow for proper emplacement.

Once the well is set, conventional flush-mount or aboveground well protection can be installed to prevent tampering or damage to the well head (Fig. 2.1-B). These wells can be sampled by several available methods (bladder pump, peristaltic pump, mini-bailer, Geoprobe® tubing check valve, etc.) to obtain high integrity water quality samples. These wells also provide accurate water level measurements and can be used as observation wells during aquifer pump tests.

When installed properly, these small-diameter wells generally meet regulatory requirements for a permanent monitoring well. While a detailed installation procedure is given in this document, it is by no means totally inclusive. **Always check local regulatory requirements and modify the well installation procedure accordingly.** These methods meet or exceed the specifications discussed for direct push installation of permanent monitoring wells with prepacked screens in the U.S. Environmental Protection Agency's guidance document, *Expedited Site Assessment Tools For Underground Storage Tank Sites*, (EPA, 1997) and ASTM Standards *D 6724* (ASTM, 2002) and *D 6725* (ASTM, 2002).

* *The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

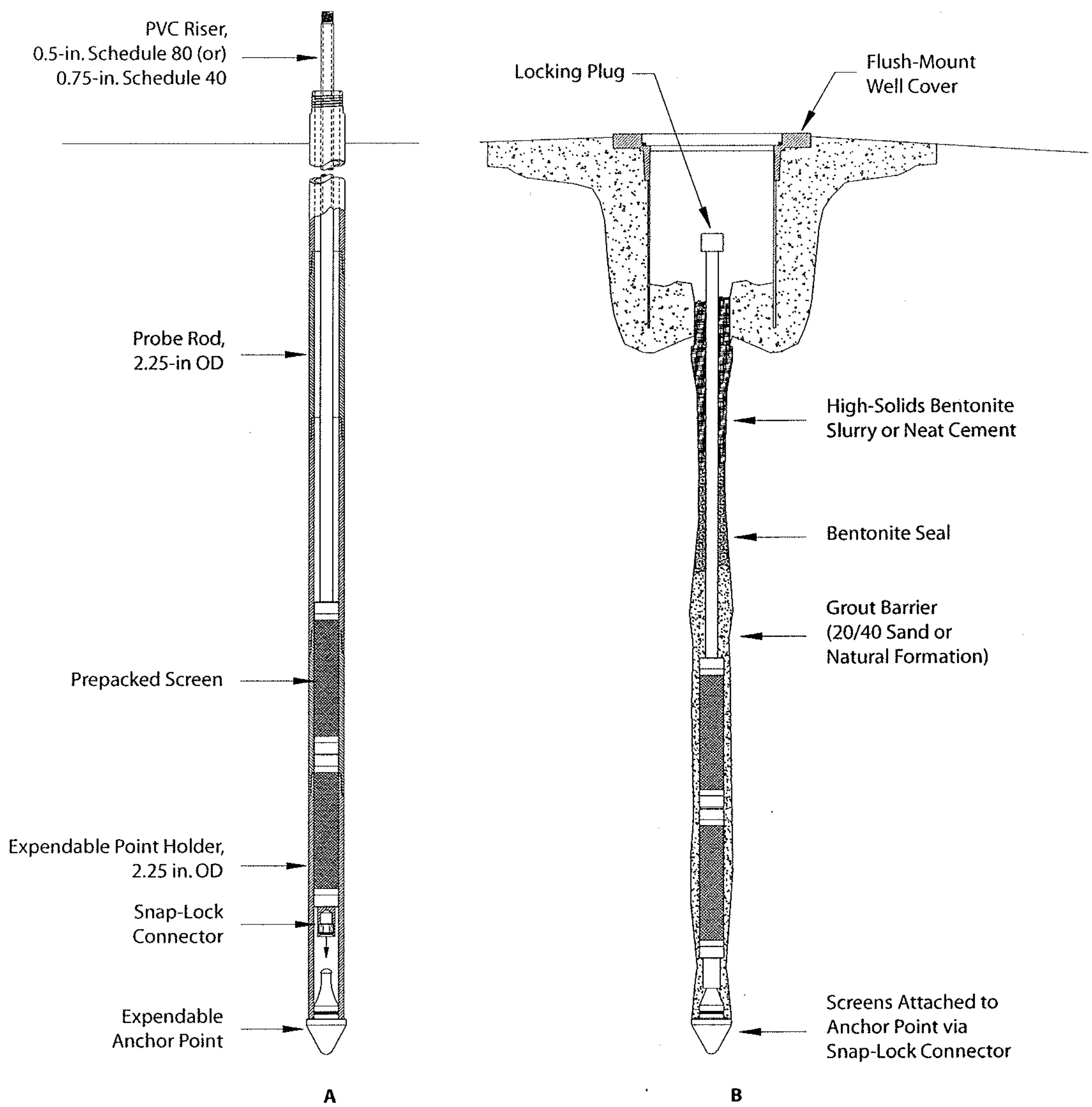


FIGURE 2.1:
Insertion of Prepacked Screens (A) and Installed Geoprobe Monitoring Well (B)

3.0 TOOLS AND EQUIPMENT

The following can be used to install a permanent monitoring well with Geoprobe® 1.4-inch OD prepacked screens. Refer to Figures 3.1-3.3 for illustrations of the specified parts.

0.5-in. X 1.4-in. OD Prepack Well Components	**Part Number**
0.5-in. x 1.4-in. OD Prepacked Screen, 3-ft. length	GW2010
0.5-in. x 1.4-in. OD Prepacked Screen, 5-ft. length	GW2020
Snap-Lock Connector Assembly, 0.5-in. Sch. 80	GW2030
Expendable Anchor Point, 2.5-in. OD	GW2040
PVC Riser, 0.5-in. sch. 80, 5-ft. length	GW2050
O-rings for 0.5-in. PVC Riser, Pkg. of 25	GW430R
PVC Top Cap, 0.5-in. sch. 80 Flush Thread	GW2055
Locking Well Plug, for 0.5-in. sch. 80 riser	WP1750
Non-Locking Well Plug, for 0.5-in. sch. 80 riser	WP1751
Vinyl Cap, 0.812-in. ID (optional)	AT441
PVC Bottom Plug, 0.5-in. Sch. 80 Flush Thread (optional)	GW2056
Expendable Drive Point, 2.25-in. rods / 2.5-in. OD (optional)	AT2015
Expendable Drive Point, 2.25-in. rods / 2.5-in. OD (Extended Shank)	19442

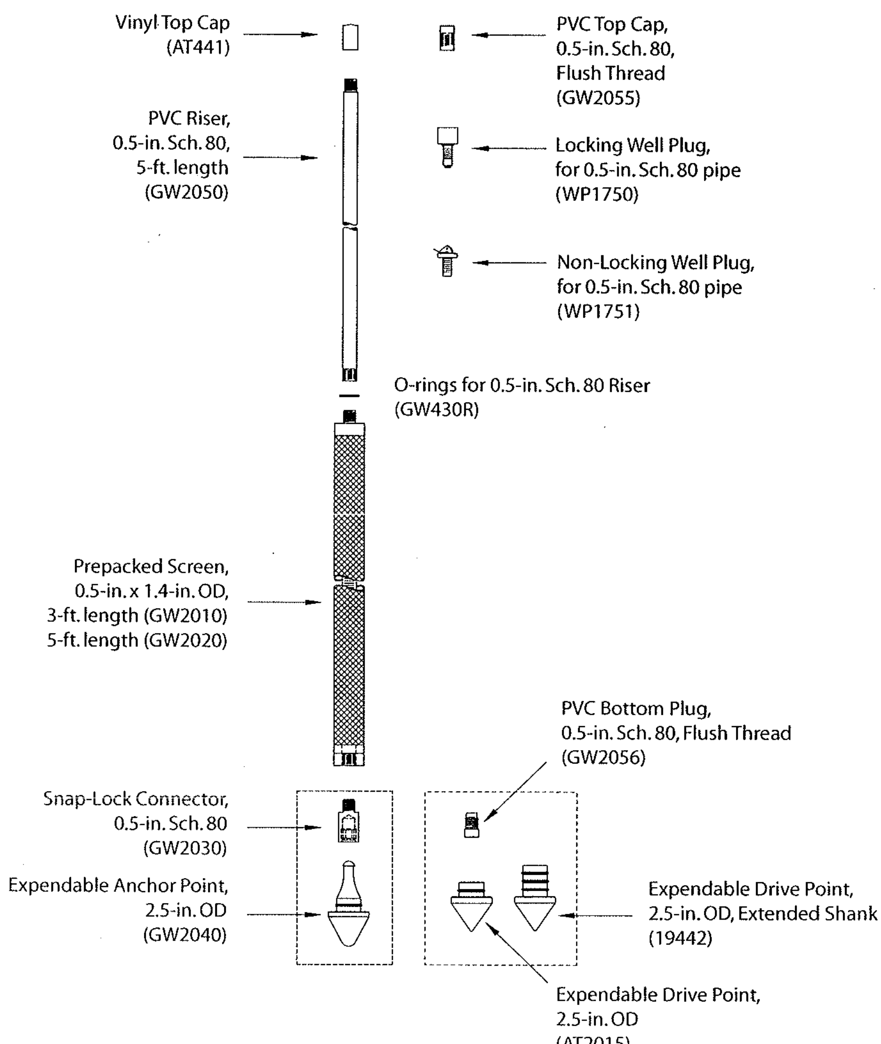


FIGURE 3.1:
0.5-in. x 1.4-in. OD Prepacked Screen Monitoring Well Parts

0.75-in. X 1.4-in. OD Prepack Well Components	**Part Number**
0.75-in. x 1.4-in. OD Prepacked Screen, 3-ft. length	11678
0.75-in. x 1.4-in. OD Prepacked Screen, 5-ft. length	17466
Snap-Lock Connector Assembly, 0.75-inch sch. 40	17469
Expendable Anchor Point, 2.5-in. OD	GW2040
PVC Riser, 0.75-in. sch. 40, 5-ft. length	11747
O-rings for 0.75-in. PVC Riser, Pkg. of 25	GW4401R
Vinyl Cap, 1.0-in. ID	12258
Locking Well Plug, for 0.75-in. sch. 40 riser	WP1775
Non-Locking Well Plug, for 0.75-in. sch. 40 riser	WP1776
PVC Bottom Plug, 0.75-in. Sch. 40 Flush Thread (optional)	12385
Expendable Drive Point, 2.25-in. rods / 2.5-in. OD (optional)	AT2015
Expendable Drive Point, 2.25-in. rods / Extended Shank	19442

