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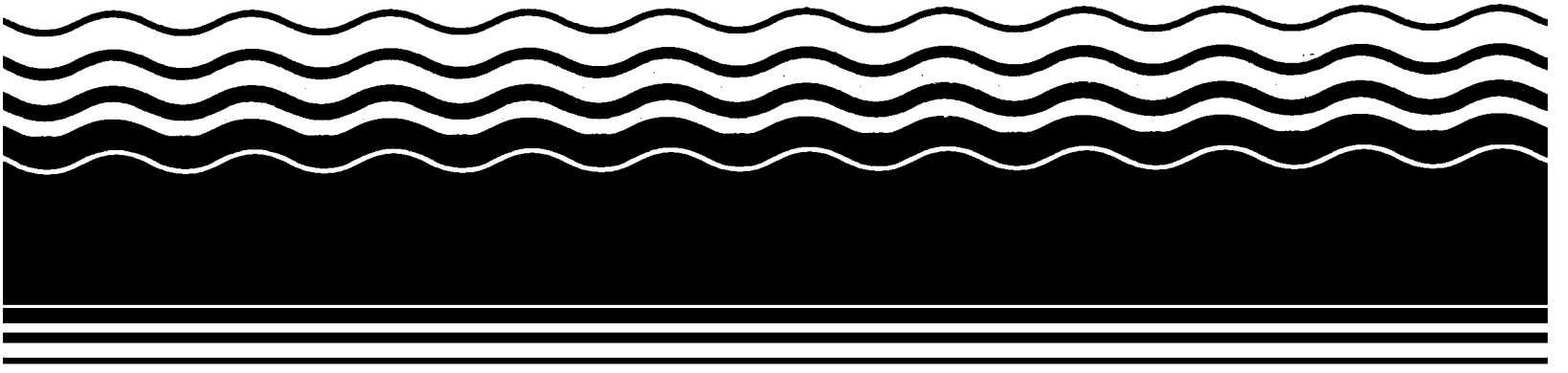
September 1993

PB94-964014

EPA

Superfund Record of Decision:

Helena Chemical Landfill, SC



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15. Supplementary Notes

PB94-964014

16. Abstract (Limit: 200 words)

The 4-acre Helena Chemical Landfill site is located on the northern portion of the 13.5-acre Helena Chemical Company property in Fairfax, Allendale County, South Carolina. Land use in the area is mixed commercial, industrial, agricultural, and residential. A water supply well to the city of Fairfax supplies water to 2,300 residents, and is located 200 feet west of the property. Surface water at the facility drains into a small ditch which subsequently drains into Duck Creek, a tributary located northwest of the property that flows into the Cooswatchie River located to the west of the property. In addition, several wetland areas occur in the northern portion of the facility in close proximity to the former landfill. Prior to the 1960s, and until 1978, the Helena Chemical Company and two previous owners manufactured liquid and powdered insecticides onsite. The facility consists of three buildings: the north warehouse, which was used to formulate liquid insecticides; the south warehouse, which was used to formulate powdered insecticides; and the office. The former landfill is located north of the north warehouse and was reportedly used for disposal of chemical wastes. Several above-ground solvent tanks, which have since been removed, were used to store solvents transported to the site by rail. Types of chemicals formulated or stored onsite included pesticides, solvents, diesel fuels, and clays. In 1980, State

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Helena Chemical Landfill, SC
First Remedial Action - Final
Contaminated Media: soil, sediment, gw, sw
Key Contaminants: VOCs (benzene), other organics (pesticides), metals (chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 100
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EPA/ROD/R04-93/157
Helena Chemical Landfill, SC
First Remedial Action - Final

Abstract (Continued)

investigations regarding an onsite waste dump indicated high levels of various pesticides at the site. In 1981, the State required Helena Chemical to provide additional information regarding site activities. The State, EPA, and Helena Chemical conducted additional site investigations from 1981 through 1992. These investigations confirmed the presence of site-related pesticides in the soil and indicated the presence of pesticides in sediment, debris, ground water, and surface water in the vicinity of the former landfill. Two removal actions were conducted at the site during 1984 and 1992, and 500 and 1,000 yds^3 of contaminated soil, respectively, were removed to a permitted hazardous waste landfill. This ROD addresses a first and final remedy for the remaining onsite contamination in the soil, sediment, ground water, and surface water. The primary contaminants of concern affecting the soil, sediment, ground water, and surface water are VOCs, including benzene; other organics, including pesticides; and metals, including chromium and lead.

The selected remedial action for this site includes excavating approximately 20,000 yd^3 of contaminated soil and debris from the former landfill and areas adjacent to the northern warehouse; treating the soil an debris using hydrolytic/photolytic dechlorination (HPD), followed by ex-situ biodegradation; returning the treated soil and debris to the original excavated areas; covering the treated soil with at least one foot of clean fill; providing for a contingent remedy including low temperature thermal desorption, if treatability studies indicate that the HPD/biological treatment cannot attain the soil remediation goals; demolishing the former formulation buildings, if necessary, to allow for removal and treatment of all contaminated soil; testing the demolished buildings to determine appropriate handling and disposal options; mitigating any impact to wetlands; extracting and treating contaminated ground water onsite to POTW pre-treatment requirements, with discharge to the local POTW; and monitoring excavated and treated soil and ground water (in-situ, as well as, extracted and treated) to ensure compliance with all performance standards. The estimated present worth cost for this remedial action is $3,900,000.

PERFORMANCE STANDARDS OR GOALS:

The soil excavation standard is based on protection of human health and the environment and is equal to 50 mg/kg total pesticides. Soil treatment standards are based on RCRA LDRs and range from 66 ug/kg to 1,300 ug/kg. Chemical-specific ground water treatment goals are based on SDWA MCLs, and include benzene 5 ug/l; chromium 100 ug/l; lead 15 ug/l; and pesticides 0.002-3 ug/l.

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

HELENA CHEMICAL SUPERFUND SITE

FAIRFAX, ALLENDALE COUNTY
SOUTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Helena Chemical
Fairfax, Allendale County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Helena Chemical Superfund Site (the Site) in Fairfax, South Carolina, which was chosen in accordance with the the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). This decision is based on the Administrative Record file for this Site.

The State of South Carolina concurs with the selected remedy. Appendix B contains the letter indicating their concurrence.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action addresses onsite soil contamination, the principal threat at this Site; as well as onsite and offsite groundwater contamination.

The major components of the selected remedy include:

SOURCE CONTROL

- Excavation of contaminated surface and subsurface soil, with verification sampling;
- Treatment of the contaminated soils by means of hydrolytic/photolytic dechlorination and biological degradation;
- Placement of the treated soils into on-Site excavations.
- Site re-grading to prevent uncontrolled storm-water run off into waters of the State or the United States.

GROUNDWATER

- Extraction of contaminated groundwater from the surface (shallow) aquifer;
- Treatment and discharge of the treated groundwater to a local Publicly-Owned Treatment Works (POTW).

MITIGATION FOR ADVERSE IMPACTS TO WETLANDS

- Mitigation for adverse impacts to environmental receptors in accordance with regulatory guidelines established under the authority of Section 404 of the Clean Water Act.

SITE MONITORING

- Quarterly sampling of groundwater and nearby public water supply to monitor the concentrations and movement of contaminants in affected and potentially affected aquifers.

