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HYDRO PUNCH

Site Investigation Without Wells

The HydroPunch® system enables drill rig operators to locate, measure and sample ground water and floating layers of gasoline and other hydrocarbons—rapidly and economically, without installing wells.

HydroPunch Collects Samples of Ground Water & Floating Layer

QUALITY SAMPLES IN AN HOUR OR LESS—AT MUCH LOWER COST

HydroPunch technology is a breakthrough in site investigation. Sampling is so rapid, you can have reliable data in hours, not the weeks or months required by traditional monitoring well surveys. Unlike geophysical or soil gas techniques, HydroPunch delivers actual samples of ground water and hydrocarbons—not indirect and sometimes misleading readings.

HydroPunch samples are consistent with monitoring requirements for all priority pollutants. HydroPunch II hydrocarbon samples accurately identify and show relative thickness of floating layers.

Best yet, HydroPunch sampling costs 50-90% less than drilling, casing, and developing conventional monitoring wells. HydroPunch sampling is not intended to replace wells for long-term monitoring; it helps optimize location and minimize the number of wells needed for effective monitoring—greatly speeding up site assessment.

ENVIRONMENTALLY SAFE, WITH NO PERMANENT INSTALLATION

HydroPunch operates with minimal disturbance to environmentally sensitive areas. There's no need to dispose of well development water, or of drill cuttings when pushed directly from the surface. The unobtrusive technique won't interfere with normal site operations.

HydroPunch boreholes can be easily abandoned (for example, by pressure-grouting from the bottom up). This leaves no permanent well to be monitored unnecessarily, and helps protect against possible short-circuiting of contamination between vertical zones.



HydroPunch (top) and HydroPunch II (bottom).

8 / SITE INVESTIGATION

QED GROUNDWATER SPECIALISTS

HYDROPUNCH

HOW IT WORKS

The HydroPunch sampler is driven to the desired depth in unconsolidated soils. The HydroPunch system can be used in formations suitable for a standard 2" split barrel (spoon) soil sampler—such as clays, silts, sands, and fine gravels.

Preliminary borings, an initial site test sample, or other information helps estimate sampling depth. An auger or split barrel sampler may provide a "pilot hole" to the area just above the sampling zone. (In some conditions, the tool can be driven directly from the surface for faster sampling.)

GROUND WATER SAMPLING

Check valves, stainless steel screen, and O-rings are inserted in the tool body, then the replaceable point is attached. The tool is driven to the proper depth—at least 5 feet below the static water level, to allow sufficient hydrostatic pressure for the sample chamber to fill—and pulled back approximately 18". After filling (time varies according to submergence and formation yield), the tool is withdrawn to discharge up to 1250 ml of sample, leaving the steel point in the ground.

FLOATING LAYER SAMPLING

After inserting the replaceable polypropylene or PVC screen and attaching the point, the tool is driven to the proper depth. It is then withdrawn about 48", and a 2" O.D. hydrocarbon bailer is lowered through the hollow casing to provide the floating layer thickness estimate and sample.

WHY HYDROPUNCH ASSESSMENT TECHNOLOGY IS THE BEST

Indirect techniques (soil gas or geophysical surveys) don't deliver actual samples, but rather provide remote readings which may be misleading because of interpretation or errors due to subsurface conditions. In addition, soil gas analysis is useless in detecting non-volatile contaminants, while geophysical sensing requires highly specialized equipment and personnel, not just a standard drill rig and crew.

One direct device, the porous filter liquid probe, is too fragile for many soil conditions. Other problems include very limited sample volume; clogging or extrusion of the filter tip in upper soil zones; and sample alteration, because of exposure to negative pressure (suction) during collection and to headspace venting in the sample vial.

Other direct techniques include well points, driven probes, and augers or shovels below water tables. All are limited in usefulness and accuracy. Well points are restricted to shallow depths, require development and pumping, can clog or become clogged, and are generally permanent installations. Driven probes can also be limited in depth, and use suction pumps that alter sample chemistry. Augers require development and pumping, sample from irregular vertical zones, and have a high probability of contamination.

Compared to these techniques, the HydroPunch system has been shown in many independent, published studies (papers on file at QED) to deliver accurate, undisturbed samples from extremely porous vertical zones in a wide range of soils at depths as great as 400'. HydroPunch sampling requires no development or pumping, leaves no permanent installation, and is easily done with standard drill rigs. (Abstract from David Kinsdale article in Jan. 1992 Ground Water Age)

SOME SELECTED HYDROPUNCH PAPERS:


Samples provide excellent estimate of ground water quality at discrete depths—Kabeck, Dawn and Beggs, Chris. "Testing a Ground Water Sampling Tool: Are the Samples Representative?" Proceedings, NYWA Outdoor Air/soil Conference 1990.

Sampling efficiency improves while exploration costs decrease—Stratynski, Andrew and Estrey, Timothy. "Use of Piezometric Cone Penetration Testing and Piezometer Ground Water Sampling for Mobile Organic Contaminant Plume Detection." Proceedings, NYWA Petroleum Hydrocarbons Conference 1990.

HydroPunch works multiple contaminants plumes in three dimensions—Peck, Timothy and Macfarlane, Ian. "Multi-phase Environmental Assessment of Intermingling Substances Contamination: A Case Study." Proceedings, NYWA Environmental Site Assessment Conference 1991.

Call 800-426-2026 for a free 8-page booklet, including a bibliography and abstracts of these and other papers demonstrating the accuracy and practicality of HydroPunch sampling.