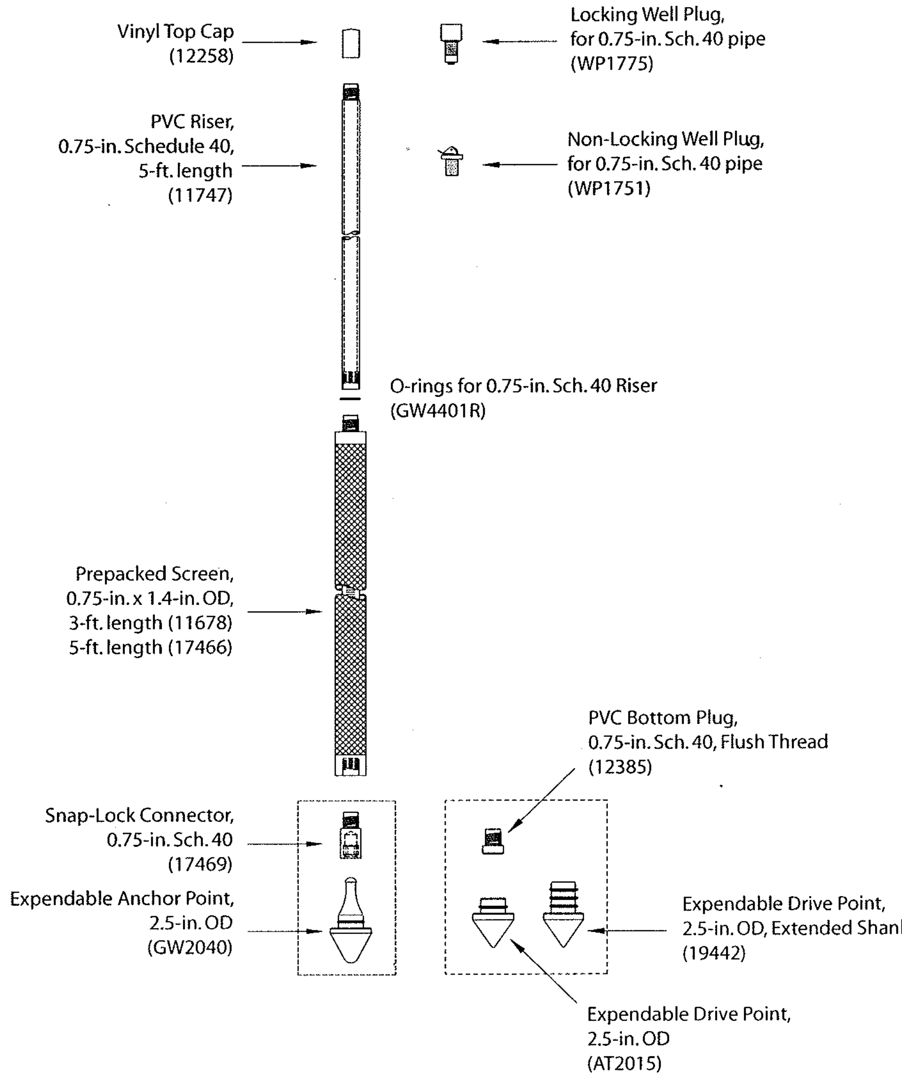


FIGURE 3.2:
0.75-in. x 1.4-in. OD Prepacked Screen Monitoring Well Parts

Monitoring Well Accessories	Part Number
Well Cover, flush-mount, 4-in. x 12-in., cast iron / ABS skirt (optional)	WP1741
Well Cover, flush-mount, 7-in. x 10-in., cast iron / galvanized skirt (optional)	WP1771
Sand, environmental grade (20/40 mesh, 50 lb. bag)	AT95
Bentonite, granular (8 mesh, 50 lb. bag)	AT91
Bentonite, powdered (200 mesh, 50 lb. bag)	AT92

Geoprobe® Tools and Equipment	Part Number
Rod Grip Puller Assembly (GH40)	29461
Rod Grip Puller Assembly (GH60)	29385
2.25-in. OD Probe Rods*	
Drive Cap, 2.25-in. Threaded (GH40 Hammer)	25362
Expendable Point Holder, 2.25-in. x 48-in.	25355
Expendable Point Holder, 2.25-in. x 1 meter (optional)	25354
Probe Rod, 2.25-in. x 48-in.	25300
Probe Rod, 2.25-in. x 1 meter (optional)	25352
Miscellaneous**	
O-rings for 2.25-in. Probe Rod, Pkg. of 25	AT2100R
Extension Rod, 48-in.	AT671
Extension Rod, 1 meter (optional)	AT675
Extension Rod Coupler	AT68
Extension Rod Quick Link Coupler, Box	AT696
Extension Rod Quick Link Coupler, Pin	AT695
Extension Rod Handle	AT69
Grout Machine	GP300 or GP 350
Grout System Accessories	GS1012 or GS1015
Water Level Meter, 0.438-in. OD Probe, 100-ft. cable*	GW1200
Screen Push Adapter	GW1535
Stainless Steel Mini-Bailer Assembly (optional)	GW41
Check Valve Assembly, 0.375-in. OD Tubing	GW4210
Polyethylene Tubing, 0.375-in. OD, 500-ft. (for purging, sampling, etc.)	TB25L
High PressureNylon Tubing, 0.375-in. OD, 100-ft. (for tremie tube grouting)	11633
MBP***	MB470

Additional Tools, Equipment, and Supplies

Locking Pliers
Pipe Wrench
Volumetric Measuring Cup
PVC Cutting Pliers
Weighted Measuring Tape (optional)
Small Funnel or Flexible Container (for pouring sand)
Duct or Electrical Tape Roll
Bucket or Tub (for dry grout material, water, and mixing)
Portland Cement, Type I
Concrete Mix (premixed cement and aggregate)
Clean Water (of suitable quality for exposure to well components)

**Tools and equipment are listed for Geoprobe® 54 Series Direct Push Machines. See Appendix A for tool options for 66 and 77 Series Direct Push Machines.*

***Refer to Appendix A for additional tool options.*

****Refer to Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.*

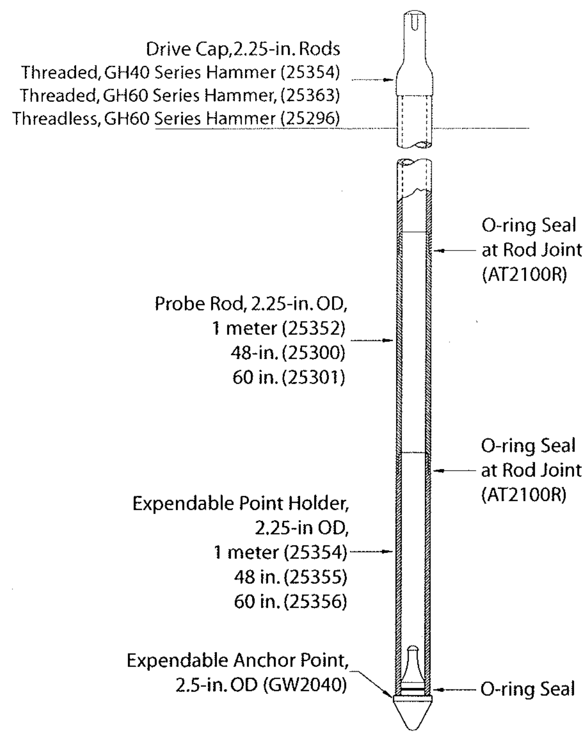


FIGURE 3.3:
2.25-inch OD Probe Rod Assembly

4.0 WELL INSTALLATION

Monitoring well installation can be broken down into five main steps:

- Anchoring the well assembly at depth
- Providing a sand pack and grout barrier
- Installing a bentonite seal above the screen
- Grouting the well annulus
- Installing well protection

4.1 Anchoring the Well Assembly

In this portion of the well installation procedure, an expendable anchor point is driven to depth on the end of a 2.25-inch (57 mm) OD probe rod string (Fig. 3.3). A prepacked screen assembly is inserted into the I.D. of the rod string with 5-foot (1.5 m) sections of PVC riser pipe (Fig. 4.1). The screens and riser pipe are attached to the anchor point via a snap-lock connector.

1. If the monitoring well is to have a flush-mount finish, it is a good practice to prepare a hole large enough to accept a standard well protector before driving the probe rods.

2. Move the Geoprobe® direct push machine into position over the proposed monitoring well location. Unfold the probe and place in the proper probing position as shown in the unit Owner's Manual. Access to the top of the probe rods will be required. It is therefore important to allow room for some derrick retraction when placing the unit in the probing position.

3. Referring to Figure 4.3, place an O-ring in the groove of an Expendable Anchor Point (GW2040) or Drive Point (AT2015 or 19442). Insert the point into the unthreaded end of a 2.25-inch Expendable Point Holder.

4. Attach a 2.25-inch Drive Cap to the threaded end of the point holder (Fig. 3.3).

5. Place the expendable point holder under the probe hammer in the driving position (refer to unit Owner's Manual). Drive the point holder into the ground utilizing percussion if necessary. It is important that the rod string is driven as straight as possible to provide a plumb monitoring well. If the point holder is not straight, pull the assembly and start over with Step 2.

6. Remove the drive cap from the expendable point holder. Install an O-ring (AT2100R) on the point holder in the groove located at the base of the male threads (Fig. 4.2).

   Note: The operator may choose to lubricate the O-ring with a small amount of clean water. Lubricating the O-ring makes it easier to thread the probe rods together and nearly elimate torn O-rings. A small spray bottle works well for applying the water.

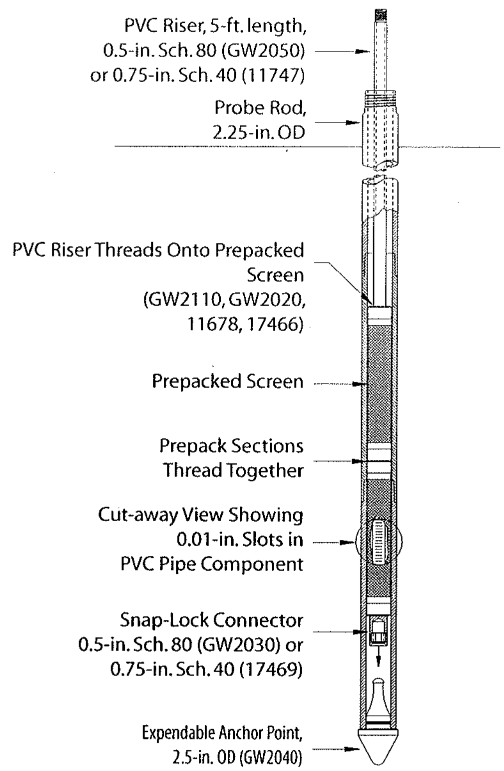


FIGURE 4.1:
Prepacked Screens Inside Probe Rod String

7. Thread a 2.25-inch probe rod onto the expendable point holder. Place the drive cap on the probe rod and advance the rod string.

8. Remove the drive cap and install an O-ring (AT2100R) at the base of the male threads of the probe rod (Fig. 4.2). Add another probe rod and replace the drive cap. Once again, advance the rod string.

9. Repeat Step 8 until the end of the rod string is approximately 4 inches (102 mm) below the bottom of the desired screen interval. The additional depth allows for the connection between the expendable anchor point and screen assembly. The top probe rod must also extend at least 1 foot (25 mm) above the ground surface to allow room for the rod grip puller later in this procedure. Move the probe foot back to provide access to the top of the rod string.

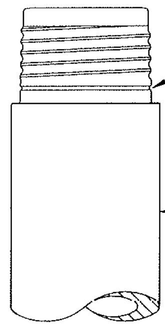


FIGURE 4.2:
O-ring Groove in 2.25-inch Expendable Point Holders and Probe Rods

10. With the probe rods and anchor point driven to the proper depth, the next step is to deploy the screen(s) and riser pipe. Thread together 1.4-inch OD prepack sections to achieve the desired screen interval. As shown in Figure 4.3, 1.4-inch OD prepacks are available with 0.5-inch Schedule 80 PVC or 0.75-inch Schedule 40 PVC components and in lengths of 3 or 5 feet (0.9 or 1.5 m). O-rings (GW430R) can be installed between the screen sections if desired.

