# THE USE OF THE HYDROCONE AS AN INVESTIGATIVE TOOL

Berg Keshian, Jr., P.E. and Michael Garman
Roy F. Weston, Inc.

Dwain Farley,
Technical Support Office
Los Alamos National Laboratory

David Ingle
Pinellas Plant
DOE Area Office

## ABSTRACT

Under the direction of the U.S. DOE-AL Environmental Restoration Program at the Pinellas Plant in Largo, Florida, a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was completed at 15 Solid Waste Management Units (SWMUs) to fulfill the requirements of the Hazardous and Solid Waste Amendment (HSWA) 1984 permit issued 9 February 1990 by the U.S. EPA Region IV. Based on the results of the RFI Report, the EPA has directed the DOE to perform corrective measure studies at four SWMUs. One of these sites is the Northeast Site, which has a groundwater plume contaminated primarily with the chlorinated solvents methylene chloride, vinyl chloride, 1,2, DCE and TCE, with total VOC concentrations ranging up to 3 million parts per billion (ppb).

Investigations during the RFI were conducted primarily to determine the lateral extent of groundwater contamination, as it was concluded that the center of the plume was well defined by the well cluster 2S/2D, since concentrations of methylene chloride had been measured up to 2 million ppb. However, in order to select the best remedial alternative during the CMS, it was determined that additional information on the vertical extent and movement of the plume was required. It was also determined that the best and most economic way to define the vertical and horizontal extent of the plume was to conduct a Hydrocone investigation, using a 25-foot radial grid away from the highest concentration well. This paper presents a summary of the Hydrocone investigation results and conclusions, along with a discussion of the advantages and disadvantages of the hydrocone over conventional monitoring wells.

## INTRODUCTION

Under the direction of the U.S. DOE-AL Environmental Restoration Program at the Pinellas Plant in Largo, Florida (Fig. 1), a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was completed at 15 Solid Waste Management Units (SWMUs) to fulfill the requirements of the Hazardous and Solid Waste Amendment (HSWA) 1984 permit issued 9 February 1990 by the U.S. EPA Region IV (EPA 1990). Based on the results of the RFI Report (DOE 1991), the EPA directed the DOE to perform corrective measure studies at four SWMUs. One of these sites is the Northeast Site, which has a groundwater plume contaminated primarily with the chlorinated solvents methylene chloride, vinyl chloride, 1,2 DCE and TCE, with total VOC concentrations ranging up to 3 million parts per billion (ppb).

The distribution of the contamination within the plume and the areal extent of the VOC plume were determined during the RFI, based on a network of wells shown on Fig. 2. This well network was made up of well clusters, with shallow wells of screens from 5 to 15 ft and deep wells with screens from 20 to 30 ft.

## GEOLOGY

The geology of the area consists of approximately 30 ft of surficial silty sands, overlying a clay layer known as the Hawthorn Formation, which is approximately 50 to 70 feet in thickness. The Hawthorn Formation acts as an aquitard and protects the underlying Floridan Aquifer, which is the primary drinking water source for the area. The surficial silty sand layer has a surficial aquifer which extends from approximately 3 ft below ground surface to the top of the Hawthorn Formation. The water quality of the surficial aquifer is high in TDS, calcium, sulfate, and iron and is not used as a drinking water supply, but is used regionally for irrigation.

## ADDITIONAL CHARACTERIZATION

In order to comply with the requirements of the CMS process, the most important of which was to determine the proposed method of cleanup and the time required for that cleanup, it was determined that additional characterization of the plume would be necessary. The reason for the additional characterization was that the peak contaminant levels (~3,000,000 ppb) were centered around well PIN 15-0502 (Fig. 2), and concentrations dropped off rapidly to only several hundred ppb at the next closest well in any direction.

The method chosen for the additional characterization was the Hydrocone. The Hydrocone is a cost effective, unique instrument based on the technology from the Dutch Cone Penetrometer, which is used for obtaining groundwater samples, without the need for costly monitoring wells. In addition, as the instrument is pushed directly to the sampling depth, no drilling wastes are generated, eliminating disposal problems and significantly reducing crew exposure to environmental contamination.

The Hydrocone system is comprised of the sampler body with a telescoping porous tip, an argon gas source with a gas/electronic umbilical cable connecting the sampler body to a microcomputer located at the surface, on a hydraulic push system. A schematic of the Hydrocone is shown on Fig. 3.