QED GROUNDWATER SPECIALISTS



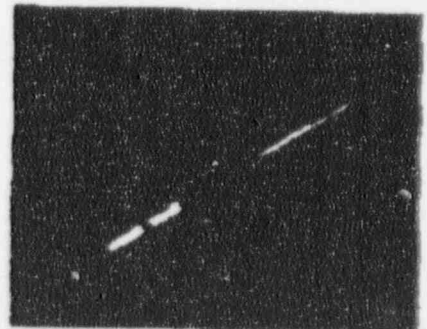
HYDROPUNCH ON VIDEO

Sampling Ground Water And Hydrocarbons Without Wells

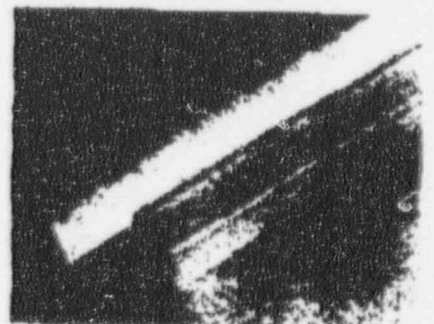
This 15-minute tape shows how the HydroPunch system collects ground water and floating hydrocarbon samples for field investigation and plume definition without installing permanent wells, with 90-95% savings in cost and time. Economics, speed, and accuracy are explored with animation, graphics, and interviews with consultants, drillers, and industrial and users, explaining the advantages of this new technology.

HydroPunch II User's Guide

This step-by-step video, included with every HP1000 kit, provides detailed, step-by-step instructions covering all aspects of HydroPunch II use. Major areas include: how the system works; assembly and operation in both ground water and hydrocarbon sampling modes; decontamination procedures; driller's rules; and field troubleshooting techniques.



Hydrocarbon bailer for floating layer sampling with HydroPunch II or in wells.



HydroPunch II components consist of PVC or standard polypropylene for floating layers, stainless steel for ground water.

SITE INVESTIGATION / 9

HYDROPUNCH

HYDROPUNCH I

SPECIFICATIONS:

O.D.: 1.75"
 Length: 64.50" (closed)
 Top thread: AW box
 Weight: 24 lbs.
 Sample volume: 500 ml
 Materials:

Body & fittings: 304 S.S.
 Check balls: S.S.
 Screen: S.S.
 Barbed point: S.S.
 Discharge tubing: Teflon
 O-rings: Viton

* Teflon is a registered trademark of E.I. duPont de Nemours Company, Inc.

HYDROPUNCH II

SPECIFICATIONS:

O.D.: 2.00"
 Length: 60" (closed)
 Top thread: AW Box and NW Casing
 Weight: 26 lbs. (ground water mode)
 24 lbs. (hydrocarbon mode)
 Sample volume: 1230 ml (ground water mode)
 Unlimited (floating layer)

Materials:

Body & fittings: 304 S.S.
 Drive shaft: Carbon Steel (S.S. optional)
 Adapters: Carbon Steel
 Check valves: Ethylenepropylene (EPDM)
 Screens: S.S. (ground water),
 Polypropylene or PVC (hydrocarbon)
 Points: Lead-free Carbon Steel
 O-rings: Viton
 Discharge tubing: Teflon

HydroPunch or HydroPunch II:

For most applications, the HydroPunch II (S.S. Point No. 36069) will be the tool of choice. It is more rugged, capable to operate in hydrocarbons as well as ground water, and collects a larger sample volume. The original HydroPunch will be the choice when it is not possible to use expensive drive casing (either casing in the ground, or when the tool is to be driven by some power-transmitting equipment other than a drill rig).

HydroPunch I:

- Collects ground water samples only
 - Not for use in hydrocarbons
 - Power-transmitting drive shaft and screen must be driven by the ground
 - Can collect only one sample volume
- HydroPunch II:
- Collects floating layer and ground water
 - Rechargeable screen and screen are 12" in ground (one screen may be extended)
 - Stronger for rough duty; used with steel rig

SYSTEM COMPONENTS:

MODEL NO.	DESCRIPTION
HP0500	HydroPunch Kit—Includes HydroPunch w/ barbed point; cleaning brush & handle set; top discharge valve & tubing; 12 extra O-ring sets, 12 S.S. screen sets, and check balls; instruction book; carrying case.
35500	Basic HydroPunch without case or accessories

OPERATING SUPPLIES:

(One set of each per drive)

35540	O-ring Kit—12 sets
35760	Screen Kit—12 screens w/clamps

SYSTEM COMPONENTS:

MODEL NO.	DESCRIPTION
HP1000	HydroPunch II Kit—Includes HP1; cleaning brush & handle set; top discharge valve & tubing; hydrocarbon baller; 8 sets check valves (reusable), 10 sets O-rings; instruction book; how-to-use video; carrying case. (Does not include points & screens).
36067	Basic HydroPunch II without case or accessories

OPERATING SUPPLIES:

(One each per sample in appropriate mode)

Both modes:

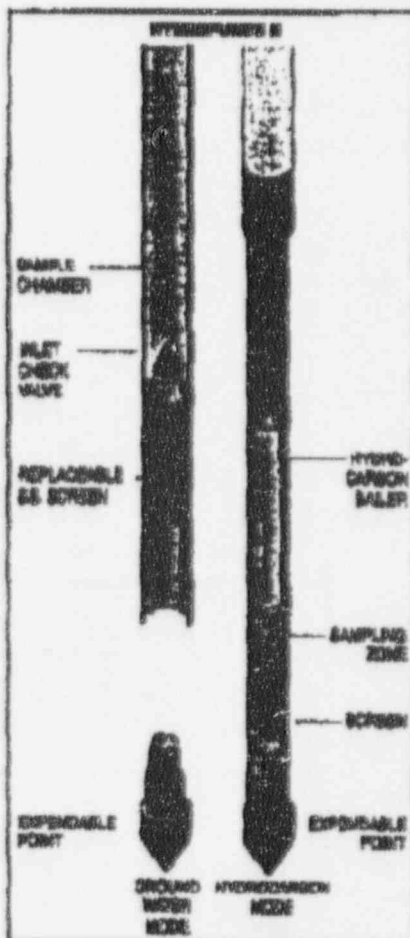
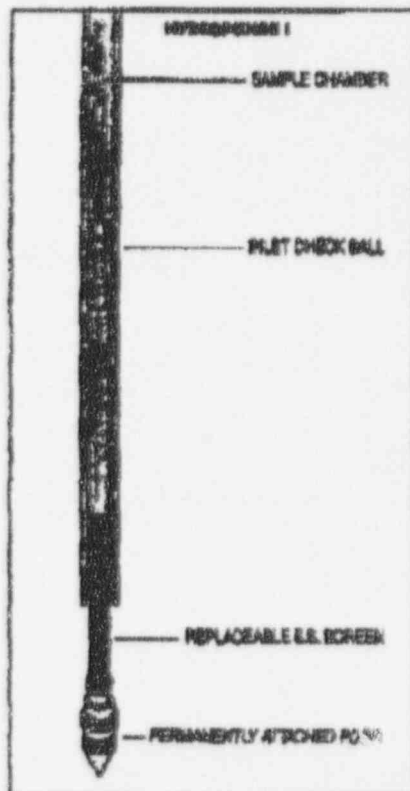
36080	Drive Point Kit—10 ea.
36069	O-ring Kit—10 sets
Ground Water mode:	
36051	S.S. Screen Kit (4' long)—10 ea.
36061	Discharge Kit (6' long Teflon-lined tubes)—20 ea., plus two pinch clamps, 1 barb

Hydrocarbon mode: (choice of)

36202	Standard Polypropylene Screen Kit (5' long, .040" slot)—50 ea.
36203	PVC Screen Kit (5' long, .010" slot)—20 ea.

ACCESSORIES:

35509	1" O.D. Teflon Baller
36164	1" O.D. Hydrocarbon Baller
8340100	Baller Reel w/ 100' Cable
36306	Sub AW Box—BW Casing
36654	NW Adapter
36063	BW Adapter



RAPID CONTAMINATION ASSESSMENT OF SAPROLITE AQUIFERS WITHOUT WELLS

Thomas A. Mann, A. Michel Pelletier, and Thomas L. Lammons

ABSTRACT

A phased ground water assessment is being conducted at a manufacturing facility in the Piedmont physiographic province of upstate South Carolina. The initial phase of work revealed ground water contamination by various chlorinated hydrocarbon compounds. To date, field activities have been directed toward defining the extent of the ground water contamination.

A HydroPunch™ sampling tool was used as a screening device during this assessment. The tool provided rapid, cost-effective collection of ground-water samples from the undisturbed saturated zone, without the installation of monitoring wells. Utilization of the HydroPunch™ facilitated assessment planning by quantitatively delineating contaminant plume boundaries, both horizontally and vertically, optimizing monitoring well locations, reducing the number of monitoring wells and allowing for ground water sampling in locations inaccessible for well installations. A number of HydroPunch™ samples were also collected from soil borings which were later converted to permanent monitoring wells.

KEY WORDS: Rapid assessment, ground water contamination, sampling device, saprolite, site study, Piedmont.

HYDROPUNCH™ DESCRIPTION AND OPERATION

The HydroPunch™ sampling tool is constructed almost entirely of stainless steel and teflon, using viton O-rings and a polypropylene screen. It is easily cleaned in the field and will collect a 500-ml water sample. The HydroPunch™ consists of a drive point, a one-foot-long perforated section for sample intake, a sample chamber, and an adapter to attach the unit to either penetrometer push rods or standard soil sampling drill rods. Figure 1 is a schematic detail of the tool in both the driving and sampling modes.

As the unit is pushed (by rig hydraulics) or driven (by standard 140-lb. hammer) into the undisturbed saturated soil, the sample intake pipe is shielded by a watertight sleeve that prevents contaminated soil or ground water from entering the unit. The tubular shape of the sampler and its smooth exterior surface prevents the downward transport of the surrounding soil or liquid as the tool is advanced. When the desired sampling depth is reached, the perforated intake pipe is exposed to the water-bearing zone, permitting ground water to flow through the screen and into the sample chamber. During installation, no

foreign materials (i.e., gravel pack, drilling fluid, or cuttings) are introduced into the zone being sampled, thereby minimizing the potential for sample quality being influenced by extraneous contaminants. The sample is collected under in-situ hydrostatic pressure with minimal agitation. Once the sample chamber is filled, the HydroPunch™ is then pulled towards the surface. This increases the hydrostatic pressure in the unit, which closes the check valves and retains the sample within the sample chamber (after Cordry, 1986).