CONTINGENCY REMEDY

- Low temperature thermal desorption (LTTD) is a contingency remedy for soil treatment, to be implemented should the chosen soil treatment technology prove incapable of achieving performance standards.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative and/or innovative treatment technology to the maximum extent practicable for this Site. The selected groundwater remedy component satisfies the preference for treatment. The selected remedy for source control and soil treatment also satisfies the preference for treatment.

Since selection of this remedy will result in contaminated groundwater remaining onsite above health-based levels until remedy implementation is complete, a review will be conducted within five years after commencement of remedial action to insure that the

remedy continues to provide adequate protection of human health and the environment.

Patrick M Tobin

Patrick M. Tobin
Acting Regional Administrator

9-8-93

Date

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1.0 SITE LOCATION AND DESCRIPTION

1.1 SITE LOCATION

Helena Chemical Company, Fairfax, South Carolina is located on 13.5 acres adjacent to Highway 321 in Allendale County, South Carolina. Figure 1.1 is a vicinity map. Located at the facility is a former landfill which contains pesticide residues and other waste materials generated on-Site. The former landfill occupies approximately four (4) acres on the northeast portion of the Fairfax property. Figure 1.2 is an approximately scaled survey of the facility showing the location of the landfill. The site is encircled by a chain link security fence topped with barbed wire. A city water well that is utilized by a population of approximately 2,300 is located 200 feet west of the property.

1.2 SITE DESCRIPTION

Three buildings exist on the Fairfax property; the north warehouse, the office, and the south warehouse. The north warehouse, which was once utilized to house the liquid insecticide formulation operation, is currently used to store various pesticides, herbicides, and fertilizers which are sold to farmers. There are several significant features of the liquid formulation building which were focal points of the investigation. Two 22,000 gallon above ground solvent tanks were once located near the north entrance to the "kettle room" in the former liquid formulation building. These tanks were present prior to Helena's occupancy of the property. Solvents used in the formulation process were delivered to the site by rail car via a rail spur which was used to serve the facility. The solvents were offloaded by pressurizing the tanker cars and pumping the solvents through product lines which ran under the formulation building to the storage tanks. The storage tanks were located in the area identified as the "tank farm" on Figure 2. The solvents were then gravity fed to the kettle as needed. The solvent tanks are no longer present; however, the concrete slab on which the tank saddles rested still exists. The remains of a tank farm which was used to store the technical grade pesticide compounds are located on the east side of the liquid formulation building. Only the concrete pads on which the tanks rested and a retaining wall remain. During the Remedial Investigation (RI) a drain pipe which originates inside the warehouse was observed and is suspected to have been used to discharge effluent onto the ground surface in an area northwest of the structure. The south warehouse where powdered insecticides were formulated is no longer in use. A septic tank system which serviced the property is located between the north liquid formulation building and the office.

Figure 1; Helena Location Map

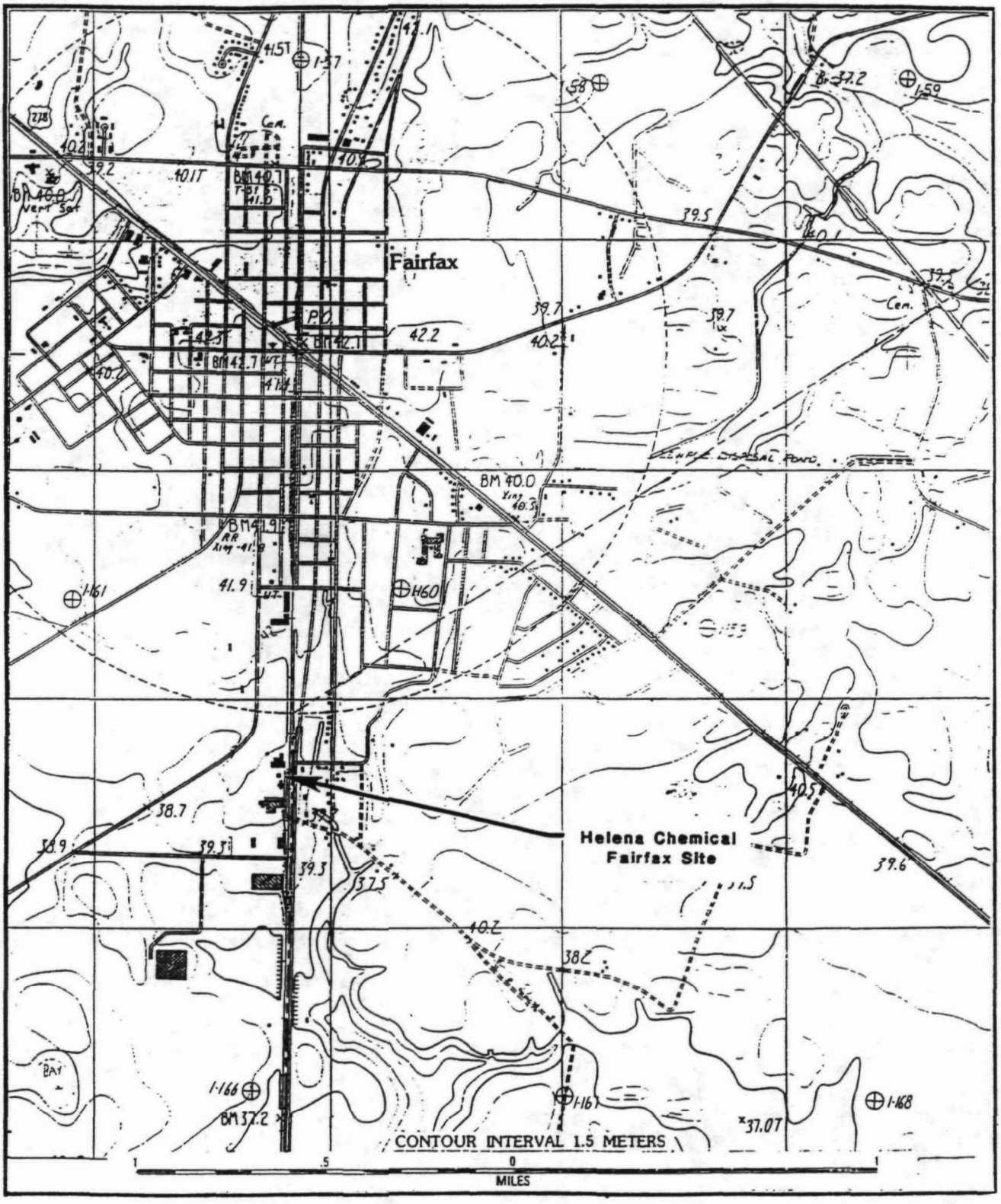
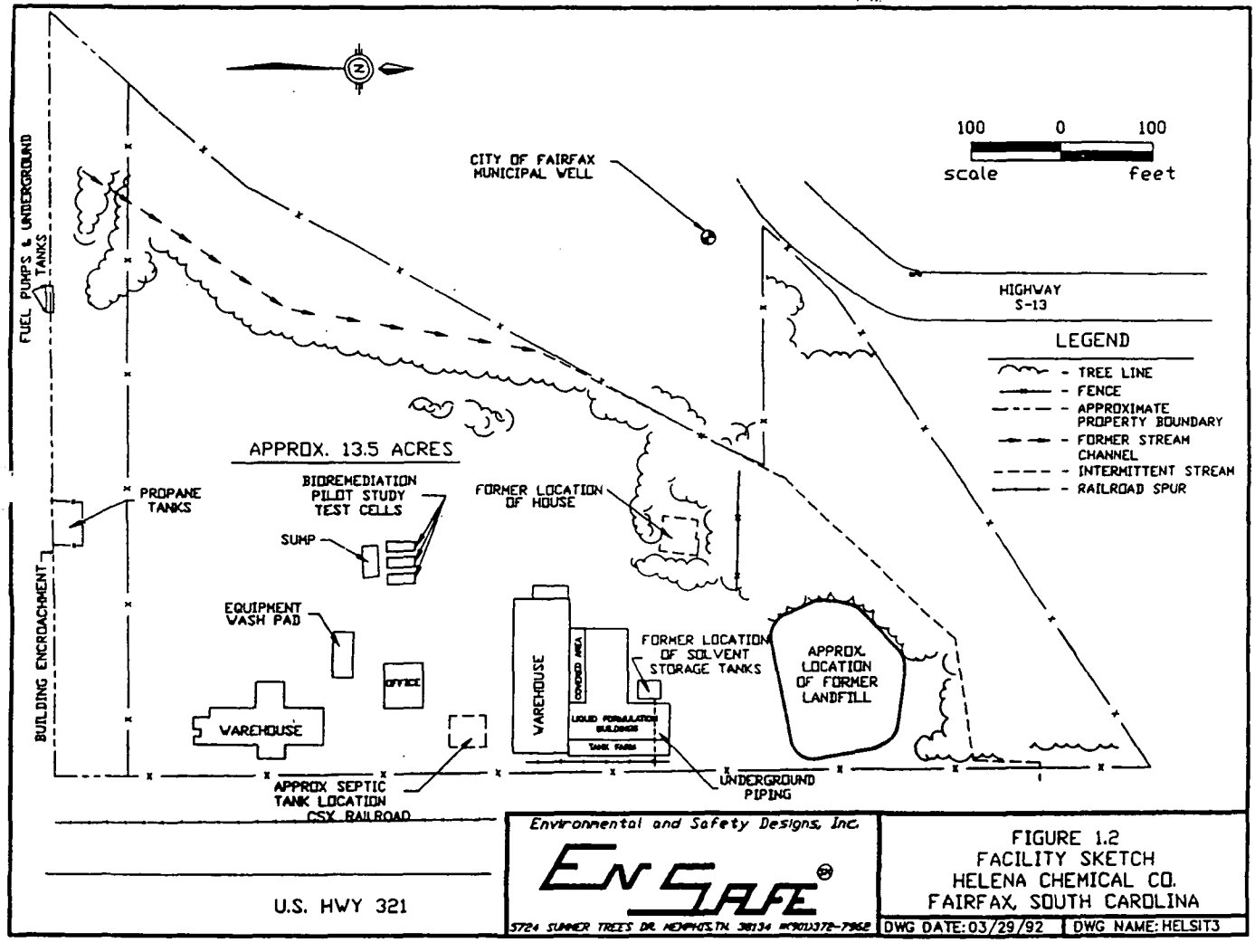