11. Thread a Snap-lock Connector (0.5-inch GW2030 or 0.75-inch 17469) or a bottom plug (0.5-inch GW2056 or 0.75-inch 12385) into the female end of the assembled prepacks (Fig. 4.3). An O-ring can be placed on the male threads of the connector if desired.

12. Insert the screen assembly into the top of the probe rod string with the connector or bottom plug facing toward the bottom of the rods as shown in Figure 4.1.

13. With the assistance of a second person, attach 5-foot (1.5 m) sections of 0.5-inch Schedule 80 or 0.75-inch Schedule 40 PVC Riser (GW2050 or 11747) to the top of the screen assembly. O-rings are required at each riser joint to prevent groundwater from seeping into the well from above the desired monitoring interval. Continue adding riser sections until the assembly reaches the bottom of the rods (Fig. 4.1). At least 1 foot (0.3 m) of riser should extend past the top probe rod.

14. Install a PVC top cap, non-locking, or locking well plug on the top riser (Figure 4.3). If using the vinyl cap, secure the cap with two wraps of duct tape or electrical tape.

15. Raise the screen and riser assembly a few inches and then quickly lower it onto the expendable anchor point. This should force the snap-lock connector over the mushroomed tip of the anchor (Fig. 4.4). Gently pull up on the riser to ensure that the connector and anchor are firmly attached. Approximately 0.25 inches (6 mm) of play is normal. Or pop the bottom plug against the Expendable Anchor Point (AT 2015)

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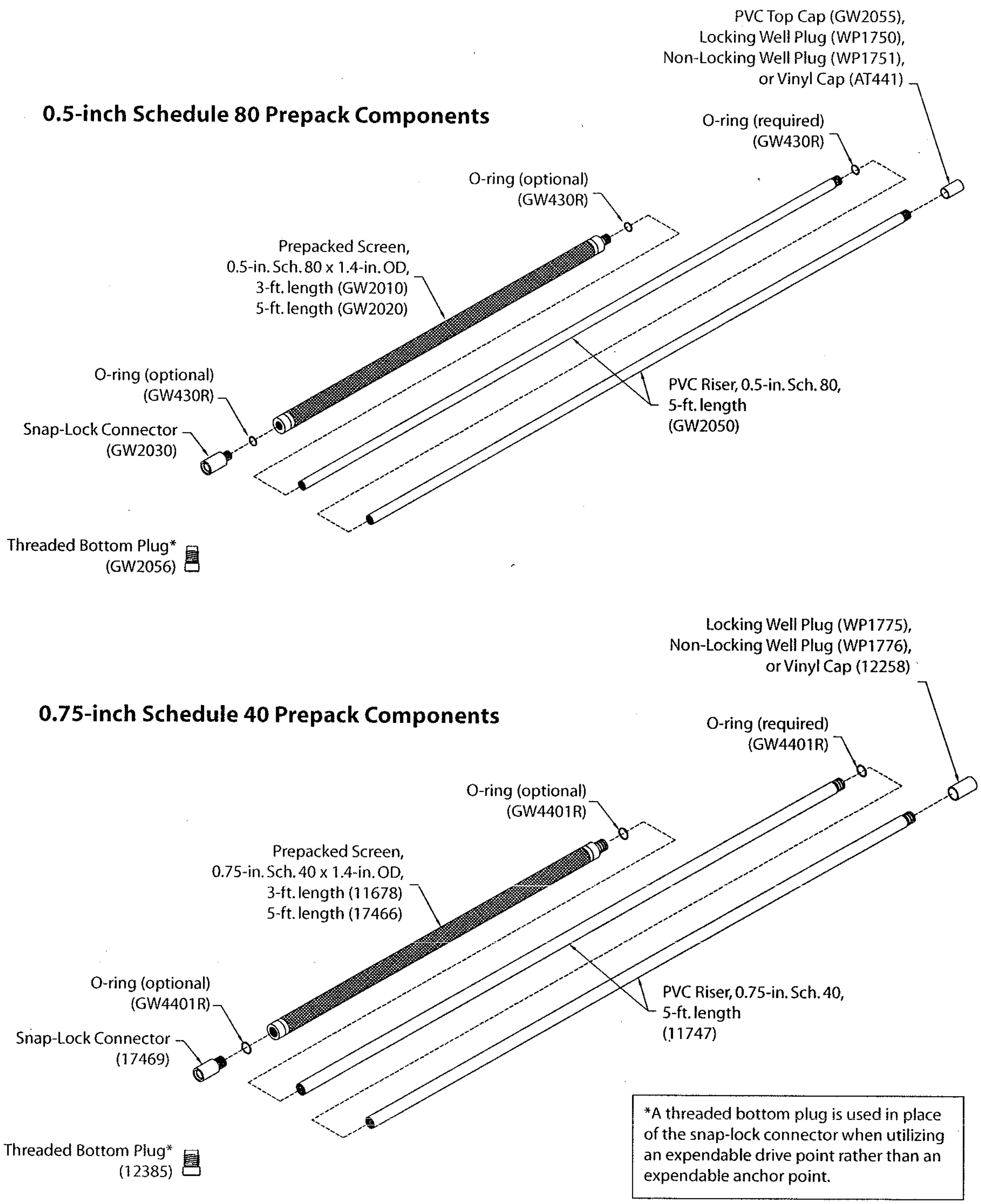

FIGURE 4.3:
0.5-inch Schedule 80 and 0.75-inch Schedule 40 Prepacked Screen Components

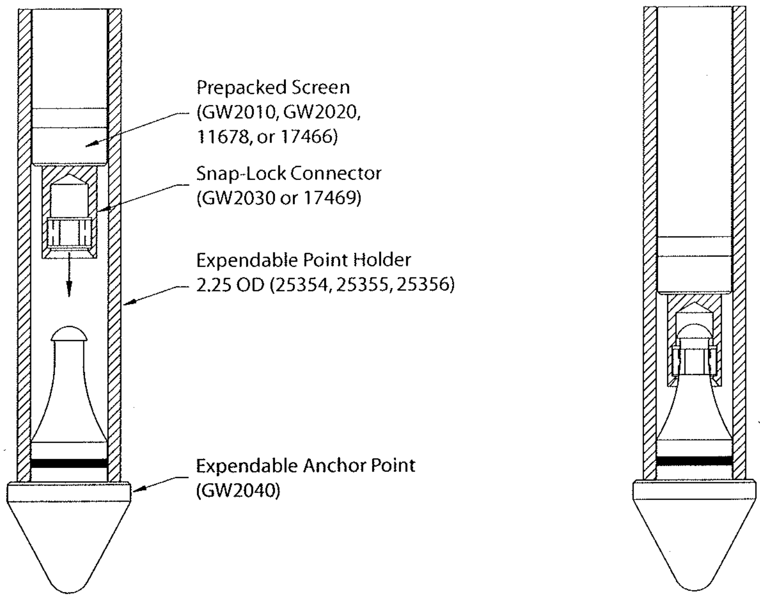

FIGURE 4.4:
Connecting Prepack(s) To Expendable Anchor Point

16. It is now time to pull up the probe rods from around the well screen and riser. Reposition the probe unit so that the Rod Grip Puller can be attached to the rod string.

17. Retract the rod string the length of the screens plus an additional 3 feet (1 m). Hold the riser as retracting rods. While pulling the rods, observe whether the PVC risers stay in place or move up with the rods.

a. If the risers stay in place, stable formation conditions are present. Continue retracting the rods to the depth specified above. Go to Section 4.2.

b. If the risers move up with the probe rods, have a second person hold it in place while pulling up the rods. An additional section of PVC riser may be helpful. Once the probe rods have cleared the anchor point and part of the screen, the screen and riser assembly should stop raising with the rods. Continue retracting to the depth specified above. Go to Section 4.2.

c. If the risers continue to move up with the probe rods and can not be held in place by hand, the anchor point is most likely located in heaving sands. Extension rods are now required. (Refer to Figure 4.4 for an illustration of extension rod accessories.)

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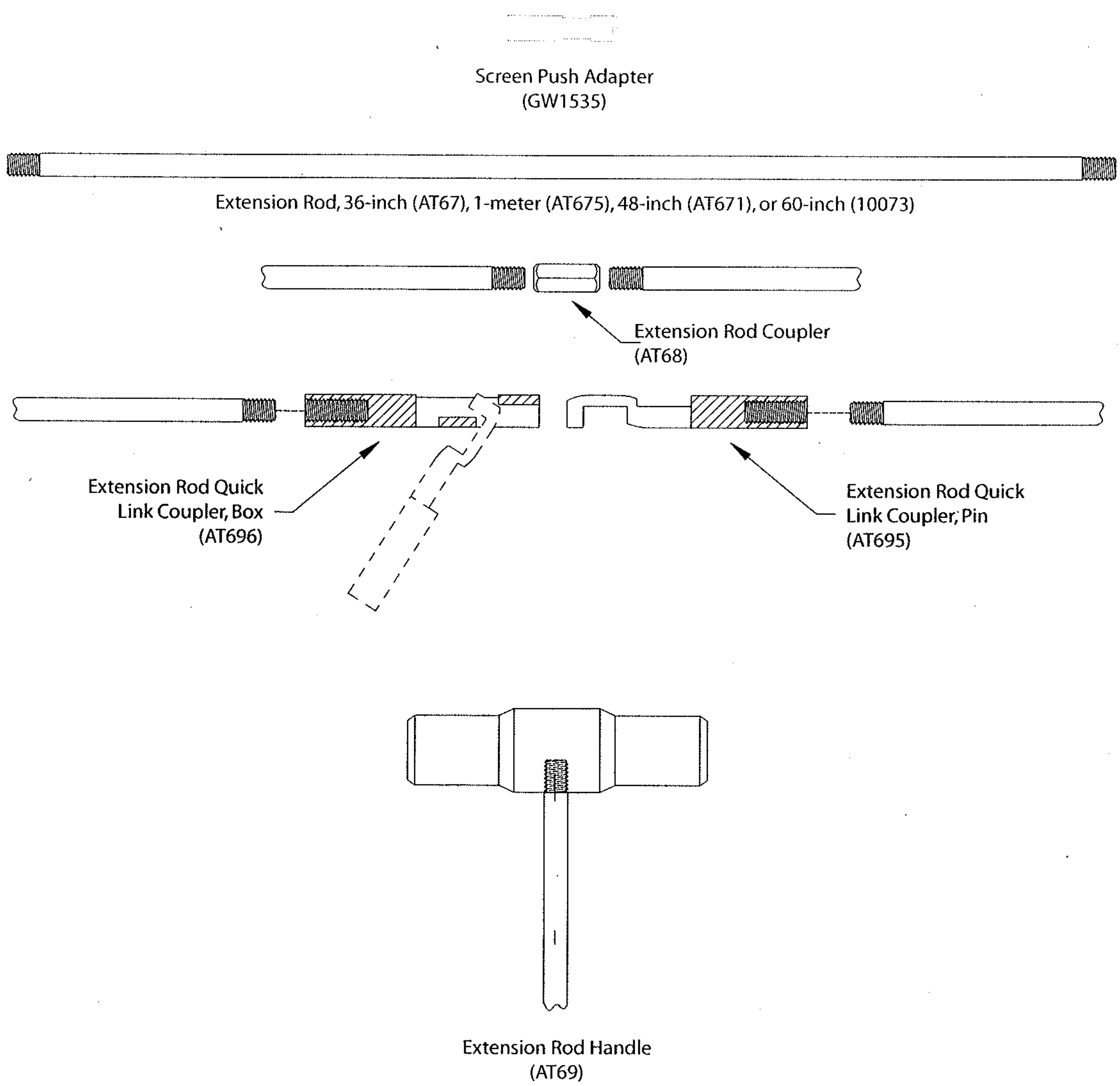

FIGURE 4.5:
Geoprobe Extension Rods and Accessories

d. Place a Screen Push Adapter (GW1535) on the end of an Extension Rod. Insert the adapter and extension rod into the PVC riser and hold by hand or with an Extension Rod Jig (AT690). Attach additional extension rods with Extension Rod Couplers (AT68) or Extension Rod Quick Links (AT695 and AT 696) until the push adapter contacts the bottom of the screens (Fig. 4.6). Place an Extension Rod Handle (AT69) on the top extension rod after leaving 3 to 4 feet (1 to 1.2 m) of extra height above the last probe rod.

e. Slowly retract the probe rods while another person pushes and taps on the screen bottom with the extension rods (Fig. 4.6). To ensure proper placement of the screen interval and prevent damage to the well, be careful not to get ahead while pulling the probe rods. The risers should stay in place once the probe rods are withdrawn past the screens. Retrieve the extension rods. Place the cap back on the top riser and secure the cap with duct tape if necessary.