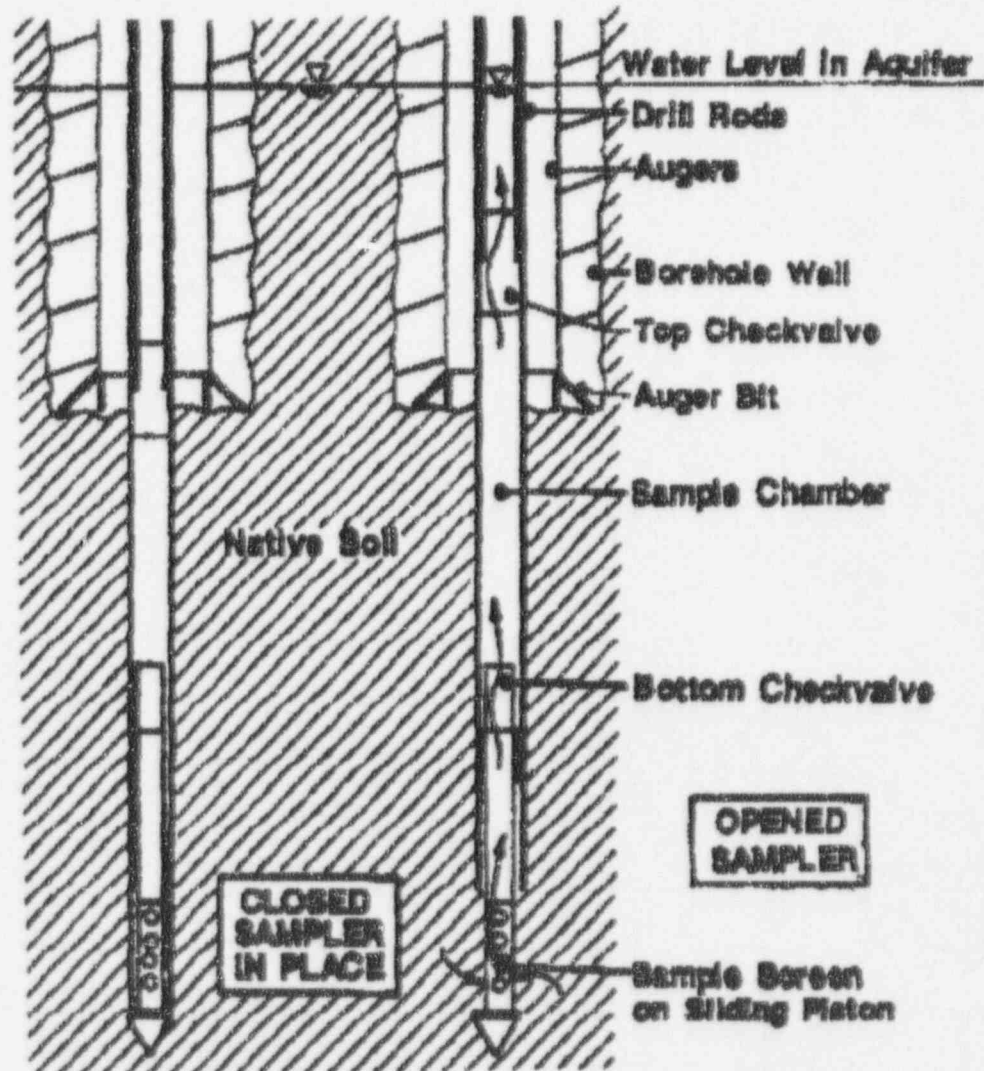


Figure 1. -- Schematic diagram showing operational features of the HydroPunch™ sampler.

After using the HydroPunch™ in a number of geologic environments, including the South Carolina Piedmont, the following observations have been made:

- the tool performs well in fine-grained soil such as silty, clayey sands and fine gravel, where there is some degree of cohesion;
- in clean, well-sorted sands, the tool is harder to open in the subsurface because of lack of cohesion of the soils;
- boulders, cobbles, and very coarse-grained gravels can severely damage the tool, because of the excessive force required to advance it in those materials;
- generally, the tool can be driven or pushed in the same fashion as a standard 2-inch split- spoon sampler. However, to prevent tool damage, the density of the sampling medium should not exceed 50 blow counts per foot, or the hydraulic pressure while pushing it should not exceed 700-1000 psi in holes over 3.25 inches in diameter. Inside 3.25 inch ID or smaller hollow-stem augers, pressures up to 10,000 psi have been used safely;
- the sample screen must be placed at least 5 feet below the water table to fill the sample chamber;
- allowance should be made for additional time to fill the sample chamber in fine-grained soils of low permeability; and
- the tool must be completely disassembled and decontaminated after each sample is collected. This procedure includes replacing all thirteen O-rings as well as the polypropylene screen.

Some of the advantages derived from HydroPunch™ use during field investigations include:

- a greater number of locations can be sampled for detailed plume boundary discrimination than would have been economical by installing and sampling monitoring wells;
- at each location, samples can be collected from discrete depths to characterize the vertical distribution of contaminants, and optimize well screen placement;
- once the HydroPunch™ samples have been analyzed, prospective well locations can be adjusted or eliminated altogether;
- samples can be collected from off-site locations, where permanent monitoring well installations may not be possible;
- the HydroPunch™ borings can be temporarily left open to allow water levels to be measured; and
- the boreholes are abandoned, leaving no permanent sampling point or sampling liability.

CASE STUDY

A light industrial facility, located in the Piedmont physiographic province of South Carolina, is underlain by a relatively homogeneous saprolite material which exhibits a relict fabric consistent with the in-situ weathering of a mica schist and a granitic gneiss. The saprolite is composed of mostly silt and fine sand with a large fraction of non-plastic clay and mica. At present, assessment of the ground water quality and hydrogeology have been limited to the saprolite aquifer because there is no indication that the contamination has reached the bedrock. A water table map of the saprolite aquifer is presented in Figure 2 and depicts ground water flow radiating in all directions from the west.