Figure 2; Helena Site Map



Located northwest of the north warehouse are the remains of a house that burned sometime prior to 1988. The house belonged to the previous property owner, Charles Blue.

According to City of Fairfax Water Department records, a 12" water main constructed of cast iron extends across the site between the north warehouse and the former landfill. The water line trends in a general east-west direction and is reported to have been installed approximately ten years ago.

Between the years of 1971 and 1978, Helena used the Fairfax facility for the formulation of liquid, and some dry, agricultural insecticides. Prior to the ownership by Helena Chemical Company (beginning in 1971), two other chemical companies operated at the Fairfax facility: Atlas Chemical Company, owned by Billy Mitchell (prior to the mid 60's), and then Blue Chemical Company, owned by Charles Blue (mid 60's through 1971). Both Atlas Chemical Company and Blue Chemical Company utilized the Fairfax facility for the formulation of insecticides. Chemicals formulated and/or stored at the facility prior to Helena's ownership include: DDT, aldrin, toxaphene, disulfoton, dieldrin, chlordane, BHC (benzene hexachloride), and ethoprop (Mocap). The Fairfax facility is presently being operated as a retail sales outlet and warehouse for agricultural chemicals. Chemicals used in the previous formulation of insecticides by Helena at the Fairfax facility include: toxaphene, methyl parathion, EPN (ethyl p-nitrophenyl thionobenzene-phosphonate), and disulfoton. In producing the insecticides, the chemicals were formulated as mixtures with other ingredients including diesel fuel, aromatic solvents, and clays.

1.3 SITE TOPOGRAPHY AND DRAINAGE

The local topography of the Fairfax area exhibits little relief. The Helena Chemical property slopes slightly to the north. North of the property is a topographically low area that collects surface water during period of high rainfall. Additionally, surface water from the facility drains into a small ditch that parallels the property to the northwest. This ditch carries the water to Duck Creek, a tributary located northwest of the property, which in turn flows into the Coosawatchie River located to the west of the Fairfax property. The creek and the river are located within a three (3) mile radius of the Site.

1.4 CLIMATE

The relatively temperate climate of Fairfax is typical of the South Carolina coastal plains region. This is largely due to the close proximity of the Atlantic Ocean and its warm Gulf Stream current flowing northward near the southeastern border of the state creating a warming effect on the region.

Data provided by the South Carolina State Climatology office indicated the annual mean temperature in the vicinity of Fairfax is 65.1°F. The mean annual precipitation of Fairfax is approximately 47.95 inches. These figures are based on data gathered at Hampton, S.C. which is the closest reporting station to Fairfax (a reporting station has recently been established in Allendale, S.C.; however, at the present time insufficient data has been gathered to calculate the annual means).

Prevailing winds in the Fairfax area exhibit seasonal variations. In the spring, southwest winds are predominate; summer, south and southwest winds prevail; autumn, prevailing winds are from the northeast; and in winter, northeast and southwest winds have close to the same frequency. Average wind speeds throughout the year range from 6 to 10 miles per hour (Climate Report No. G5, S.C. State Climatology Office, May 1990).

1.5 GEOLOGY AND HYDROGEOLOGIC SETTING

Site specific geological and stratigraphic data were developed during the installation of test borings and monitoring wells. Three distinct stratigraphic units were observed in the upper 145 feet of unconsolidated sediments encountered at the site, and a fourth may be present.

The lowermost stratigraphic unit identified during the investigation was a gray to green, fine grained clayey sand interbedded with clay laminae and numerous shell fragments. The unit was moist, but did not exhibit the saturated properties as seen in the overlying sands. Based on lithology, this unit is presumed to be the upper portion of the McBean/Santee Limestone Formation. The observed thickness of this unit was approximately 45 feet. The maximum thickness of this formation was not determined during the investigation.

Overlying what is presumed to be the McBean Formation is a predominantly yellow to gold, fine to coarse sand. This unit is also characterized by numerous shell fragments interspersed among the sand grains. These sands are thought to be a member of the Barnwell Group. The Barnwell Group is comprised of the Tobacco Road Sand and the Dry Branch Formation. Recent investigations have indicated that the contact between the formations is a one to three foot thick layer of coarse sand and gravel. This gravel layer was not positively identified in any of the borings; therefore, distinct facies changes were not stratigraphically identified during the RI.

Overlying the sands of the Barnwell Group is a light gray and green medium sand which in some locations graded to a coarse tan sand with some pebbles and shell fragments. The lower contact between the formations was distinguished by a silicified shell hash in other locations. The sands graded in a fining upward sequence to a

very fine to medium grained sand intermingled with a dense red, orange, and gray mottled clay. These sediments are characteristic of what is thought to be the Duplin Formation.