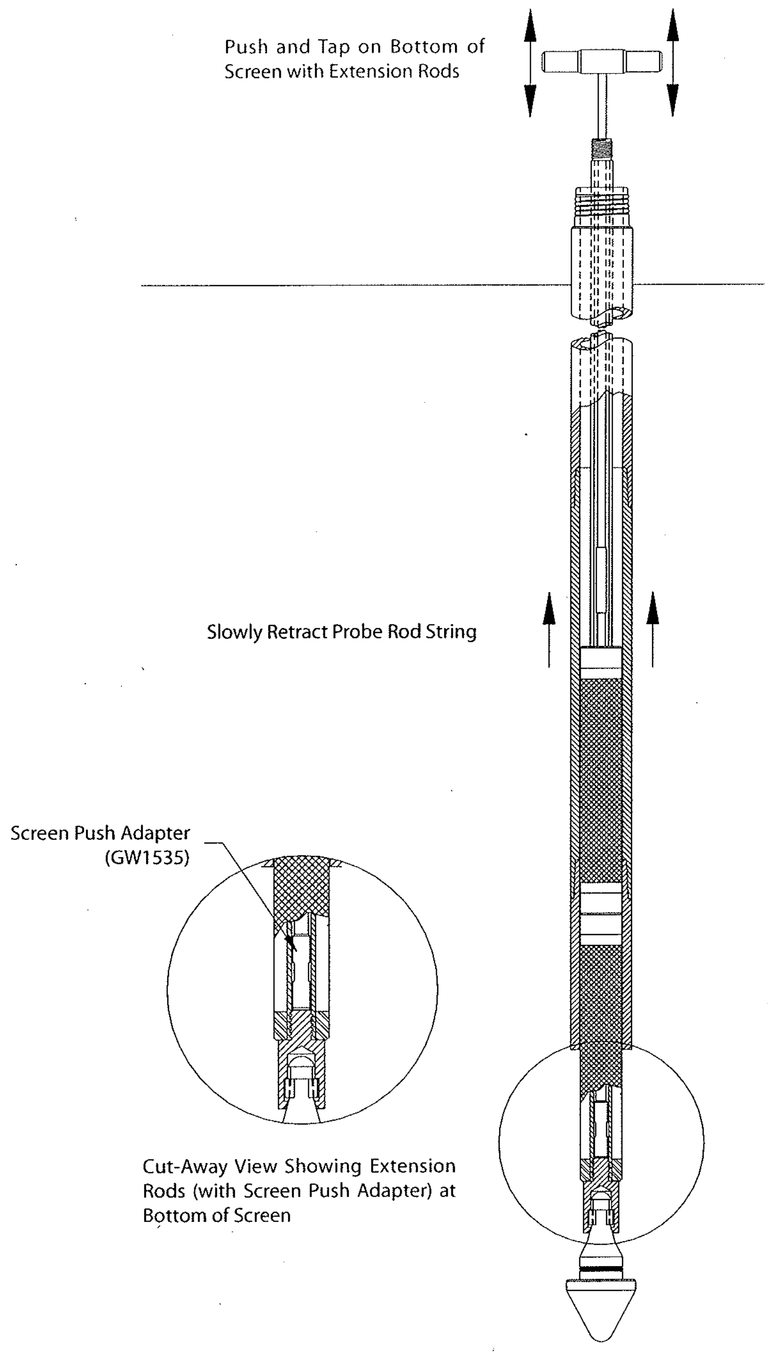

FIGURE 4.6:
Use Extension Rods To Tap Out Wedged Screens

4.2 Sand Pack and Grout Barrier

The natural formation will sometimes collapse around the well screens as the probe rod string is withdrawn. This provides an effective barrier between the screens and grout material used to seal the well annulus. If the formation does not collapse, a sand barrier must be placed from the surface. This portion of the well installation procedure is important because an inadequate barrier will allow grout to reach the well screens. Nonrepresentative samples and retarded groundwater flow into the well may result from grout intrusion.

1. Using a Water Level Meter (GW2000) or flat tape measure, determine the depth from the top of the PVC riser to the bottom of the annulus between the riser and probe rods. Two scenarios are possible:

   a. Measured depth is 2 to 3 feet (0.6 to 0.9 m) less than riser length. This indicates that unstable conditions have resulted in formation collapse. A natural grout barrier has formed as material collapsed around the PVC riser when the probe rods were retracted. This commonly occurs in heaving sands. No further action is required. Proceed to Section 4.3 and perform Step 2 (for unstable formations).

   b. Measured depth is equal to or greater than riser length. This indicates that stable conditions are present and the cohesive formation did not collapse. The probe hole has remained open and void space exists between the riser (and possibly the screen) and formation material. Clean sand must be placed downhole to provide a suitable grout barrier. Continue with Step 2.

2. Begin slowly pouring 20/40 mesh sand (AT95) down the annulus between the PVC riser and probe rod string. Reduce spillage by using a funnel or flexible container as shown in Figure 4.6. Add approximately 2.0 liters of sand for each 3-foot (1 m) screen section or 3.25 liters of sand for each 5-foot (1.5 m) screen, plus 1.75-2.0 liters for a minimum 2-foot (0.6 m) layer of sand above the top screen section.

   Note: The sand volumes specified above assume maximum annular space where no formation collapse has occurred. Actual volumes may be less in field conditions.

3. Measure the annulus depth after each 1.0-1.5 liters of sand. The sand may not fall all the way past the screens due to the tight annulus and possible water intrusion. This is acceptable, however, since the prepacked screens do not require the addition of sand. The important thing is that a sand barrier is provided above the screens.

4. Sand may also bridge within the annulus between the risers and probe rods and consequently fail to reach total depth (Fig. 4.7). This most likely occurs when the sand contacts the water inside the probe rods during well installations below the water table. Wet probe rods also contribute to sand bridging. If the annulus is open, skip to Section 4.3, Step 1. If bridging is evident, continue with Step 5.

5. In case of a sand bridge above the screens (wet rods, high water table, etc.), insert clean extension rods into the well annulus to break up the sand (Fig. 4.7). Simultaneously retracting the probe rods usually helps. Check annulus depth again. If sand is no longer bridged, proceed to Section 4.3. If bridging is still evident, continue with Step 6.

6. If the sand bridge can not be broken up with extension rods, inject a small amount of clean water into the annulus. This is accomplished with a Geoprobe® Model GP300 or GP350 Grout Machine and 3/8-inch (9.5 mm) OD nylon tubing (11633). Simply insert the nylon tubing down the well annulus until the sand bridge is contacted. Attach the tubing to the grout machine and pump up to one gallon of clean water while moving the tubing up and down. The jetting action of the water will loosen and remove the sand bridge. Check annulus depth again. The distance should be 2 to 3 feet (0.6 to 0.9 m) less than the riser length when the sand barrier is completed. Proceed with Section 4.3.

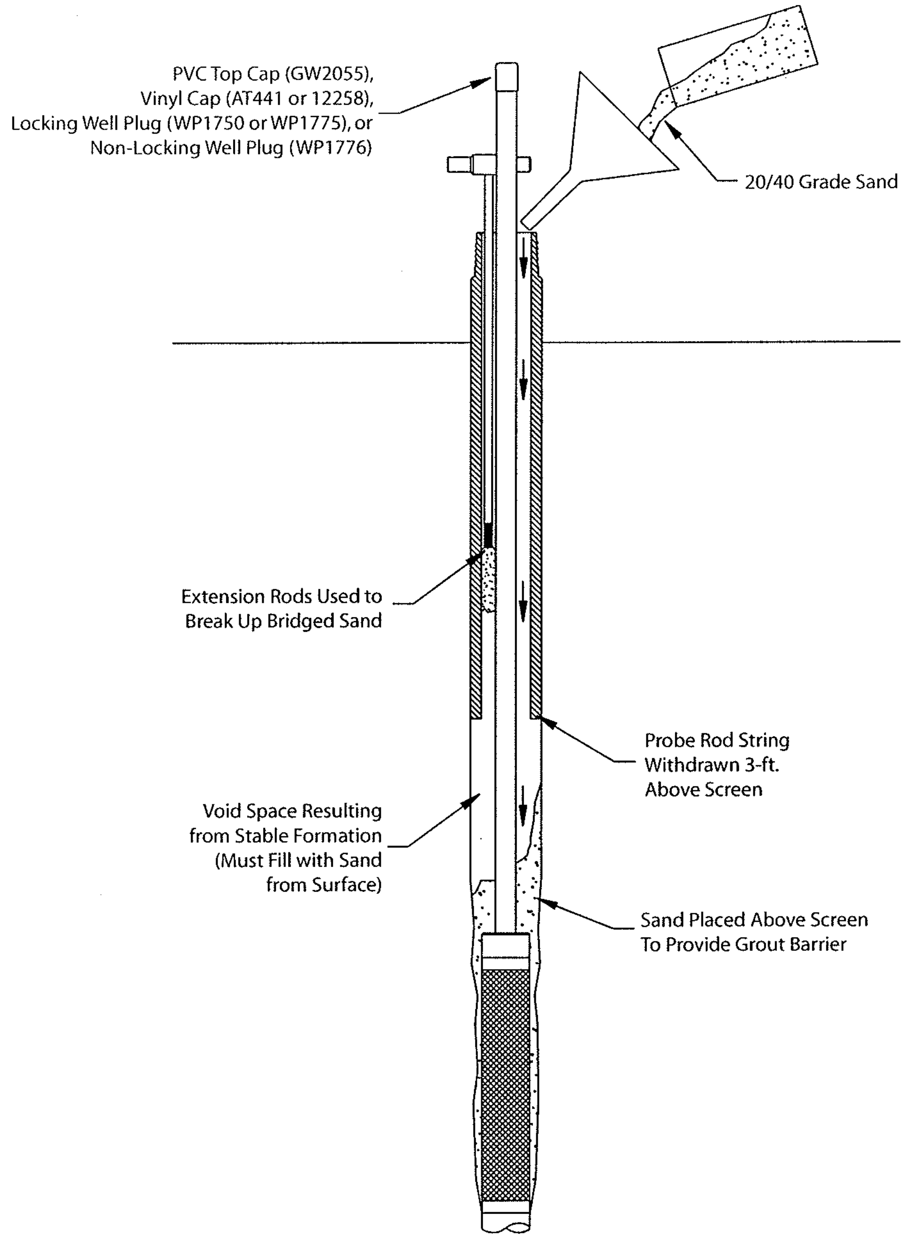

FIGURE 4.7:
Installing Grout Barrier from Ground Surface with 20/40 Mesh Sand

4.3 Bentonite Seal Above Screen

Bentonite is a clay material which exhibits very low permeability when hydrated. When properly placed, bentonite can prevent contaminants from moving into the well screens from above the desired monitoring interval. The seal is formed either by pouring granular bentonite into the annulus from the ground surface, or by injecting a high-solids bentonite slurry directly above the grout barrier. The use of bentonite chips is limited to cases in which the top of the screen ends above the water table (no water is present in the probe rods). Whichever method is used, at least 2 feet (0.6 m) of bentonite must be placed above the sand pack.