The analytical results to date show two distinct parent volatile organic compounds to be present in the ground water: Trichloroethene (TCE), and 1,1,1-Trichloroethane (1,1,1-TCA). Breakdown products of TCE include 1,1-Dichloroethene (1,1-DCE) and Trans-1,2-

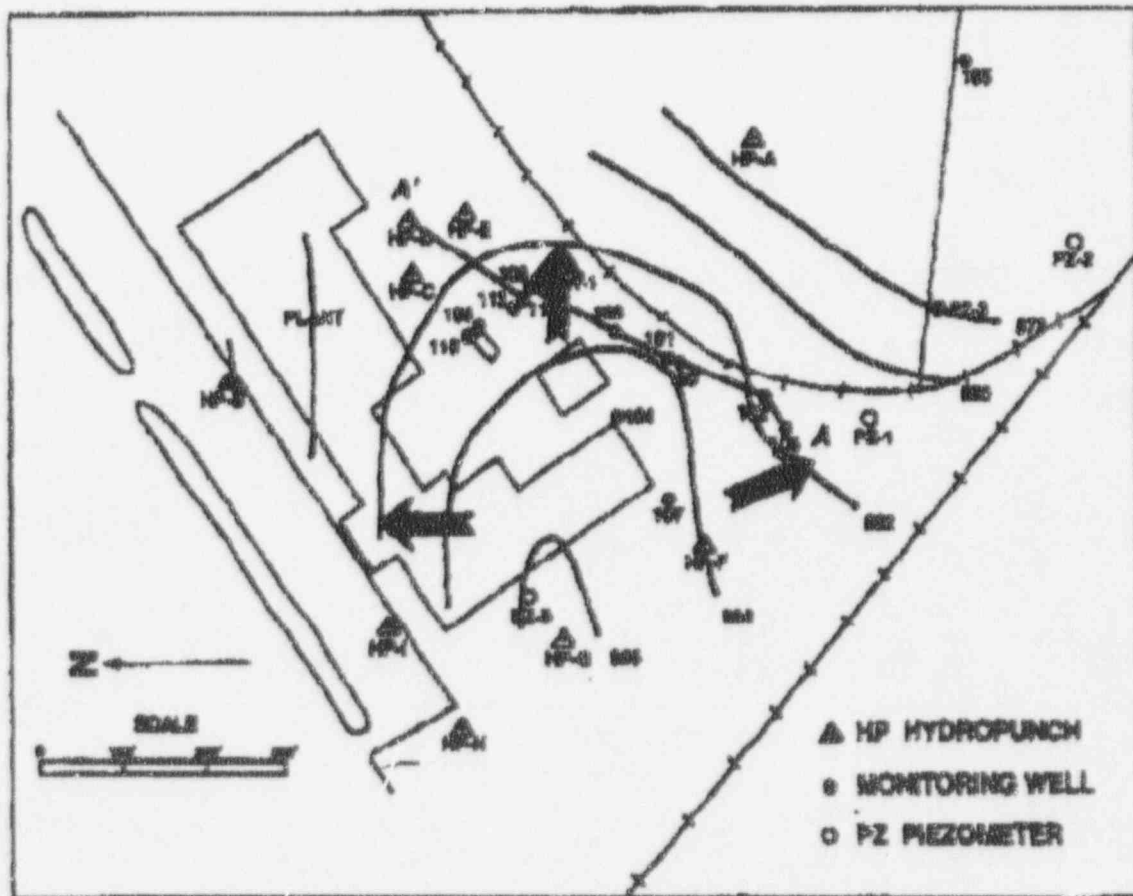


Figure 2. -- Site plan with cross-section line A-A' and water table elevations in September 1988.

Dichloroethane (T-1,2-DCE). The breakdown product of 1,1,1-TCA is 1,1-Dichloroethane (1,1-DCA). Characterization of the site, based on the information collected to date, has been very difficult. The factors contributing to this difficulty are:

- the apparent multiple, scattered sources of chemical constituents that are adversely affecting the site;
- the intermixing of separate plumes, both horizontally and vertically;
- the location of the ground water divide on the site which causes the plumes to flow in various directions. this situation is aggravated by the possibility that the divide may migrate over time, causing the plume flow directions to shift.

With these major influences taken into consideration, an attempt was made to generally define the plumes as shown in Figures 3 and 4. Multiple TCE and 1,1,1-TCA plumes exist at the site. These plumes appear in both the shallow and deep parts of the saprolite aquifer, and their constituents vary in concentration and extent.