Based on the boring logs from MW-12, MW-14, MW-19 and MW-20, there appears to be a lateral facies change to the north of the landfill. Surface soils north of the landfill consist of a dark gray, dense clay. Due to limited information, it is unclear whether the detrital sand underlying this area is a continuation of the Duplin or if a portion of the Duplin has been eroded and the sand a product of more recent depositional processes.

The highest yielding aquifer in the area surrounding Fairfax is found within the sands of the Cape Fear, Middendorf, and Black Creek Formations. These regional aquifers are some of the most permeable units in the stratigraphic column, providing large quantities of water for both municipal and private use.

The high clay content of the Black Mingo Formation results in relatively low permeability. This has led to the designation of the formation as an aquitard or aquiclude. Some small domestic wells, however, may be utilizing water from more permeable portions of the Black Mingo.

Although previous studies have indicated the McBean was not thought to be important as a public or commercial source, member beds within this formation produce sufficient water for use. The Town of Fairfax south municipal well is screened within the McBean/Santee Formation. A pumping test on the municipal well conducted by the city engineers indicated a transmissivity of 500 $ft.^2/day$ at a pumping rate of approximately 298 gpm. The overlying sands of the Barnwell Group have been described as a relatively low permeability, low yielding aquifer that is used primarily for domestic water supply. The Barnwell underlying the site, however, is recognized as a highly permeable, saturated sand.

Previous investigations tentatively identified the presence of the Cooper Marl at the Site. Recent investigations, however, have indicated that the surficial sediments are characteristic of the Duplin Formation of Miocene age. The upper portion of the Duplin Formation appears to be acting as an aquitard at the Site.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Several companies have operated pesticide formulation facilities on the Site currently owned by Helena. Prior to the mid-60's, the Site was owned by Atlas Chemical Company, and from the mid-60's until 1971 by Blue Chemical Company. Between the years 1971-1978, Helena Chemical company used the Site for the formulation of both liquid and dry agricultural insecticides. Chemicals that have been stored and/or formulated at the facility during its active life

include DDT, aldrin, toxaphene, disulfoton, dieldrin, chlordane, benzene hexachloride (BHC), ethoprop, methyl parathion and ethyl p-nitrophenyl thionobenzene-phosphonate (EPN). During the formulation process these chemicals were mixed with carrying agents including diesel fuel, volatile organic chemicals and adsorbent materials.

The first regulatory actions taken with respect to the Helena Site occurred in November, 1980, as a result of reports by a former employee of Helena and a newspaper reporter that a waste dump was being operated on the Site. The Site was investigated at that time by the South Carolina Department of Health and Environmental Control (SCDHEC). Numerous soil samples were collected and analyzed in December, 1980. High levels of various pesticides, including aldrin, BHC isomers, chlordane, dieldrin, disulfoton, endrin and toxaphene were detected in these samples. As a result of these findings, SCDHEC requested that Helena provide further information regarding activities at the Site, including chemicals handled as part of the operation, waste disposal practices and other pertinent information with respect to past and present Site activities.

SCDHEC issued a Notice of Violation to Helena in July, 1981, for the operation of a waste disposal facility in violation of applicable South Carolina regulations. Negotiations between SCDHEC and Helena resulted in the issuance of Administrative Consent Order No. 81-05-SW on October 1, 1981. In compliance with the terms of this Consent Order, Helena conducted investigations at the Site lasting from October, 1981, to July, 1982. The results of these studies indicated that surficial soils were heavily contaminated with pesticides, including those identified in the earlier sampling described above. The results of analyses of ground-water samples obtained as part of this investigation were contradictory; the positive results reported from the first sampling event were not confirmed in samples taken at that time or in subsequent sampling events. Surface water samples, taken from water standing in the wetland areas in the northern portion of the Site, were found to be heavily contaminated with site-related pesticides.

Helena prepared a plan for site remediation which was submitted to SCDHEC for review, and, under the terms of an amendment to Administrative Consent Order No. 81-05-SW, dated March 12, 1984, remediation efforts were conducted that consisted mainly of the removal of contaminated soils to a permitted hazardous waste landfill.

In 1985, EPA, in conjunction with SCDHEC, conducted a Site Screening Investigation at the Helena Chemical Site in order to prepare a Hazard Ranking System (HRS) package for the Site in order to determine whether the Site should be included on the National Priorities List (NPL). The HRS ranking was completed in June, 1987, and the Helena Site was proposed for listing in June, 1988.

The Site was listed on the NPL in February, 1990.

In April, 1989, an Administrative Order by Consent (AOC) was jointly developed, negotiated and agreed to by EPA and Helena Chemical Company. Under the terms of this AOC, Helena agreed to conduct a Remedial Investigation (RI) and Feasibility Study (FS) at the Site under the oversight of EPA. The purpose of the RI/FS process was to develop an appropriate remedy for the Site as required by the National Contingency Plan (NCP). Helena retained the services of Environmental Safety and Designs, Inc. (ENSAFE), of Memphis, Tennessee as their contractor to conduct the RI/FS. RI field activities began in May, 1989, and were completed in April, 1992.

Two removal actions for contaminated soils have taken place at the Site. In addition to the removal of approximately 500 cubic yards of contaminated material conducted by Helena in March, 1984, as discussed above, in April, 1992, approximately 1000 cubic yards of contaminated soils were also removed by Helena under the oversight of EPA and likewise transported to a secure hazardous waste landfill.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Initial community relations activities at the Helena Chemical NPL Site included development and finalization of the Community Relations Plan in December 1989. An information repository was established at the Fairfax City Hall in January 1990.

A "kickoff" fact sheet announcing the start of the RI/FS was issued in April 1990. On April 19, 1990, EPA held a public meeting at the Fairfax Community Center to present the Agency's plans for the RI/FS. The meeting was attended by several local citizens, representatives of Helena Chemical, elected local officials and was covered by local newspapers. EPA's presentation to the public included information on how to participate in the investigation and remedy selection process under Superfund. At the meeting, several questions were asked and a fair amount of interest was expressed by the community.

Following completion of the FS, a second public meeting was held on May 27, 1993, to update the public on the RI findings to date, and to present the proposed plan for the remedial actions at the Site. The meeting was attended by only a few members of the public, with no press coverage. At this meeting, the primary concerns expressed by the public involved the threat posed by contaminated ground water to the nearby public supply well.

Proposed Plan fact sheets were distributed on May 18, 1993. An advertisement was published in two of the local newspapers on the same date. Both the advertisement and the fact sheet highlighted

the Public Comment period extending from May 18, 1993, until June 17, 1993.

At the Proposed Plan public meeting on May 27, 1993, EPA presented the Agency's selection of Preferred Alternatives for addressing soil, sediment, surface water and groundwater contamination at the Site. Public comments and questions are documented in the Responsiveness Summary, Appendix A.

4.0 SCOPE AND ROLE OF THIS ACTION WITHIN SITE STRATEGY

The purpose of the remedial alternative selected in this ROD is to reduce current and future risks at this Site. The remedial action for soil will remove current and future health threats posed by contaminated shallow soil and will prevent leaching of the soil contaminants to groundwater. The groundwater remedial action will remove future risks posed by potential usage of contaminated groundwater. It will also serve to remove the threat to surface water by reducing the concentrations of surficial aquifer contaminants reaching nearby surface water systems. Wetlands mitigation will address the unacceptable levels of environmental risk posed by contamination of sediments and surface waters in on-site and adjacent jurisdictional wetlands. This is the only ROD contemplated for this Site.