1. **(Stable Formation)** Granular bentonite (AT91) is recommended if the following conditions are met:
   1) Top of screen interval is above the water table
   2) Formation remained open when probe rods were retracted
   3) Bridging was not encountered while installing the sand pack and grout barrier in Section 4.2.

   a. Withdraw the probe rod string another 3 to 4 feet (0.9 to 1 m) and ensure that the PVC riser does not rise with rods. It is important that the bottom of the rod string is above the proposed seal interval. If positioned too low, dry bentonite will backup into the expendable point holder. Bridging then results if moisture is present inside the probe rods.

   b. Pour approximately 1.5 liters of granular bentonite between the probe rods and PVC riser as was done with the sand in Section 4.2

   c. Measure the riser depth to the bottom of the annulus. The distance should now equal the installed riser length minus the minimum 2 feet (0.6 m) of sand pack and 2 feet (0.6 m) of bentonite seal. As was stated with the sand pack, if the measured depth is significantly less than expected, the bentonite has more than likely bridged somewhere along the rod string. A procedure similar to that identified for bridged sand (Section 4.2, Steps 5 and 6) may be utilized to dislodge the granular bentonite.

   d. Once it has been determined that the bentonite seal is properly emplaced, add 1 liter of clean water to hydrate the dry bentonite according to regulations. This is not necessary if water was used to clear bridged bentonite.

2. **(Unstable Formation)** A grout machine is required to install the bentonite seal if the formation collapsed when the rods were retracted or the sand bridged when installing the grout barrier. The pump is able to supply a high-solids bentonite slurry under sufficient pressure to displace formation fluids. Void spaces often develop when poured (gravity installed) granular bentonite is used under these conditions, resulting in an inadequate annular seal. Wet rods will often lead to bridging problems as well.

   a. Mix 1 gallon (3.8 L) of high-solids bentonite (20 to 25 percent by dry weight) and place in the hopper of the grout machine.

   b. Insert 3/8-inch nylon tubing (see note below) to the bottom of the annulus between the probe rods and well riser. Leaving at least 15 feet (5 m) extending from the top of the rod string, connect the tubing to the grout machine. This extra length will allow rod extraction later in the procedure.

   NOTE: The side-port tremie method is recommended to prevent intrusion of grout into the sand barrier. To accomplish side-port discharge of grout, cut a notch approximately one inch up from the leading end of the tubing and then close the leading end with a threaded plug of suitable size.

   c. Activate the grout pump and fill the tremie tube with bentonite. Begin slowly pulling the rod string approximately 3 feet (1 m) while operating the pump (Fig. 4.8). This will place bentonite in the void

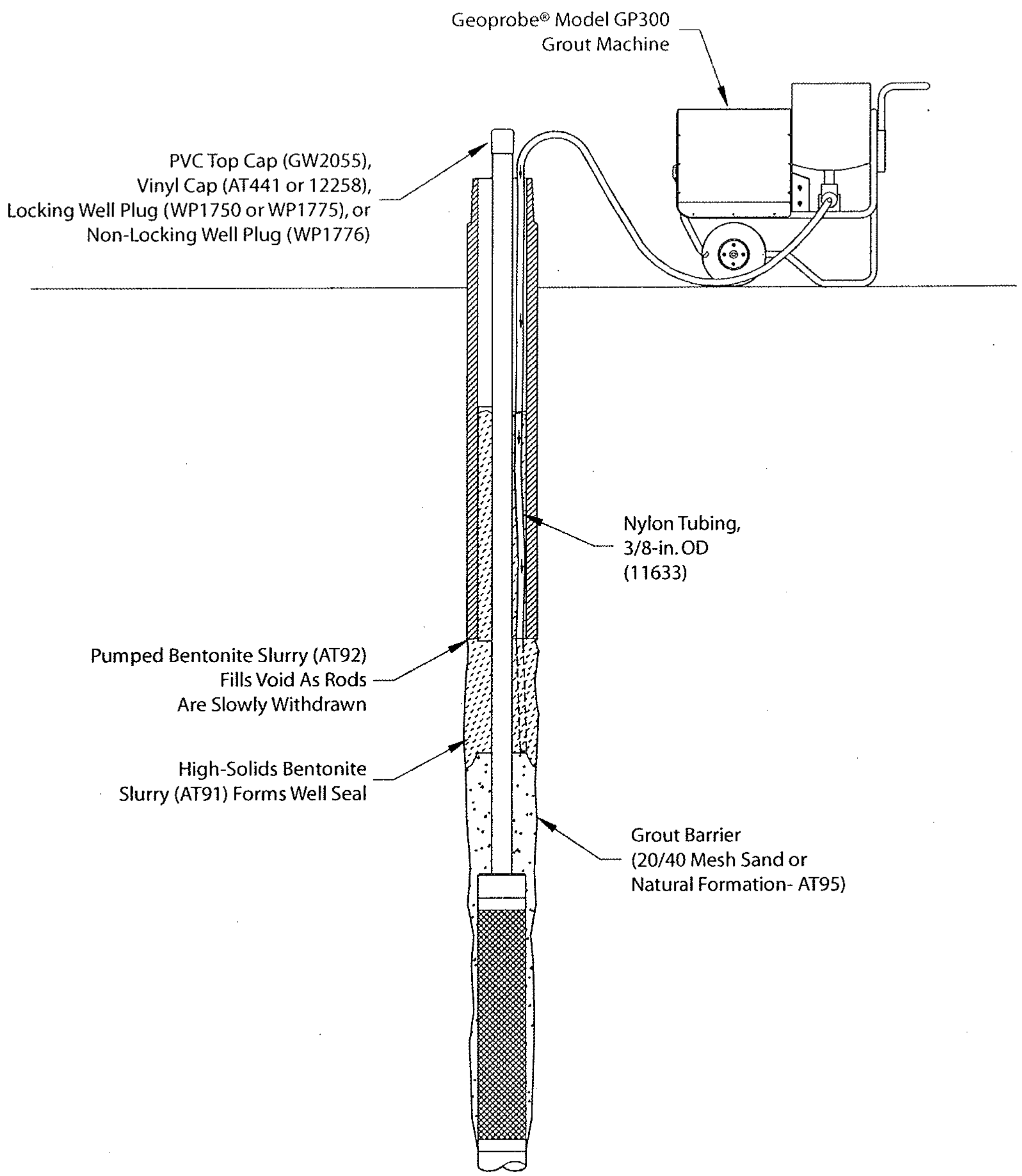

FIGURE 4.8:
Providing Bentonite Seal With Geoprobe® Model GP300 Grout Machine

left by the retracted rods before it is filled by the collapsing formation. Continue to watch that the PVC riser does not come up with the rod string. When removing the retracted probe rod, slide the rod over the nylon tubing and place it on the ground next to the grout machine. This eliminates cutting and reattaching the tubing for each rod removed from the string. Take care not to "kink" the tubing during this process as it will create a weak spot in the tubing which may burst when pressure is applied.

d. Measure the annulus depth to ensure that at least 2 feet (0.6 m) of bentonite was delivered. Pump additional bentonite slurry if needed.

4.4 Grouting Well Annulus

The placement of grout material within the remaining well annulus provides additional protection from vertical contaminant migration. Most grout mixes are composed of neat cement, high-solids bentonite slurry, or a combination of cement and bentonite. Such mixes must be delivered with a high-pressure grout pump. When stable formations exist, the well may be sealed by pouring dry granular bentonite directly into the annulus from the ground surface. Consult the appropriate regulatory agency to determine approved grouting methods.

This section presents the procedure for grouting the well annulus with the Geoprobe® Model GP300 or GP350 Grout Machines. Refer to Figure 4.9 as needed.

1. Mix an appropriate amount of grout material and place it in the hopper on the grout machine. (Refer to the Geoprobe® Yellow Field Book for tables on grout volume requirements.)

   NOTE: It is recommended that an additional 25 to 30 percent of the calculated annulus volume is included in the total grout volume. This allows for material that is left in the grout hose and tubing or moves into the formation during pumping. An approximate range is 0.25 to 0.30 gallons (0.9 to 1.1 L) of grout for each foot of riser below ground surface.

2. A side-port tremie tube may be made from a roll of .375-inch OD High Pressure Nylon Tubing (11633) by cutting a notch in the side of the tubing approximately 1 inch (25 mm) up from the discharge end. Thread a bolt or screw of suitable diameter into the end of the tubing so that pumped grout is forced out through the notch in a side-discharge manner.

   Insert the side-port tremie tube into the well annulus until the leading end of the tube reaches the top of the bentonite seal. At least 15 feet (5 m) of tubing should extend from the top of the rod string. This extra length allows rod extraction with the tubing attached to the pump.

3. Attach the tubing to the grout machine and begin pumping. If the bentonite seal was below the water table (deep well installation), water will be displaced and flow from the probe rods as the annulus is filled with grout. Continue operating the pump until undiluted grout flows from the top probe rod.

4. Reposition the direct push machine and prepare to pull rods.

5. Begin pulling the probe rods while continuing to pump grout. Match the pulling speed to grout flow so that the rods remain filled to the ground surface. This maintains hydraulic head within the probe rods and ensures that the space left by the withdrawn rods is completely filled with grout.

   NOTE: Slide the probe rods over the nylon tubing and place neatly on the ground next to the grout machine. **Be careful not to pinch or bind the tubing as this forms weak spots which may burst when pressure is applied.**

   NOTE: Try to avoid filling the upper 12 inches (305 mm) of well annulus with grout when pulling the expendable point holder. This will make for a cleaner well protector installation.

6. When all probe rods have been retrieved and the well is adequately grouted, unstring the tremie tube and begin cleanup. It is important to promptly clean the probe rods, grout machine, and accessories. This is especially true of cement mixes as they quickly set up and are difficult to remove once dried.