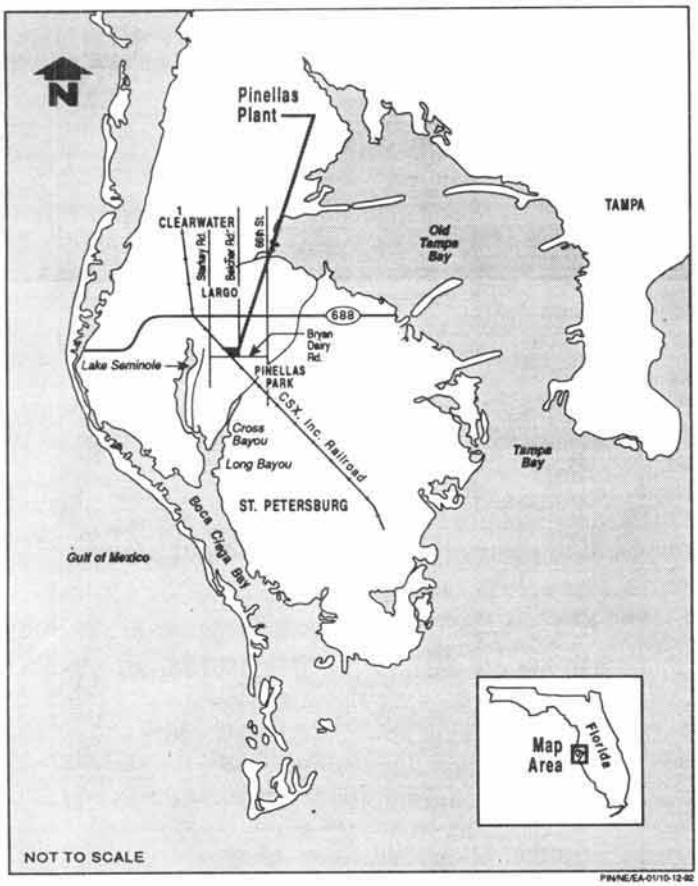


Fig. 1. Pinellas Plant location.

Following comprehensive decontamination and surface checkout procedures, the Hydrocone is sealed until arriving at sampling depth; thus, the instrument works extremely well sampling under free product. Once sampling depth is reached, the porous tip is extended and groundwater sampling is initiated. Natural hydrostatic pressure is used to collect the sample with the inside of the sampler body under a variable argon gas backpressure. This is done to control the rate of filling and to minimize sample volatilization. Data collected within the sampler includes the volume of collected sample, which is continuously relayed to the surface computer. The surface computer then presents a real-time graphic display as the test proceeds. Following sample collection, the argon gas backpressure is increased to secure the sample and the Hydrocone is returned to the surface. As no borehole exists following sampling, the Hydrocone can be used repeatedly at increasing depths at the same location for detailed vertical delineation. Once the profile is completed, the hole is grouted from the bottom up using the tremie method.

Data presentation includes a graphic display of the sample collection and argon gas pressure as a function of time. As all system parameters are monitored by electronic sensors and computer-stored, later data reduction includes the calculation of the hydraulic conductivity of the strata where each Hydrocone groundwater sample was obtained.

The rationale for the location of additional characterization points was to start at well PIN 15-0502 (the highest concentration), and move out radially in a north, south, east, and west direction at 25-ft horizontal intervals until concentrations dropped off. Additionally, samples would be taken at 15.5 ft and 25.5 ft below ground surface in order to determine