5.0 SUMMARY OF SITE CHARACTERISTICS

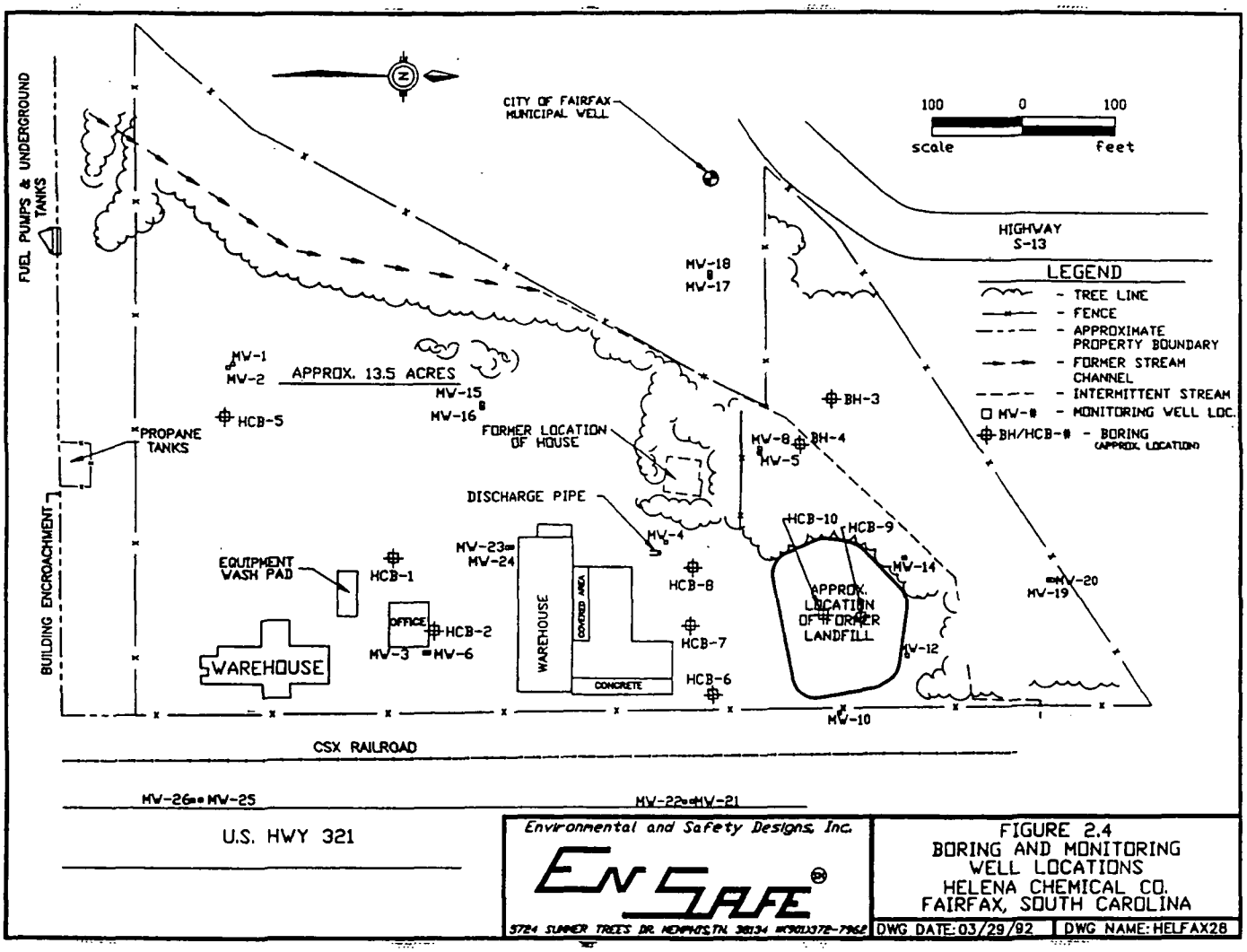
The RI investigated the nature and extent of contamination on and near the Site, and defined the potential risks to human health and the environment posed by the Site. A supporting RI objective was to characterize the Site-specific geology and hydrogeology. The main portion of the RI was conducted from May 1989 through April 1992. Onsite locations of soil borings, soil samples, and monitor wells are shown in Figure 3.

5.1 SITE SPECIFIC GEOLOGY AND HYDROGEOLOGY

The local hydrogeologic characterization discussed below was derived from RI data, including falling head permeability tests, grain size analyses, slug tests, piezometric surface maps, and numerous boring logs. In addition, the Barnwell Group aquifer system was monitored to determine if the City of Fairfax Municipal well affected the aquifer during pumping and non-pumping events as described below.

For the purpose of the RI, the hydrogeologic assessment concentrated primarily on the uppermost aquifer at the Site. The

Figure 3; Monitoring Wells and Soil Borings



uppermost aquifer occurs within sands of the Barnwell Group and the lower portion of the Duplin Formation. Member beds within these formations may exhibit minor facies changes; however, they are considered to be hydraulically connected.

Beneath the site, the upper portion of the Duplin Formation at times demonstrates the hydrogeologic characteristics of an aquitard. High clay content and corresponding low permeability are two characteristics that limit vertical groundwater flow in this unit. Grain size analyses and boring logs indicate that the Upper Duplin has a high silt and clay content. The average silt and clay fraction from nine (9) soil samples was 33 percent. The samples averaged 90 percent finer than the upper limit designation for fine sand. These analyses suggest that the Upper Duplin is a silty, clayey very fine sand with the capability to retard groundwater flow.

Estimates of permeability were determined with Shelby tube samples collected from the Upper Duplin. Eight undisturbed soil samples were obtained from MW-4, MW-8, MW-10, MW-14, MW-20, MW-22, MW-24, and MW-26 by pushing a thin walled Shelby tube 12-24 inches into the soil. Rigid wall falling head permeability tests were conducted on these samples in accordance with the Corp of Engineers method EM 110-2-1906. The resulting permeability values were indicative of an aquitard, and they highlight the capability of this unit to restrict near surface groundwater movement. Two additional thin wall Shelby tubes were collected from the clay cap overlying the closed landfill, and these soil samples also exhibit low permeabilities.

The upper aquifer system appears to be comprised of, in descending order, the lower sands of the Duplin Formation, the Tobacco Road Sand Formation, and the Dry Branch Formation. These units exhibit saturated conditions and appear hydraulically connected in the study area. Although there are a few thin clay/silt laminae present in the upper 30 feet of the unit the limited thickness and lateral extent of these laminae suggest that they do not impede vertical groundwater flow. Well logs indicate these sands to be vertically uninterrupted from an average depth of approximately 12 feet to a depth of at least 90 feet below ground surface. The overall thickness of the uppermost aquifer is estimated to be approximately 80 feet.

The Fairfax municipal well log included in the RI describes a yellow and gray clay from 90 to 103 feet. During the installation of soil boring HCB-5 on the north end of the Helena property a dark gray to green, fine grained clayey sand interbedded with clay laminae and numerous shell fragments was identified from approximately 95 to 145 feet below ground surface. The unit was moist, but did not exhibit the saturated properties as seen in the upper Eocene sands and appeared relatively impermeable. Based on the aforementioned lithological descriptions, this unit is thought

to be representative of the upper section of the McBean Formation. Defining the lateral and vertical extent of this unit was beyond the scope of this investigation. The drillers log from the City of Fairfax municipal well, however, indicates the presence of limestone at depths of 260 to 347 below ground surface. The limestone may be representative of the Santee which varies considerably in the area and may signify actual lateral facies changes between the downdip Santee and the updip McBean.