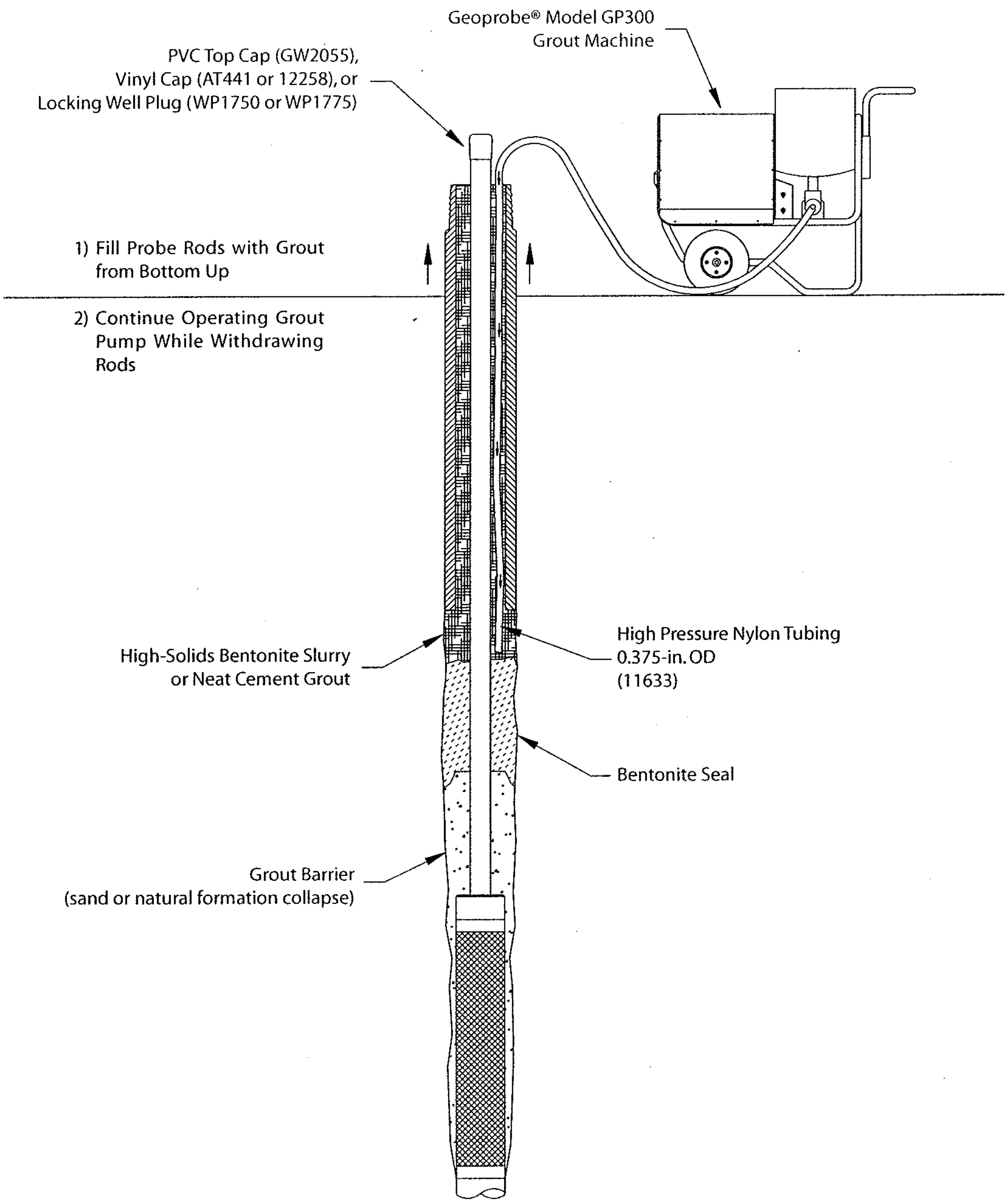

FIGURE 4.9:
Grouting Well Annulus with Geoprobe® Model GP300 Grout Machine

4.5 Surface Cover / Well Protection

A surface cover protects the PVC well riser from damage and tampering. Although aboveground and flush-mount well covers may be used, most Geoprobe® prepack monitoring wells have been installed with flush-mount covers (Fig. 4.10). Consult the project planners and/or appropriate regulators to determine the approved well cover configuration for your specific application.

1. In order to fit under a flush-mount cover, the top of the well riser must be below the ground surface. Place the well cover over the riser to mark the cover diameter. Remove the cover and excavate the soil around the well head to install the protector.

2. The top of the riser should be located several inches above the bottom of the hole (but below the adjacent ground surface) before installation of the well cover. If a riser joint is near this level, the operator may choose to unthread the top riser and adjust the depth of the hole to fit the riser height. Most prepack installations will instead require trimming the top riser to the appropriate height with PVC cutters.

   NOTE: Do not cut off the riser with a hacksaw as cuttings may fall down into the screens.

3. In most areas, regulations specify that a locking plug be installed on the top riser of permanent monitoring wells. Insert a locking well plug (Figure 4.10) into the riser and tighten the hex bolt with a 1/2-inch T-handle wrench or nut driver until the cap fits snugly.

4. Position the well cover so that it is centered over the well riser. Provide at least 0.5 inches (13 mm) of space between the top of the locking plug and bottom of the well cover lid. If flush-mount protection is used, install the cover slightly above grade to prevent ponding of runoff water at the well head.

5. Support the well cover by installing a concrete pad according to project requirements. Pads are commonly square-shaped with a thickness of 4 inches (102 mm) and sides measuring 24 inches (610 mm) or greater. Finish the pad so that the edges slope away from the center to prevent ponding of surface water on the well cover.

6. Fill the inside of the well cover with sand up to approximately 2 to 3 inches (51 to 76 mm) from the top of the riser and locking plug.

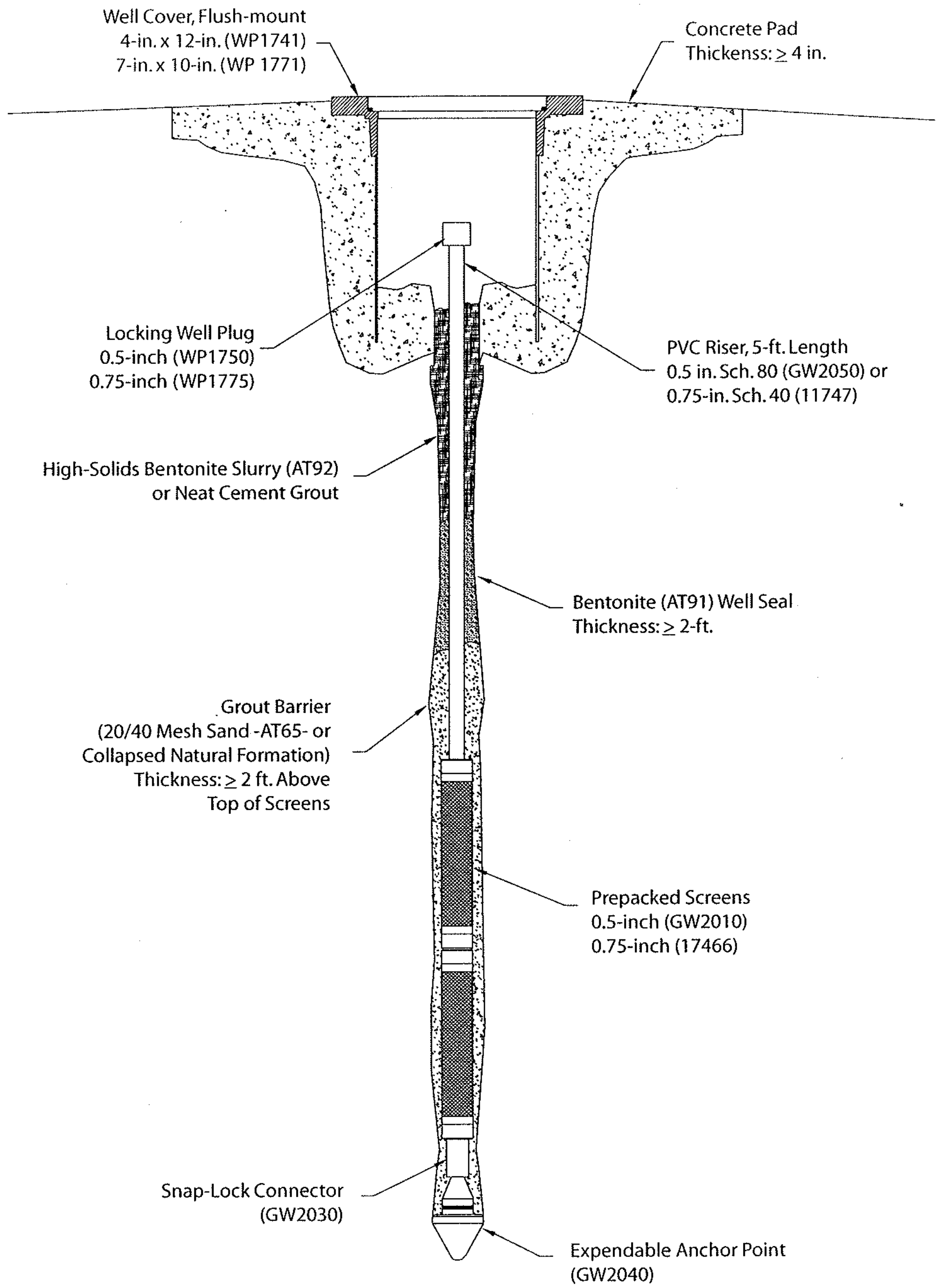

FIGURE 4.10:
A Properly Installed Geoprobe Prepacked Screen Monitoring Well

5.0 WELL DEVELOPMENT

"The development serves to remove the finer grained material from the well screen and filter pack that may otherwise interfere with water quality analyses, restore groundwater properties disturbed during the (probing) process, and to improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen," (ASTM D 5092).

The two most common methods of well development are bailing or pumping (purging) and mechanical surging.

Purging involves removing at least three well volumes of water with either a Check Valve Assembly (GW4210) or a Stainless Steel Mini-Bailer Assembly (GW41). Include the entire 2.25-inch (54 mm) diameter of disturbed soil at the screen interval when calculating the well volume.

Mechanical Surging utilizes a surge block or swab which is attached to extension rods and lowered inside the riser to the screen interval. The extension rods and surge block are moved up and down, forcing water into and out of the screen. A tubing bottom check valve or peristaltic pump is then used to remove the water and loosened sediments (Fig. 4.11).

NOTE: Mechanical surging may damage the well screen and/or reduce groundwater flow across the filter pack if performed incorrectly or under improper conditions. Refer to ASTM D 5521, "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers" for a detailed discussion of mechanical surging.

Fine Grained Formations: Many times field conditions or regulations require us to install monitoring wells in fine-grained formations that would not be considered a true aquifer. Development in these conditions is difficult at best. There are various development methods that may be useful depending on the specific grain size distribution of the formation. In formations with a good proportion of sand, using a rod brush slightly larger than the ID of the well as a swab may help in surging the well without clogging the filter pack. Caution is required. Adding water to slow-yielding wells may also help to loosen fines and improve recharge when swabbing. Purging wells in fine-grained formations with a peristaltic pump or bladder pump may offer the best means of development as high-energy surging can clog the screens. For more information on this topic request the Geoprobe® bulletin titled *Groundwater Quality and Turbidity vs. Low Flow.*

Development should continue until representative water is obtained and natural flow is established into the well. Previously, representative water was defined primarily on the basis of consistent pH, specific conductance, temperature measurements, and visual clarity (ASTM D 5092). To meet the more stringent requirements of the low-flow sampling protocol (EPA 1996), monitoring of additional parameters such as dissolved oxygen (DO) and oxidation/reduction potential (ORP or Eh), and quantitative measurement of turbidity may be required.