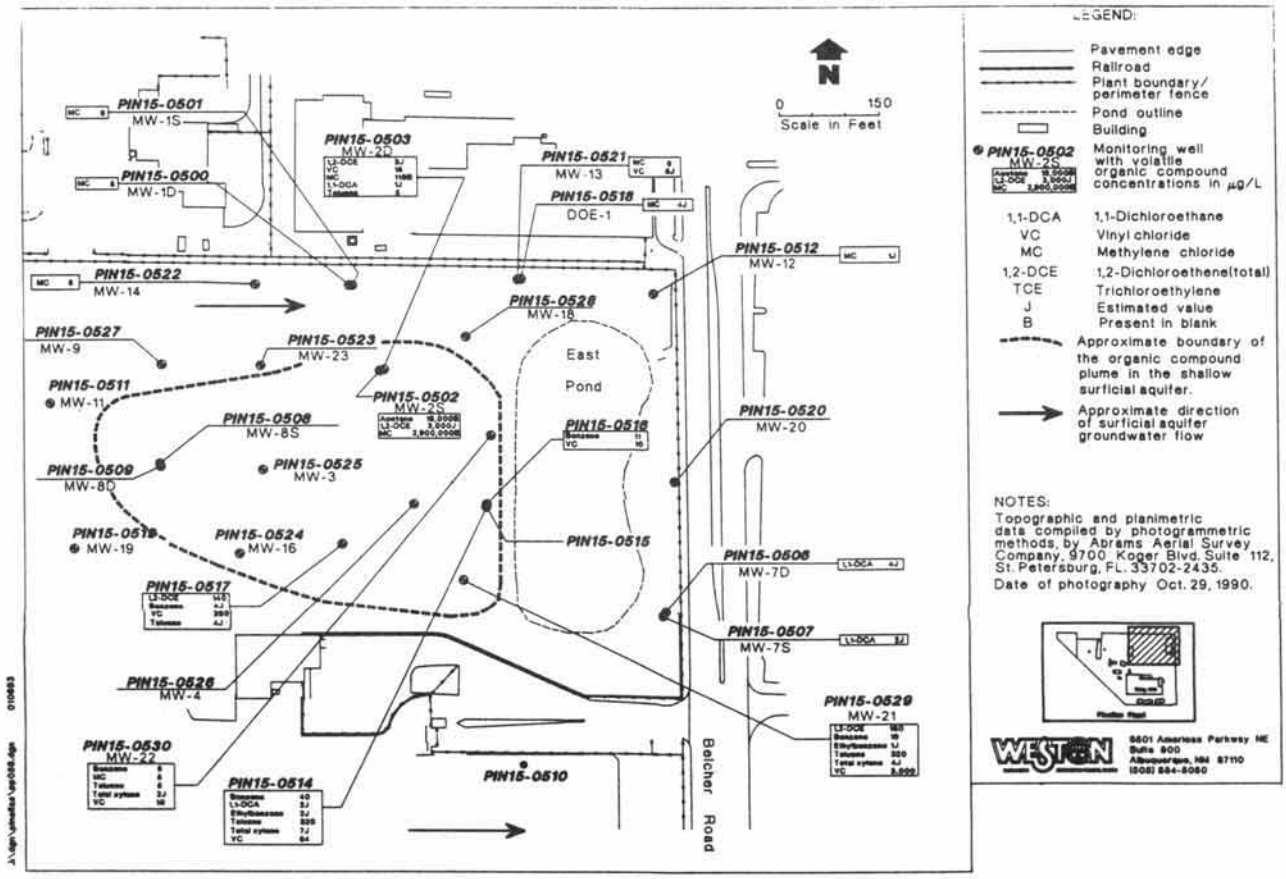


Fig. 2. Pinellas Plant-distribution of VOCs in groundwater samples at the northeast site.

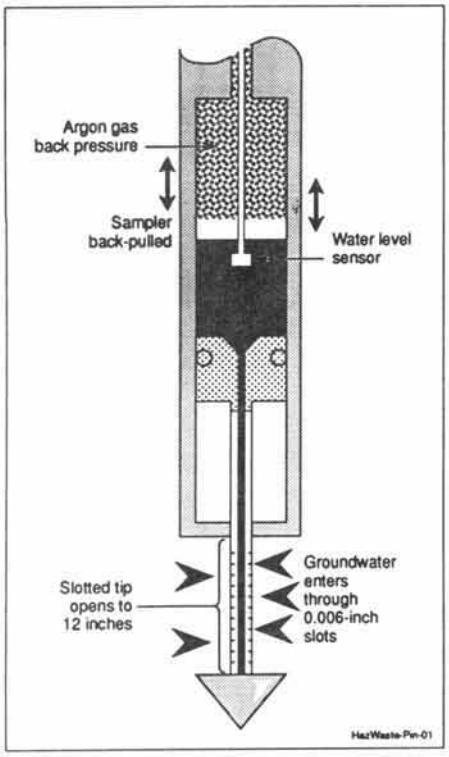


Fig. 3. Schematic of Hydrocone.

if the contamination was *sinking through the* water. Samples were also taken at the top of the clay layer (approximately 32 ft) at some locations to determine if the contamination had sunk to the top of the clay layer. A total of 59 Hydrocone locations were sampled in a two-week period, as shown on Figs. 4 and 5.