Water level measurements conducted during the RI indicate that groundwater flow directions in both the shallow and deep portions of the upper aquifer exhibit seasonal variation. Summer water levels indicate that shallow flow is directed to the south-southwest. The piezometric diagram of water levels taken in April 1991, however, reveals directional components to the south, east and southeast. Similarly, but to a lesser extent, groundwater flowing in the deeper portions of the aquifer exhibits variation in direction throughout the year. Although deep well control is limited, flow direction in the summer is directed to the southwest. This corresponds with shallow flow directions. The data for April and September, 1991, indicate that the deeper groundwater flow was toward the south-southeast.

The lack of vertical groundwater flow is apparent from the minimal differences in water level between wells in the nine (9) deep/shallow well clusters at the site. From the eight (8) water level measuring events that have been conducted, the maximum downward vertical gradient was 0.018 feet per foot between MW-1 and MW-2 for July, 1990. The minimum was 0.0001 feet per foot between MW-19 and MW-20 for October, 1991. The average downward gradient of the nine (9) well clusters for the eight (8) measurement events was 0.002 feet per foot.

Interestingly, the upper aquifer appears to change from unconfined to confined conditions at different times throughout the year. The July, 1990 water levels for most of the wells on site were from 2 to 2.5 feet below the top of the confining portion of the Duplin formation. This suggests unconfined conditions may exist for at least a portion of the year. Conversely, confined conditions were encountered in the spring of 1991 when water levels were well above the contact between the more permeable sands of the upper aquifer system and the overlying less permeable clayey sands. This artesian condition was further supported by groundwater flowing out the top of MW-14 in March, 1991. One simple explanation for this phenomenon is associated with changing water levels in the upper aquifer.

During the dryer portion of the year (July and August), water levels fall below the base of the clayey sands of the Duplin Formation. This effectively dewaters the upper portion of the aquifer. Dewatering is a characteristic behavior of unconfined aquifers. During wet periods when water levels rise above the

contact between the permeable sands and the low permeability clayey sand within the Duplin, the aquifer exhibits confined conditions.

To obtain estimates of groundwater velocity, several slug tests were conducted at the site on March 4 and 5, 1991. Testing consisted of rising and/or falling head slug tests for MW-2, MW-4, MW-6, MW-8, and MW-10.

Rising and falling head slug tests were performed to characterize the hydraulic conductivity (K) of aquifer materials. Slug tests were initiated during Phase II-B and Phase III of the RI. Before each slug test was initiated, the static water level in the well was measured using an electronic water level indicator. A stainless steel cylinder of known volume was then introduced "instantaneously" into the well, at which time, the water level and the time were recorded. Periodically, water level/elapsed time measurements were made as the head fell back to the original level. Similarly, rising head slug tests were preformed by removing the slug and recording water level/elapsed time measurements as the head rose back to normal. For slug tests, the time required for the water level to return to normal is a function of the hydraulic conductivity (K) of the aquifer.

For this investigation, an In-Situ, HERMIT 1000B data logger and a 50 psi pressure transducer were used to record water level/elapsed time measurements during each slug test. For purposes of graphing data, the instrument was programmed to record measurements on a logarithmic time scale. The slug consisted of a five-foot (5) long, 1.66-inch diameter stainless steel cylinder with a stainless steel ring welded on one end. A teflon coated stainless steel cord tethered to the ring served to suspend the slug in the well just above or below the water level. At the beginning of each test, the data logger was activated the instant the slug was either lowered into or removed from the water.

The hydraulic conductivity (K) calculated from each slug test is presented in Table 1 below. The methods used to arrive at these values are discussed below. Rising and falling head slug test data from each well were graphed as time (elapsed) versus Log(H/Ho) in order to create a straight line. Log(H/Ho) is the Log base ten of the change in head divided by the initial head. Hydraulic conductivity (K) was computed from these plots using a method developed by Hvorslev.

This method utilizes a variable known as the basic time lag in an equation that calculates the hydraulic conductivity. Hvorslev contends that the basic time lag is the time at which the head ratio (H/Ho) equals 0.37. Log (H/H_0) was plotted against time on standard graph paper. A corresponding basic time lag was taken from the time scale at the bottom of each diagram, and then calculated using an equation for hydraulic conductivity.

Table 1 Hydraulic Conductivity K (ft/day) Estimated from Rising and Falling Head Slug Tests			
Well #	Method	K	
MW2	Falling	2.5	
MW4	Falling	1.23	kmax = 9.5 ft/day
MW6	Falling	9.2	kmin = 1.23 ft/day
MW6	Rising	4.6	kave = 5.3 ft/day
MW8	Rising	9.5	
MW10	Falling	4.2	
MW10	Rising	5.6	

The Hvorslev equation used in these calculations was developed for confined conditions with the assumption that the test well is screened in the upper portion of a permeable unit that is overlain by an impermeable unit. This scenario approximately describes Fairfax site conditions.

To estimate groundwater velocity, the hydraulic gradient was derived from the piezometric data generated during the RI. The maximum and minimum slopes between contour lines were measured directly from the isocon maps developed from this data, and these values are shown in Table 2.

Table 2 Hydraulic Gradient i (ft/ft) Estimated Maximum and Minimum		
Shallow Wells	Max	0.0026
	Min	0.00033
Deep Wells	Max	0.0035
	Min	0.0007

Estimates of the shallow horizontal groundwater velocity (V) were calculated from the following formula:

$$V = Ki/n$$

Where:

V = groundwater velocity
K = hydraulic conductivity
i = hydraulic gradient
n = porosity

A porosity (n) of 25 percent was chosen based on estimates for medium-to coarse-grained, poorly sorted sand aquifers. The maximum and minimum estimated velocities were calculated using the maximum and minimum hydraulic conductivities and corresponding hydraulic gradients in the formula.

Estimated Shallow Groundwater Velocity V (ft/day)

Vmax = (Kmax * imax)/n = 0.1 ft/day
Vmin = (Kmin * imin)/n = 0.0016 ft/day

Additional slug tests were completed upon completion of Phase III field activities. With the following exceptions, Phase III slug tests were conducted in a manner similar to the Phase II-B slug tests:

- Phase III tests incorporated a different type of slug than Phase II-B. Instead of using the stainless steel cylinder, one gallon of deionized water was "instantaneously" introduced in the well.

- Only falling head tests were conducted as water was not "instantaneously" removed from the well.

For the Phase III investigation, an In-Situ HERMIT 2000 data logger and a 20 psi pressure transducer were used to record water level/elapsed time measurements during each slug test. A one gallon jug of deionized water was used to slug each well. At the beginning of each test, the data logger was activated the instant that water was poured into the well.

Data reduction and compilation were conducted using the same equations and calculations described for the Phase II-B slug tests. The Phase III slug test graphs are presented in Appendix C and Table 3 summarizes the hydraulic conductivity values derived from the graphs.

To determine if the aquifer supplying the Fairfax municipal well is separate from the shallow aquifer beneath the site, two aquifer communication tests were conducted the week of November 11, 1991. The City of Fairfax public works department provided full cooperation during the tests.