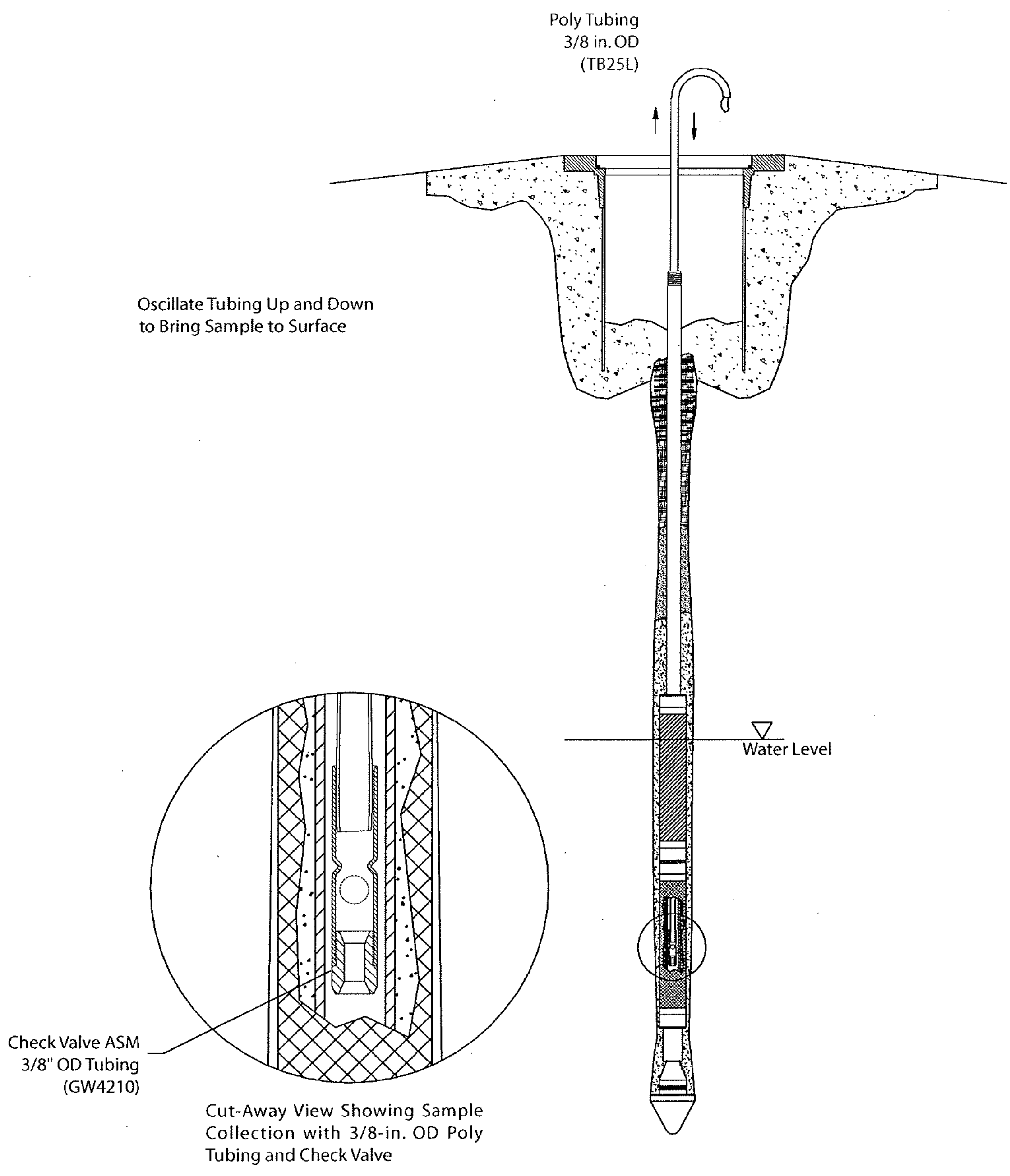

FIGURE 4.11:
Sampling With Polyethylene Tubing and a Tubing Bottom Check Valve

6.0 SAMPLE COLLECTION

As the federal EPA and more state agencies are recommending or requiring use of the "low-flow" sampling protocol (EPA 1996), the ability to sample small-diameter, direct push (DP) installed monitoring wells with bladder pumps has significantly increased. The latest option for collecting groundwater is to utilize a Geoprobe® MB470 Mechanical Bladder Pump. It may be used to meet requirements of the low-flow sampling protocol (EPA 1996). The low-flow sampling method is preferred when sampling for volatile contaminants or metal analytes. The Mechanical Bladder Pump can be used with any of the available flow-through-cells and water quality monitoring probes. Smaller volume flow-through-cells are recommended when available. Use of the Mechanical Bladder Pump and flow-through-cell allows you to meet the stringent requirements for monitoring pH, specific conductance, DO, and ORP, and obtaining low-turbidity samples for metals analysis.

Groundwater samples may be collected with a check valve assembly (with 3/8-inch OD poly tubing as shown in Fig. 4.11) or a stainless steel mini-bailer assembly when appropriate. While the check valve is the quicker and more economical sampling device, some operators still prefer the traditional mini-bailer.

Before going into the field to sample monitoring wells (or groundwater samplers), be sure to know the level of sample quality that will be required. For high-integrity samples that must meet strict data quality objectives, sampling with a mechanical bladder pump may be required. Conversely, if screening level data is required (is it there and about how much?) a check valve assembly may be sufficient and could save time and money. For further information on this topic, request the Geoprobe® bulletin titled *Groundwater Quality and Turbidity vs. Low Flow.*

7.0 REFERENCES

American Society for Testing and Materials (ASTM), 1992. ASTM D 5092 *Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 1995. ASTM D 5521 *Standard Guide for Development of Ground Water Monitoring Wells in Granular Aquifers.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 2002. ASTM D 6724 *Standard Guide for Selection and Installation of Direct Push Ground Water Monitoring Wells.* ASTM West Conshohocken, PA.

American Society for Testing and Materials (ASTM), 2002. ASTM D 6725 *Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers.* ASTM West Conshohocken, PA.

Geoprobe Systems®, 2003. *Tools Catalog, V. 6.*

U.S. Environmental Protection Agency (EPA), 1996. Robert W. Puhls and Michael J. Barcelona. *Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.* OSWER. EPA/540/S-95/504. April.

U.S. Environmental Protection Agency (EPA), 1997. *Expedited Site Assessment Tools For Underground Storage Tank Sites: A Guide for Regulators.* EPA 510-B-97-001. March, 1997.

APPENDIX A
ALTERNATIVE PARTS

Geoprobe® Tools and Equipment	Part Number
2.25-in. OD Probe Rods	
Drive Cap, 2.25-in. Threaded (GH60 Hammer)	25363
Drive Cap, 2.25-in. Threadless (GH60 Hammer)	25296
Expendable Point Holder, 2.25-in. x 60-in	25356
Probe Rod, 2.25-in. x 60-in	25301
Rod Grip Puller Assembly (GH60)	29385
Miscellaneous	
Extension Rod, 36-in.	AT67
Extension Rod, 60-in.	10073

Groundwater Purging and Sampling Accessories	Part Number
Polyethylene Tubing, 0.25-inch OD, 500 ft.	TB17L
Polyethylene Tubing, 0.5-inch OD, 500 ft	TB37L
Polyethylene Tubing, 0.625-inch OD, 50 ft.	TB50L
Check Valve Assembly, 0.25-inch OD Tubing	GW4240
Check Valve Assembly, 0.5-inch OD Tubing	GW4220
Check Valve Assembly, 0.625-inch OD Tubing	GW4230
Water Level Meter, 0.375-inch OD Probe, 100-ft. cable	GW2001
Water Level Meter, 0.438-inch OD Probe, 200 ft. cable	GW2002
Water Level Meter, 0.375-inch OD Probe, 200-ft. cable	GW2003
Water Level Meter, 0.438-inch OD Probe, 30-m cable	GW2005
Water Level Meter, 0.438-inch OD Probe, 60-m cable	GW2007
Water Level Meter, 0.375-inch OD Probe, 60-m cable	GE2008

**The tools and equipment listed are for the 66 and 77 Series Direct Push Machines. See Section 3.0 for tool options of the 54 Series Direct Push Machines.*

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

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Appendix B

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION II

GROUND WATER SAMPLING PROCEDURE
LOW STRESS (Low Flow) PURGING AND SAMPLING

I. SCOPE & APPLICATION

This Low Stress (or Low-Flow) Purging and Sampling Procedure is the EPA Region II standard method for collecting low stress (low flow) ground water samples from monitoring wells. Low stress Purging and Sampling results in collection of ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by minimizing stress on the geological formation and minimizing disturbance of sediment that has collected in the well. The procedure applies to monitoring wells that have an inner casing with a diameter of 2.0 inches or greater, and maximum screened intervals of ten feet unless multiple intervals are sampled. The procedure is appropriate for collection of ground water samples that will be analyzed for volatile and semi-volatile organic compounds (VOCs and SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and microbiological and other contaminants in association with all EPA programs.

This procedure does not address the collection of light or dense non-aqueous phase liquids (LNAPL or DNAPL) samples, and should be used for aqueous samples only. For sampling NAPLs, the reader is referred to the following EPA publications: DNAPL Site Evaluation (Cohen & Mercer, 1993) and the RCRA Ground-Water Monitoring: Draft Technical Guidance (EPA/530-R-93-001), and references therein.

II. METHOD SUMMARY

The purpose of the low stress purging and sampling procedure is to collect ground water samples from monitoring wells that are representative of ground water conditions in the geological formation. This is accomplished by setting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well casing.

Sampling at the prescribed (low) flow rate has three primary benefits. First, it minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity (i.e., low concentration of suspended particles). Typically, this saves time and analytical costs by eliminating the need for collecting and analyzing an additional filtered sample from the same well. Second, this procedure minimizes aeration of the ground water during sample collection, which improves the sample quality for VOC analysis. Third, in most cases the procedure significantly reduces the volume of ground water purged from a well and the costs associated with its proper treatment and disposal.

III. ADDRESSING POTENTIAL PROBLEMS

Problems that may be encountered using this technique include a) difficulty in sampling wells with insufficient yield; b) failure of one or more key indicator parameters to stabilize; c) cascading of water and/or formation of air bubbles in the tubing; and d) cross-contamination between wells.

Insufficient Yield

Wells with insufficient yield (i.e., low recharge rate of the well) may dewater during purging. Care should be taken to avoid loss of pressure in the tubing line due to dewatering of the well below the level of the pump’s intake. Purging should be interrupted before the water level in the well drops below the top of the pump, as this may induce cascading of the sand pack. Pumping the well dry should therefore be avoided to the extent possible in all cases. Sampling should commence as soon as the volume in the well has recovered sufficiently to allow collection of samples. Alternatively, ground water samples may be obtained with techniques designed for the unsaturated zone, such as lysimeters.

Failure to Stabilize Key Indicator Parameters

If one or more key indicator parameters fails to stabilize after 4 hours, one of four options should be considered: a) continue purging in an attempt to achieve stabilization; b) discontinue purging, do not collect samples, and document attempts to reach stabilization in the log book; c) discontinue purging, collect samples, and document attempts to reach stabilization in the log book; or d) Secure the well, purge and collect samples the next day (preferred). The key indicator parameter for samples to be analyzed for VOCs is dissolved oxygen. The key indicator parameter for all other samples is turbidity.