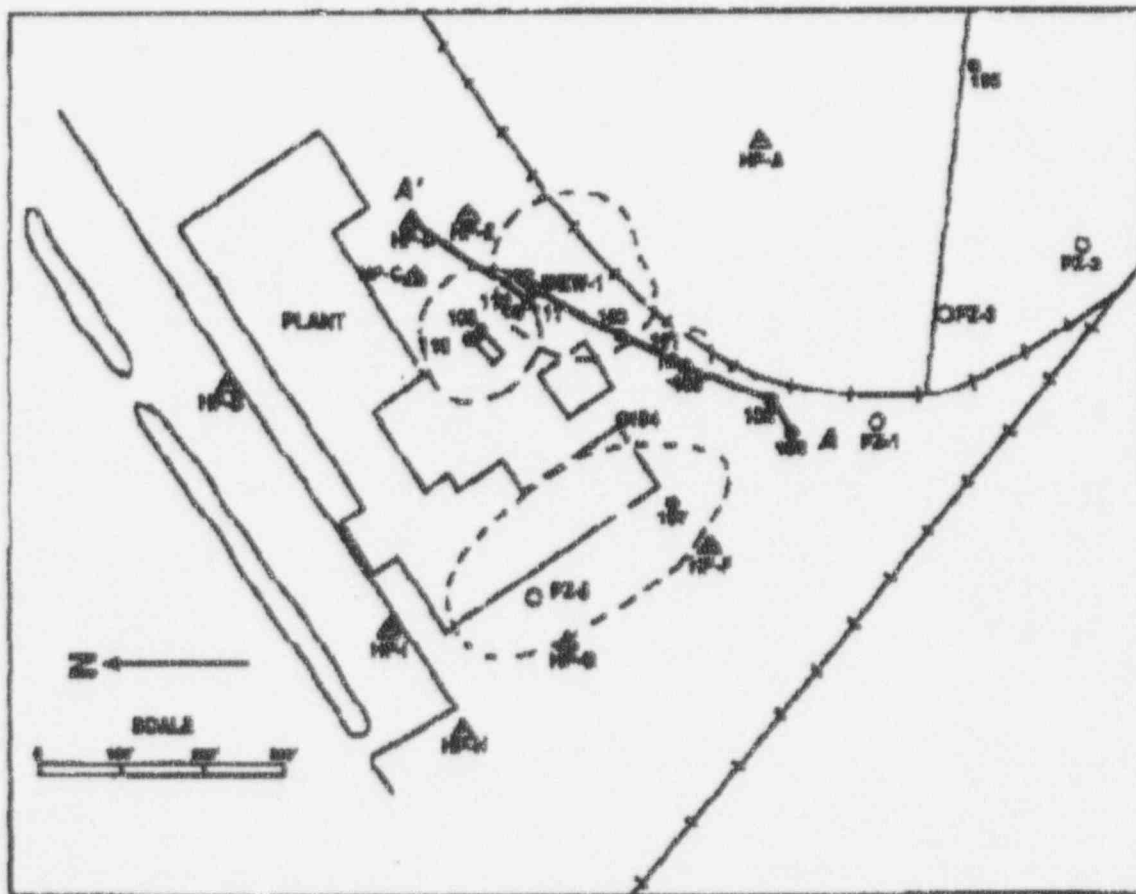


Figure 3 -- Location of TCE plumes in the ground water beneath the site.

The HydroPunch™ was used during two assessment phases at the site. Eleven HydroPunch™ locations, in addition to four piezometers and fourteen monitoring wells, have been used to assess the ground water conditions on site. Laboratory services provided rapid turn-around for volatile organic compound (VOC) analyses, enabling decisions to be made the following day as to the optimal location for monitoring wells. Because of the complicated distribution of contaminant plumes, both horizontally and vertically, numerous sampling points were required. The HydroPunch™ provided a method for rapidly collecting multiple samples in a cost effective manner.

To evaluate the quality of the samples collected using the HydroPunch™, discrete samples were collected from two permanent monitoring wells (MW-108 and MW-109). The analytical results from the ground water samples collected in the monitoring wells were compared to the HydroPunch™ samples collected at the same levels as the screened intervals of each respective well (Table 1).