Table 3 Hydraulic Conductivity K (ft/day) Estimated from Falling Head Slug Tests		
Well #	**Method**	**K**
MW5	Falling	10.04
MW15	Falling	3.23
MW17	Falling	3.15

The first test involved pumping the city well for three 1-hour long intervals separated by nonpumping periods of approximately 1-hour in length. This test was designed to approximate the normal operating conditions of the city pump system. During the test, water levels were monitored in three observation wells (MW-5, MW-15, and MW-17). Data from this test were inconclusive because identifiable trends did not develop from short duration pumping.

The second test was conducted to investigate what effects might result from pumping the city well for longer than one hour. Pumping duration for the second test lasted approximately 5.5 hours and MW-5, MW-15, and MW-17 served as observation wells again. With a pumping duration of 5.5 hours, this test was never designed or intended to be a constant rate aquifer test.

A Hermit 2000 data logger with three pressure transducers and a barometric pressure probe were used during each test. Each observation well had one of the pressure transducers monitoring water level fluctuations. The barometric probe was placed on the ground to measure changes in barometric pressure during the tests. The data logger recorded measurements from the four transducer inputs simultaneously and on five-minute intervals during pumping and nonpumping events.

For the second test, the data logger was activated approximately 17.5 hours before the city well pump was started to investigate local water level trends. The static water level in each monitoring well at the time the data logger was activated became the zero reference level for that well. Throughout the recording period, the data logger recorded water level changes from this original reference level.

Prior to the test, the city water tank was allowed to drain to approximately 1/3 capacity. Because some water had to remain in the tank to maintain water pressure, this was the lowest water tank level that Fairfax water supply officials would permit. Pumping at 390 gallons per minute (gpm), it took the city water supply well approximately 5.5 hours to refill the water tank during the test.

Drawdown values from each well were plotted against time to investigate water level trends. Drawdown is represented as a positive deflection from the original zero reference level in the data. Water levels recorded above the original reference level were recorded as negative drawdowns. Similarly, a rise in water level is represented by a negative deflection. In all three monitoring wells there was a general downward trend in water levels with time. This may be the result of increasing barometric pressure at the site. When the water level graphs were compared to the barometric pressure graph, however, the graphs show a definite change in water level with respect to pressure along the time axis. The difference in drawdown changes may be due to the difference in water level elevation.

Interestingly, water levels in each observation well rose abruptly when the pump was turned on. Although immediate, the maximum rise in any of the wells was slightly above 0.1 feet. While the pump was running, water levels fluctuated greatly. When the pump stopped, water levels dropped to levels corresponding to prepumping trends.

This phenomenon of abrupt rise and fall of water levels induced by pumping is common in confined and semiconfined aquifers. The occurrence is attributed to the elastic properties of aquifer materials (Lohman, 1972). When the hydraulic pressure in an artesian aquifer is reduced from pumping, the aquifer matrix compresses to compensate. This matrix compression is physically manifested as a slight net reduction in the thickness of the aquifer. When pumping is halted, the aquifer matrix elastically rebounds and the original aquifer thickness is recovered.

Ultimately, what appears to be a rise and fall in water levels may actually be a decrease and increase in the thickness of the aquifer. During the test, as aquifer thickness changed, the ground surface, well casings, and the transducers attached to the casings were lifted or lowered with respect to the nearly static water level. These reactions were recorded by the transducers as changes in water level.

With regard to communication between the deep city water supply aquifer and the shallow aquifer beneath the site, the results of this test are inconclusive. No large scale effects (obvious drawdown) from pumping were observed in any of the monitoring wells over the relatively short pumping duration used in this test. A much longer pumping duration (24-hours or more) may be necessary to investigate whether the observed phenomenon is the result of a hydraulic connection between the two aquifers.

While evaluating the results of this pump test, however, consideration should be given to the actual city pump system configuration. According to Fairfax water supply officials, the city pump rarely runs longer than 1/2 an hour at a time.

Therefore, the pump test duration of 5.5 hours created much more stress on the aquifer than normal pumping conditions would create. Even though greater stress occurred during this test, no excessive drawdowns were observed in the monitoring wells.

Given the uncertainty associated with the pump test already conducted and the possibility of communication between the shallow aquifer and the production zone of the City well, EPA believes that further pump tests are warranted. The details by which additional pump tests will be conducted will be determined during the Remedial Design review process.

5.2 NATURE AND EXTENT OF CONTAMINATION

Environmental contamination at the Site can be summarized as follows:

1) Organic and inorganic constituents of concern have been identified in the various media. The primary constituents of concern at the Site include: aldrin, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC, DDT, DDD, DDE, dieldrin, endosulfan, endrin, endrin ketone, toxaphene, endosulfan sulfate, disulfoton, benzene, lead and chromium. Table 4, reproduced from the **RI**, identifies the preliminary contaminants of concern for the Site.

2) Surface and subsurface soils throughout the Site have been affected by past waste disposal activities. The highest levels of contamination are found in the vicinity of the former liquid formulation building now used as a warehouse, in the vicinity of the old landfill, and near the southernmost building on the Site in an area where transhipments of materials from railroad cars occurred.

3) Ground waters in the aquifers immediately underlying the Site have been affected by waste disposal activities at the Site. The ground waters underlying the Site are considered to be Class IIB ground waters under the draft EPA Guidelines for Ground-Water Classification, indicating that they are a potential source of public water supply. These ground waters are also classified as Class GB ground waters under South Carolina regulations. The ground water has been contaminated to levels that render it a threat to public health should it ever be used for potable water supply and which exceed state ambient standards for Class GB ground waters. Ongoing sampling has to date revealed no site-specific contamination in the nearby municipal water supply well.

4) High levels of contamination remain in soils and waste materials in the old landfill located in the northern

portion of the Site. These soils and waste materials are likely to be a continuing source of ground-water contamination.

5) Surface water and sediments in on-site wetlands and drainage pathways have been affected by past waste disposal activities. Pesticide concentrations in samples taken from on-site surface waters exceeded criteria that

TABLE 4
Contaminants of Concern by Environmental Media for the Helena Chemical Company Fairfax, South Carolina

SOIL/SEDIMENTS	
Dieldrin	Aldrin
Endosulfan	Endosulfan Sulfate
Endrin Ketone	Endrin
4,4'-DDT	Methoxychlor
Disulfoton**	4,4'-DDE
Tributylphosphorotrithioate (TBPT)**	4,4'-DDD
Toxaphene	BHC (α, ß, ▲ and gamma)
GROUNDWATER	
Benzene	
Aldrin	
Endosulfan II	
Toxaphene	
DDT (plus DDE & DDD)	
BHC (α, ß, ▲ and gamma)	
Dieldrin	
Endrin	
Endrin Ketone	
Heptachlor Epoxide	
Disulfoton	
TBPT	
Lead	
Chromium	
SURFACE WATER	
BHC (ß, ▲)	
Dieldrin	
Endrin Ketone	

are protective of aquatic life. Sediments in the on-site wetland areas were found to be contaminated with site-related pesticides at levels that are likewise likely to

have an adverse impact on indigenous aquatic life.

6) Background and on-site air sampling indicates that local ambient air has not been affected by past waste disposal activities.