As data were received (based on 24- to 48-hour turnaround from the laboratory), the data were evaluated and additional Hydrocone locations added to bound the plume and identify areas of gross contamination on a real-time basis. As part of the hydrocone sampling effort, hydraulic conductivity (k) tests were performed during the collection of 115 Hydrocone groundwater samples. The geometric mean of all k values was .926 ft/day, which compared well with a pump test and slug tests performed on monitoring wells.

Groundwater samples were analyzed for VOCs using EPA Method 8010. Seven VOCs (vinyl chloride, dichloromethane (methylene chloride), 1,1-dichloroethane, 1,1-DCE, 1,2-DCE, tetrachloroethene, and TCE) were detected in Hydrocone groundwater samples. Low levels of VOCs were found at most sample locations (Fig 4. and Fig. 5). Vinyl chloride, the most commonly detected compound, was present at concentrations as high as 84,000 $\mu$g/L. Dichloromethane (methylene chloride) was detected at 6,900,000 $\mu$g/L in a sample from 25.5 ft, which is the greatest concentration of any VOC detected (Fig. 5). The greatest concentration of total 1,2-DCE was 240,000 $\mu$g/L in a sample from 15.5 ft.

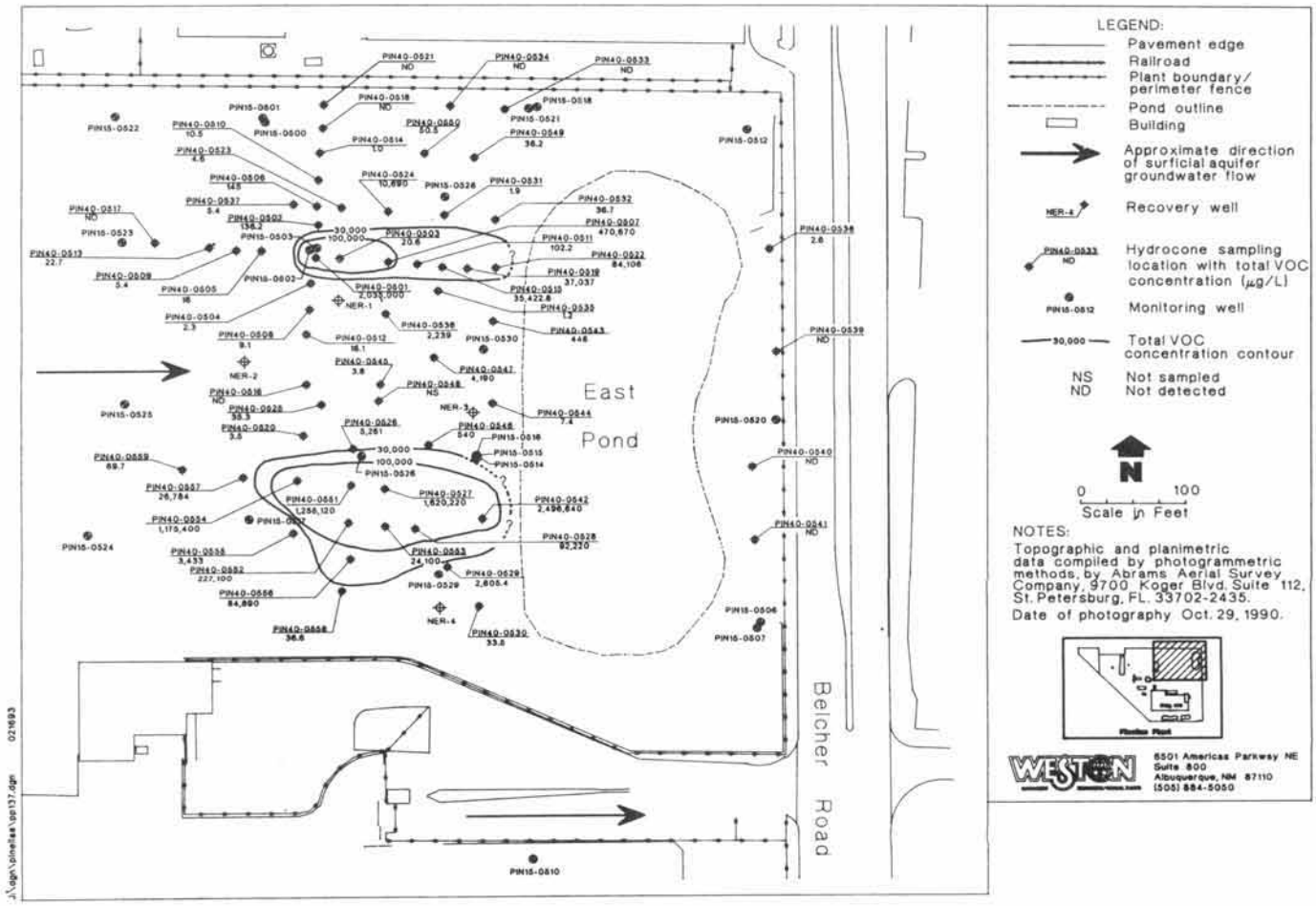


Fig. 4. Pinellas Plant-Hydrocone sampling results: total volatile organics at 15.5 ft depth.

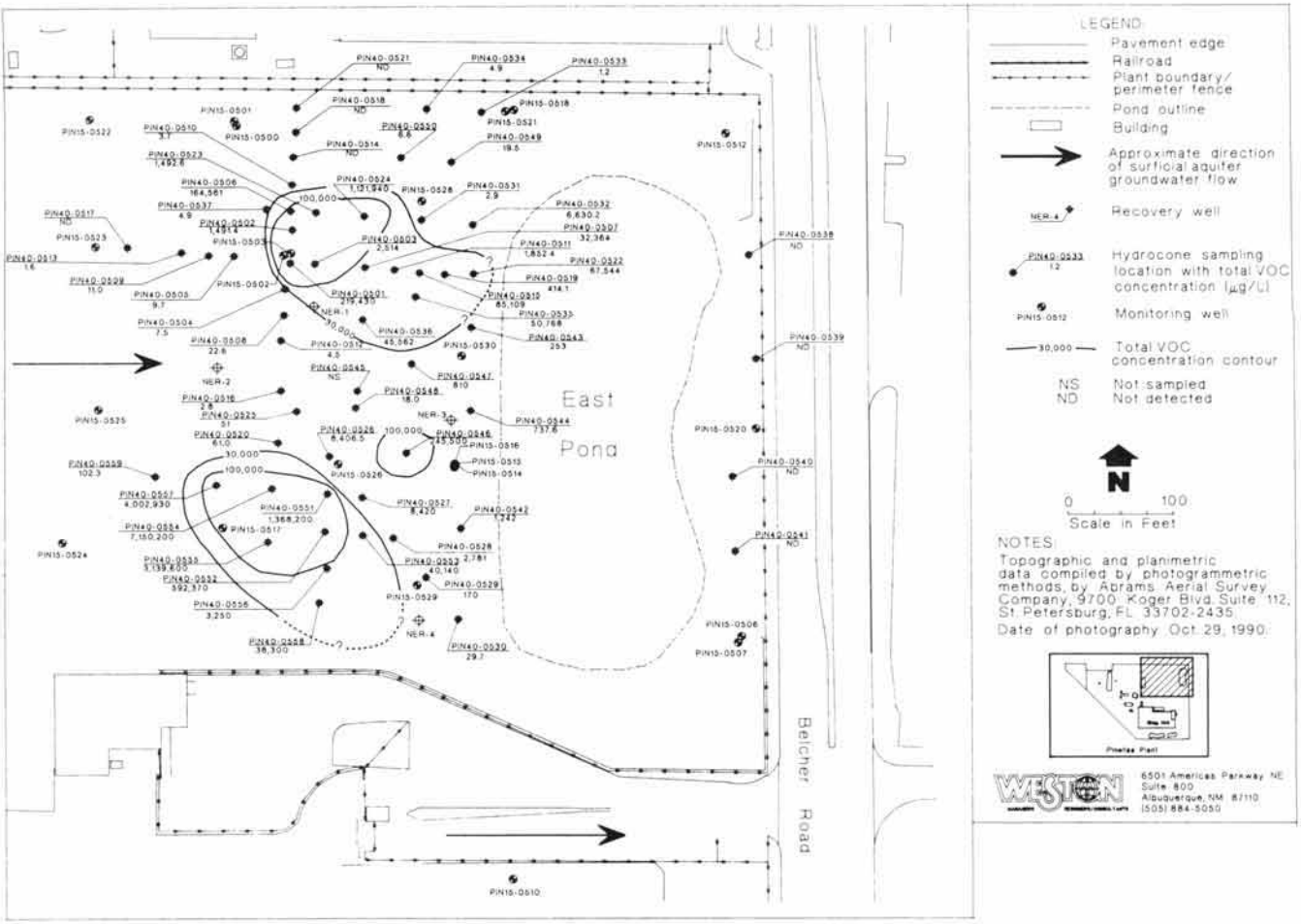


Fig. 5. Pinellas Plant-Hydrocone sampling results: total volatile organics at 25.5 ft depth.