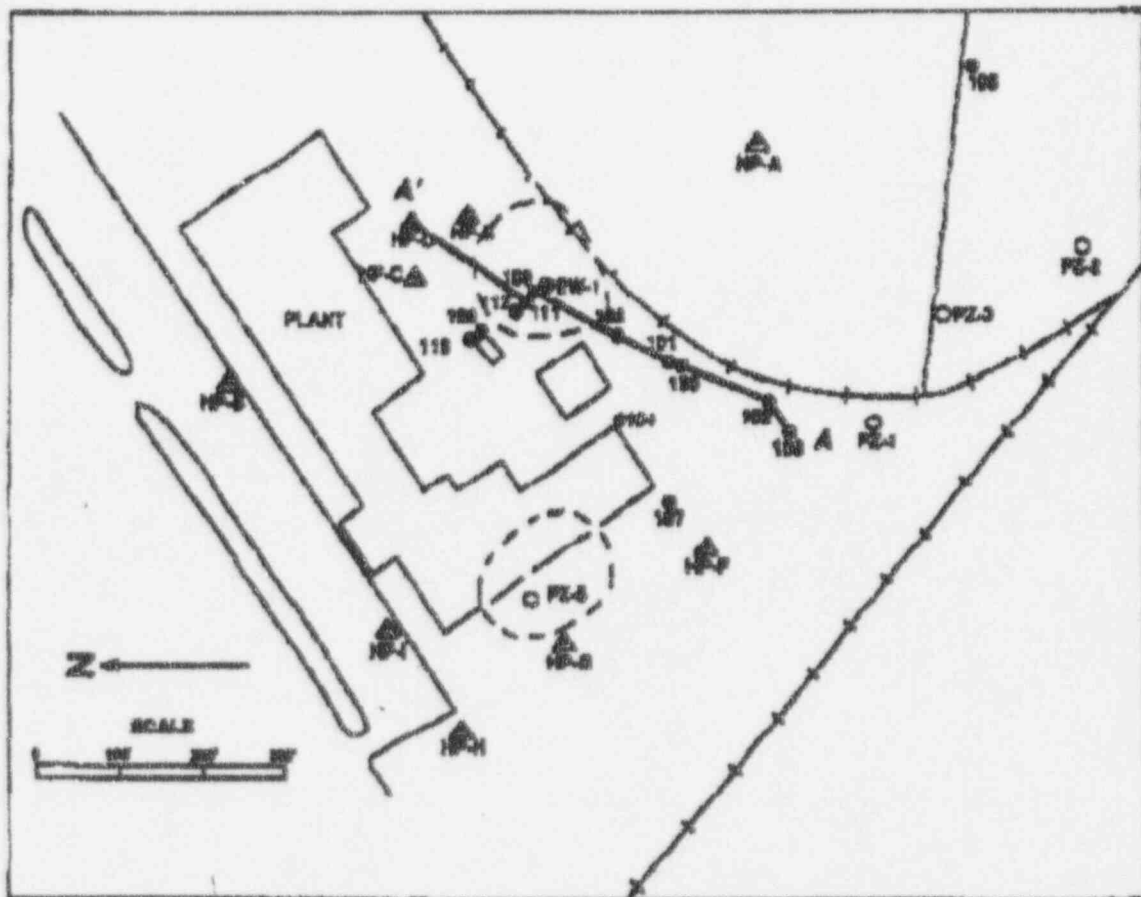


Figure 4 -- Location of 1,1,1-TCA plumes in the ground water beneath the site.

As shown in Figures 5 and 6, and in Table 1, the concentrations of TCE and 1,1,1-TCA and their breakdown products were below minimum detection levels in both the samples from MW-108 and in the HydroPunch™ samples (HP-108). The sample from monitoring well MW-109 was compared with HP-109-4, the HydroPunch™ sample taken from within the screen interval. These analytical results agreed quite favorably. A comparison was also made between samples from MW-111 and the shallow HP-109 samples

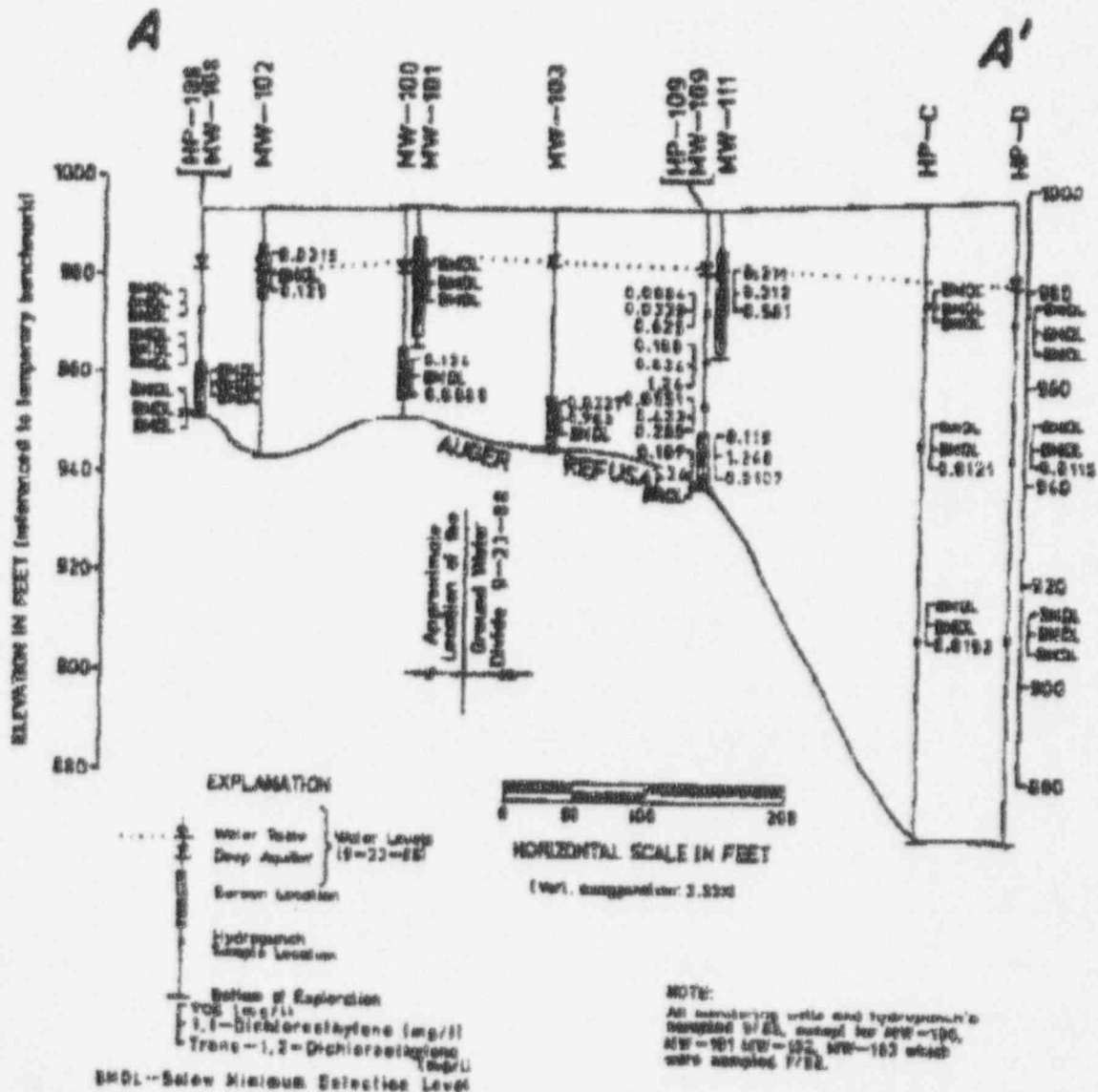


Figure 5. -- Vertical distribution of TCE-related compounds along section A-A'.