Cascading
To prevent cascading and/or air bubble formation in the tubing, care should be taken to ensure that the flow rate is sufficient to maintain pump suction. Minimize the length and diameter of tubing (i.e., 1/4 or 3/8 inch ID) to ensure that the tubing remains filled with ground water during sampling.

Cross-Contamination

To prevent cross-contamination between wells, it is strongly recommended that dedicated, in-place pumps be used. As an alternative, the potential for cross-contamination can be reduced by performing the more thorough “daily” decontamination procedures between sampling of each well in addition to the start of each sampling day (see Section VII, below).

Equipment Failure

Adequate equipment should be on-hand so that equipment failures do not adversely impact sampling activities.

IV. PLANNING DOCUMENTATION AND EQUIPMENT

< Approved site-specific Field Sampling Plan/Quality Assurance Project Plan (QAPP). This plan must specify the type of pump and other equipment to be used. The QAPP must also specify the depth to which the pump intake should be lowered in each well. Generally, the target depth will correspond to the mid-point of the most permeable zone in the screened interval. Borehole geologic and geophysical logs can be used to help select the most permeable zone. However, in some cases, other criteria may be used to select the target depth for the pump intake. In all cases, the target depth must be approved by the EPA hydrogeologist or EPA project scientist.

< Well construction data, location map, field data from last sampling event.

< Polyethylene sheeting.

< Flame Ionization Detector (FID) and Photo Ionization Detector (PID).

< Adjustable rate, positive displacement ground water sampling pump (e.g., centrifugal or bladder pumps constructed of stainless steel or Teflon). A peristaltic pump may only be used for inorganic sample collection.

< Interface probe or equivalent device for determining the presence or absence of NAPL.

< Teflon or Teflon-lined polyethylene tubing to collect samples for organic analysis. Teflon or Teflon-lined polyethylene, PVC, Tygon or polyethylene tubing to collect samples for inorganic analysis. Sufficient tubing of the appropriate material must be available so that each well has dedicated tubing.

< Water level measuring device, minimum 0.01 foot accuracy, (electronic preferred for tracking water level drawdown during all pumping operations).

< Flow measurement supplies (e.g., graduated cylinder and stop watch or in-line flow meter).

< Power source (generator, nitrogen tank, etc.).

< Monitoring instruments for indicator parameters. Eh and dissolved oxygen must be monitored in-line using an instrument with a continuous readout display. Specific conductance, pH, and temperature may be monitored either in-line or using separate probes. A nephalometer is used to measure turbidity.

< Decontamination supplies (see Section VII, below).

< Logbook (see Section VIII, below).

< Sample bottles.

< Sample preservation supplies (as required by the analytical methods).

< Sample tags or labels, chain of custody.

V. SAMPLING PROCEDURES

<u>Pre-Sampling Activities</u>

1. Start at the well known or believed to have the least contaminated ground water and proceed systematically to the well with the most contaminated ground water. Check the well, the lock, and the locking cap for damage or evidence of tampering. Record observations.

2. Lay out sheet of polyethylene for placement of monitoring and sampling equipment.

3. Measure VOCs at the rim of the unopened well with a PID and FID instrument and record the reading in the field log book.

4. Remove well cap.

5. Measure VOCs at the rim of the opened well with a PID and an FID instrument and record the reading in the field log book.

6. If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Note that the reference point should be surveyed for correction of ground water elevations to the mean geodesic datum (MSL).

7. Measure and record the depth to water (to 0.01 ft) in all wells to be sampled prior to purging. Care should be taken to minimize disturbance in the water column and dislodging of any particulate matter attached to the sides or settled at the bottom of the well.

8. If desired, measure and record the depth of any NAPLs using an interface probe. Care should be taken to minimize disturbance of any sediment that has accumulated at the bottom of the well. Record the observations in the log book. If LNAPLs and/or DNAPLs are detected, install the pump at this time, as described in step 9, below. Allow the well to sit for several days between the measurement or sampling of any DNAPLs and the low-stress purging and sampling of the ground water.

Sampling Procedures

9. Install Pump: Slowly lower the pump, safety cable, tubing and electrical lines into the well to the depth specified for that well in the EPA-approved QAPP or a depth otherwise approved by the EPA hydrogeologist or EPA project scientist. The pump intake must be kept at least two (2) feet above the bottom of the well

to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Record the depth to which the pump is lowered.

10. Measure Water Level: Before starting the pump, measure the water level again with the pump in the well. Leave the water level measuring device in the well.

11. Purge Well: Start pumping the well at 200 to 500 milliliters per minute (ml/min). The water level should be monitored approximately every five minutes. Ideally, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 ft or less). Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. As noted above, care should be taken to maintain pump suction and to avoid entrainment of air in the tubing. Record each adjustment made to the pumping rate and the water level measured immediately after each adjustment.

12. Monitor Indicator Parameters: During purging of the well, monitor and record the field indicator parameters (turbidity, temperature, specific conductance, pH, Eh, and DO) approximately every five minutes. The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows (Puls and Barcelona, 1996):

    ±0.1 for pH
    ±3% for specific conductance (conductivity)
    ±10 mv for redox potential
    ±10% for DO and turbidity

    Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. The pump must not be removed from the well between purging and sampling.

13. Collect Samples: Collect samples at a flow rate between 100 and 250 ml/min and such that drawdown of the water level within the well does not exceed the maximum allowable drawdown of 0.3 ft. VOC samples must be collected first and directly into sample containers. All sample containers should be filled with minimal turbulence by allowing the ground water to flow from the tubing gently down the inside of the container.

Ground water samples to be analyzed for volatile organic compounds (VOCs) require pH adjustment. The appropriate EPA Program Guidance should be consulted to determine whether pH adjustment is necessary. If pH adjustment is necessary for VOC sample preservation, the amount of acid to be added to each sample vial prior to sampling should be determined, drop by drop, on a separate and equal volume of water (e.g., 40 ml). Ground water purged from the well prior to sampling can be used for this purpose.

14. Remove Pump and Tubing: After collection of the samples, the tubing, unless permanently installed, must be properly discarded or dedicated to the well for resampling by hanging the tubing inside the well.

15. Measure and record well depth.

16. Close and lock the well.

VI. FIELD QUALITY CONTROL SAMPLES

Quality control samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. The appropriate EPA Program Guidance should be consulted in preparing the field QC sample requirements of the site-specific QAPP.

All field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples should be collected during the sampling event:

- Field duplicates
- Trip blanks for VOCs only
- Equipment blank (not necessary if equipment is dedicated to the well)

As noted above, ground water samples should be collected systematically from wells with the lowest level of contamination through to wells with highest level of contamination. The equipment blank should be collected after sampling from the most contaminated well.

VII. DECONTAMINATION

Non-disposable sampling equipment, including the pump and support cable and electrical wires which contact the sample, must be decontaminated thoroughly each day before use ("daily decon") and after each well is sampled ("between-well decon"). Dedicated, in-place pumps and tubing must be thoroughly decontaminated using "daily decon" procedures (see #17, below) prior to their initial use. For centrifugal pumps, it is strongly recommended that non-disposable sampling equipment, including the pump and support cable and electrical wires in contact with the sample, be decontaminated thoroughly each day before use ("daily decon").

EPA's field experience indicates that the life of centrifugal pumps may be extended by removing entrained grit. This also permits inspection and replacement of the cooling water in centrifugal pumps. All non-dedicated sampling equipment (pumps, tubing, etc.) must be decontaminated after each well is sampled ("between-well decon," see #18 below).

17. **Daily Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Disassemble pump.

E) Wash pump parts: Place the disassembled parts of the pump into a deep basin containing 8 to 10 gallons of non-phosphate detergent solution. Scrub all pump parts with a test tube brush.

F) Rinse pump parts with potable water.

G) Rinse the following pump parts with distilled/ deionized water: inlet screen, the shaft, the suction interconnector, the motor lead assembly, and the stator housing.

H) Place impeller assembly in a large glass beaker and rinse with 1% nitric acid (HNO_3).

I) Rinse impeller assembly with potable water.

J) Place impeller assembly in a large glass bleaker and rinse with isopropanol.

K) Rinse impeller assembly with distilled/deionized water.

18. **Between-Well Decon**

A) Pre-rinse: Operate pump in a deep basin containing 8 to 10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

B) Wash: Operate pump in a deep basin containing 8 to 10 gallons of a non-phosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes. Use the detergent sparingly.

C) Rinse: Operate pump in a deep basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

D) Final Rinse: Operate pump in a deep basin of distilled/deionized water to pump out 1 to 2 gallons of this final rinse water.

VIII. FIELD LOG BOOK

A field log book must be kept each time ground water monitoring activities are conducted in the field. The field log book should document the following:

- Well identification number and physical condition.
- Well depth, and measurement technique.
- Static water level depth, date, time, and measurement technique.
- Presence and thickness of immiscible liquid layers and detection method.

- Collection method for immiscible liquid layers.
- Pumping rate, drawdown, indicator parameters values, and clock time, at three to five minute intervals; calculate or measure total volume pumped.
- Well sampling sequence and time of sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations of sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.

IX. REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation, C.K. Smoley Press, Boca Raton, Florida.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, EPA/540/S-95/504.

U.S. EPA, 1993, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530-R-93-001.

U.S. EPA Region II, 1989, CERCLA Quality Assurance Manual.

Appendix C

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name ____________________________________ Date/Time Prepared ______________

Preparer's Affiliation ________________________________ Phone No.______________________

Purpose of Investigation____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: _________________

Home Phone: ____________________ Office Phone: ____________________

Number of Occupants/persons at this location _______ Age of Occupants ______________________

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: _________________________First Name: ___________________________

Address: ____

County: _________________

Home Phone: ____________________ Office Phone: ____________________

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _________________

If the property is residential, type? (Circle appropriate response)

Ranch	2-Family	3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) _______________________________________

Does it include residences (i.e., multi-use)? Y / N   If yes, how many? ______

Other characteristics:

Number of floors______   Building age______

Is the building insulated? Y / N   How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

____
____
____

Airflow near source

____
____
____

Outdoor air infiltration

____
____
____

Infiltration into air ducts

____
____
____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ________________	
e. Concrete floor:	unsealed	sealed	sealed with _________________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with _________________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			

k. Water in sump? Y / N / not applicable

Basement/Lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

____

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard	
Space Heaters	Stream radiation	Radiant floor	
Electric baseboard	Wood stove	Outdoor wood boiler	Other ___________

The primary type of fuel used is:

Natural Gas	Fuel Oil	Kerosene
Electric	Propane	Solar
Wood	Coal	

Domestic hot water tank fueled by: _____________________________

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other___________
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	____
1st Floor	____
2nd Floor	____
3rd Floor	____
4th Floor	____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car) Y / N / NA
Please specify___________________

d. Has the building ever had a fire? Y / N When?_________________

e. Is a kerosene or unvented gas space heater present? Y / N Where? ________________

f. Is there a workshop or hobby/craft area? Y / N Where & Type? ________________

g. Is there smoking in the building? Y / N How frequently? _______________

h. Have cleaning products been used recently? Y / N When & Type? ________________

i. Have cosmetic products been used recently? Y / N When & Type? ________________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _______________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _______________

l. Have air fresheners been used recently? Y / N When & Type? ________________

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?____________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?____________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_________________

Are there odors in the building? Y / N
If yes, please describe: ____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No
Yes, use dry-cleaning infrequently (monthly or less) Unknown
Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: ____________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____________________________________

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ______________________________________

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.