The spatial distribution of total VOCs at 15.5 and 25.5 ft below ground surface is shown on Figs. 4 and 5, respectively. Two areas of gross VOC contamination were identified, one of which had not been previously identified with the monitoring well network, and are shown on Figures 4 and 5. The first area is located in the vicinity of well PIN 15-0502. The total VOC concentration at Hydrocone location 501-0001 (sample from 15.5 ft) was 2,035,000 $\mu$g/L. Shallow contamination in this area appears to extend east for at least 175 ft (Fig. 4). Contamination in the deeper zone is more widely distributed to the north and south than in the shallow plume. Contamination does not appear to extend greater than 50 ft to the west of well PIN 05-0502.

The second area of gross contamination is located south of the first area. Total VOC concentrations in this area were as high as 7,150,200 $\mu$g/L at location 554-0002 (sample from 25.5 ft). The contaminant plume appears to extend further west in the deeper zone than in the shallow zone.

Four Hydrocone locations, 538, 539, 540, and 541, were located east of the East Pond (Fig. 4 and Fig. 5). VOCs were not detected in any groundwater samples collected from these locations, except at location 538. The groundwater sample collected at 15.5 ft from location 538 (538-0001) contained 2.6 $\mu$g/L vinyl chloride.

Groundwater samples collected from the base of the surficial aquifer generally contained lower levels of contaminants than samples collected at 15.5 and 25.5 ft. Hydrocone locations 504 and 523 contained higher total VOC concentrations than shallower samples.

## CONCLUSIONS

Hydrocone groundwater sampling data have provided a better picture of the horizontal and vertical distribution of VOCs in the surficial aquifer at the Northeast Site in a short period of time, without the need for installing additional monitoring wells. Results of this investigation have been considered and incorporated into the recommendations of a corrective measure, and will be used in groundwater modelling to optimize placement of recovery wells. Hydrocone groundwater sampling results are summarized as follows:

- Gross VOC contamination, where total VOC concentrations exceed 100,000 $\mu$g/L, occurs in two areas. One area is in the vicinity of well PIN 15-0502. This well has historically produced groundwater samples with high VOC concentrations. The second area of gross VOC contamination is located south of well PIN 15-0502 (Fig. 4 and Fig. 5) with concentrations as high as approximately 7,000,000 ppb total VOCs. This area of contamination was not identified previously through groundwater sampling of monitoring wells.
- Groundwater samples collected at 25.5 ft below land surface contained higher VOC concentrations than expected. Contamination at this level is more widely distributed than contamination present at 15.5 ft indicating that the contamination is sinking as a dense non-aqueous liquid.

- Concentration of VOCs in groundwater samples collected with the hydrocone were, in general, higher than water samples collected from nearby monitoring wells. This is attributed to the fact that the hydrocone samples are taken at a discrete 1- to 2-ft interval with no mixing.

## REFERENCES

1. EPA, 1990, RCRA Hazardous and Solid Waste Amendments Permit, U.S. DOE Pinellas Plant, Largo, Florida, (EPA ID No. FL6-890-090-008). February 9, 1990.
2. DOE, 1991, "RCRA Facility Investigation Report, Pinellas Plant," Environmental Restoration Program, U.S. Department of Energy, Albuquerque *Operations* Field Office, Albuquerque, New Mexico. September 1991.
3. EPA, 1986, "Test Methods For Evaluation of Solid Waste," U.S. Environmental Protection Agency Report SWl-846, Third Edition, U.S. Environmental Protection Agency, Washington, D.C.
4. DOE, 1992. "RCRA Facility Investigation Report Addendum (Draft, Revision 1)," U.S. Department of Energy, Pinellas Plant, Largo, Florida. March 1992.
5. DOE, 1992. "Corrective Measures Study Plan," (Draft, Revision 0), Department of Energy, Pinellas Plant, Largo, Florida. July 1992.