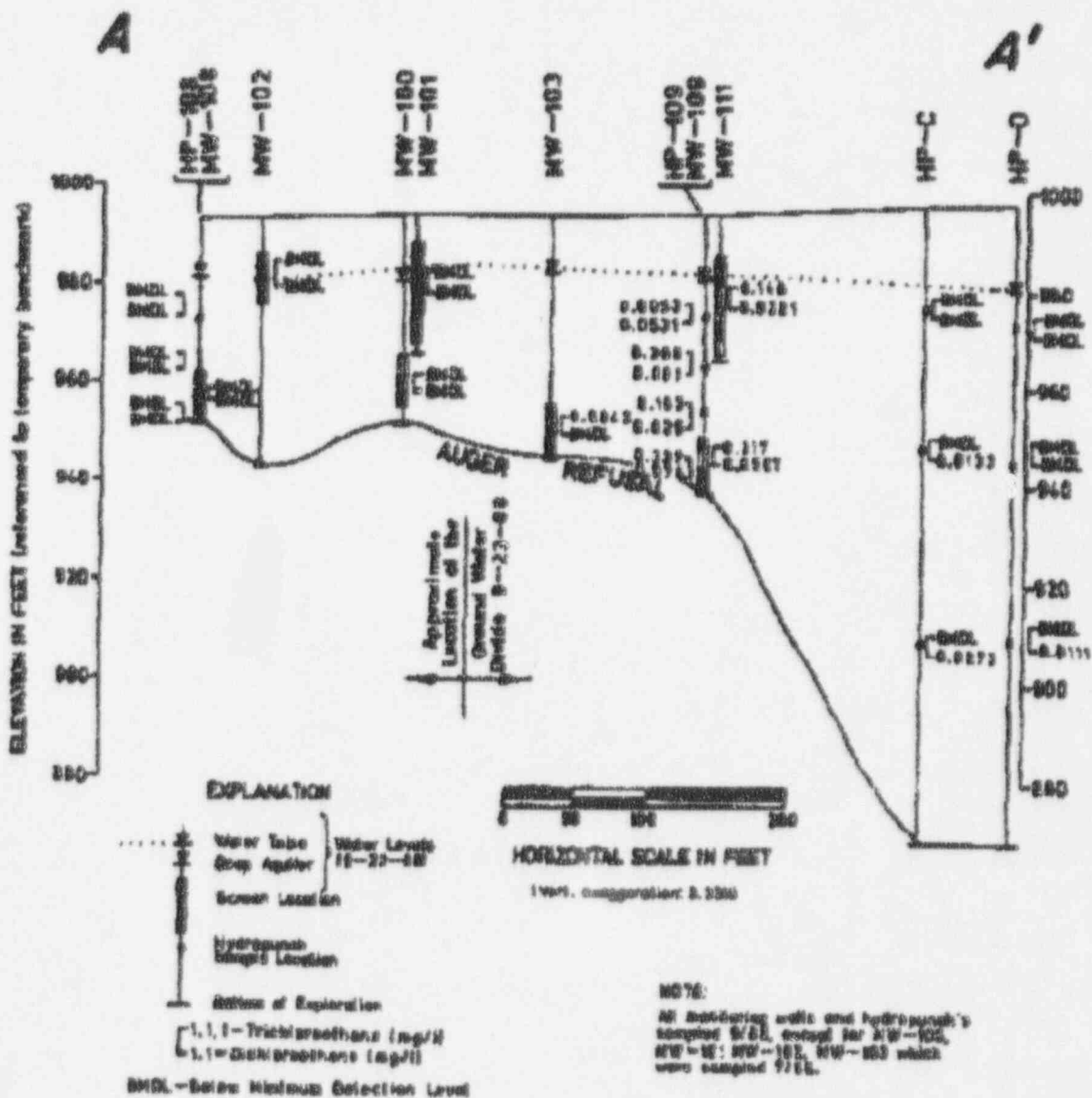


Figure 6. - Vertical distribution of TCA-related compounds along section A-A'.

Table 1. -- Comparison of monitoring well samples with HydroPunch™ samples.

Compound	Concentration (ug/L)						
	MW-108	HP-108-4	MW-109	HP-109-4	MW-111	HP-109-1	HP-109-2
TCE	BMDL*	BMDL	119.0	107.0	211	8.4	109
1,1-DCE	BMDL	BMDL	1240.0	1340.0	312	33.9	834
T-1,2-DCE	BMDL	BMDL	10.7	<5.0	581	625.0	1240
1,1,1-TCA	BMDL	BMDL	317.0	337.0	148	5.3	366
1,1-DCA	BMDL	BMDL	56.7	74.0	38.1	53.1	81.0

* BMDL = Below Minimum Detection Level

approximately 10 feet away. Though the HydroPunch™ samples were not collected within the borehole of MW-111, their close proximity to well MW-109 warranted this general comparison. These two HydroPunch™ samples were located at the approximate middle and bottom of the MW-111 screen. Analytical results of MW-111 fall within the general range of analytical results from these HydroPunch™ samples.

CONCLUSION

Based on these comparisons, the analytical results from the ground water samples collected from the monitoring wells validated the analytical results obtained from the HydroPunch™ samples. This verification indicates that the HydroPunch™ may be used as a quantitative screening tool to further assess the extent of the plumes at this site and other sites in similar geologic environments. The analyses from HydroPunch™ samples can be directly compared with samples from monitoring wells, rather than relying on qualitative comparisons necessary with other screening methods.

REFERENCES

Cordry, K.F., 1986, Groundwater sampling without wells, presented at the Sixth National Symposium and Exposition on Aquifer Restoration and Groundwater Monitoring, NWWA, Columbus, Ohio.