5.2.1 Surface and Subsurface Soils

The results of the field investigation identified varying concentrations of polychlorinated pesticide compounds and minor quantities of volatile organics in shallow surface soils (0 to 3 feet). Soils from the 1 to 3 foot interval would normally be considered shallow subsurface soils; however, for purposes of this discussion soils from 0 to 3 feet will be referred to as surface soils. Surface soils were collected employing hand augering techniques as previously described. Figure 4 is an isocon displaying the relative distribution of total pesticides in surface soils at the Fairfax site.

In addition to surface soil samples, ten soil borings were completed utilizing hollow stem auger techniques. Soil samples were collected for analysis from the surface, and from just below the interface of the vadose and saturated zones. Analytical results from some deep soil boring samples have indicated elevated levels of chlorinated pesticides.

5.2.1.1 VOCs in Soils

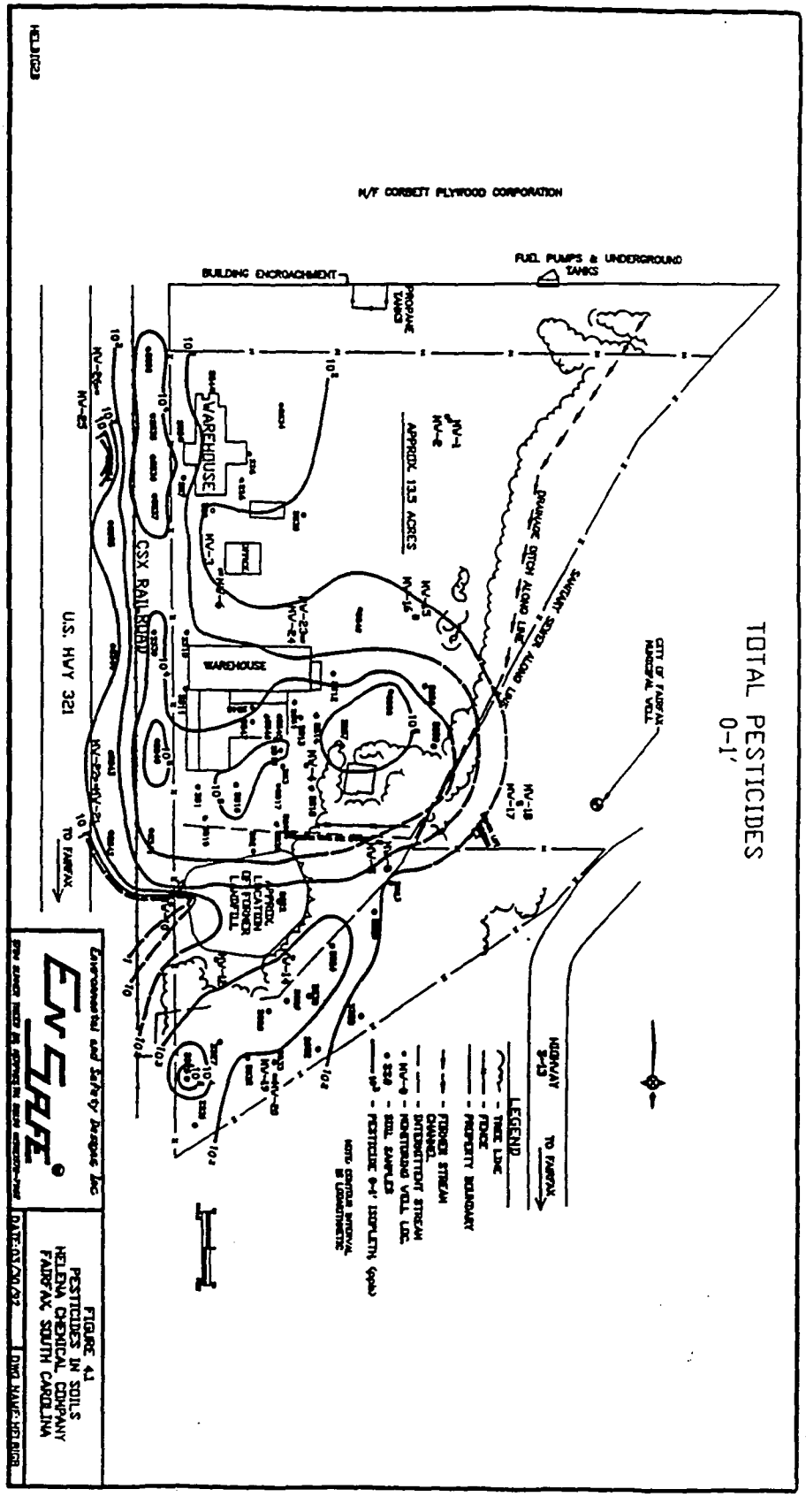
Soil samples collected throughout the RI have identified relatively low levels of various volatile organic chemicals (VOCs). The most commonly detected were acetone and methylene chloride; however, the data validation review suggests that these and some other contaminants may be laboratory artifacts. Two other chlorinated solvents were identified in soil samples, tetrachloroethylene (PCE), and trichloroethylene (TCE), although the TCE detected in two samples is believed to be a laboratory artifact. In addition, the aromatic solvents, benzene, toluene, ethylbenzene, and xylene were identified. Xylene is considered to be directly related to the formulation process. The VOCs found during the RI are discussed below.

Acetone

Acetone is a clear, colorless liquid with a fragrant mint-like odor. Acetone is a common organic solvent which is highly soluble in water. It is also one of the most common laboratory contaminants found in environmental samples. Acetone was

Figure 4

Pesticides in Surficial Soils



identified in approximately 57 percent of the soil samples collected. Concentrations range from 2 µg/kg (ppb) - 13,000 µg/kg (ppb).

Methylene Chloride

Methylene chloride is a clear, colorless, highly volatile liquid. It is used as a degreaser, photographic film processing chemical, solvent, raw material for organic synthesis, and a fumigant. It is soluble in water to 20,000 mg/l. Methylene chloride is a common laboratory contaminant found in environmental samples.

Approximately 38 percent of the surface soil samples analyzed indicated variable levels of methylene chloride. Concentrations range from 2 ppb - 140 ppb.

Tetrachloroethylene

Tetrachloroethylene (PCE) is a colorless liquid with a chloroform-like odor, and is slightly soluble in water (150 mg/l). It is used for dry cleaning, metals degreasing and heat exchange fluid. PCE was formerly used in mixtures with grain protectants and certain liquid grain fumigants (vermifuge).

Tetrachloroethylene was identified in less than one percent of the soil samples. Concentrations ranged from 11 ppb - 240 ppb.

Trichloroethylene

Trichloroethylene (TCE) is a colorless, mobile, volatile liquid with a chloroform-like odor. It is used as a degreaser, dry cleaning solvent, gas purification agent, and a raw material in organic chemical manufacturing.

Trichloroethylene was identified in two soil samples, SS-10-1 and SS-19-2. The concentrations were 24 and 210 ppb, respectively. TCE was also detected at 19 ppb in the trip blank submitted with these samples on 02/26/91. The samples were run consecutively indicating the values may be laboratory artifacts or lab error.

Benzene

Benzene is a clear, colorless, volatile liquid which is very slightly water soluble. Benzene is a component of gasoline and an organic solvent which was formerly used (on a limited basis) in pesticide formulation.

Benzene was identified in approximately three percent of the samples. Concentrations ranged from 3 to 1,300 ppb.

Toluene

Toluene is a colorless liquid with a benzol-like odor. It is used as a solvent, and in dye manufacturing, artificial leather production, asphalt and naphtha constituents, fuel blending and extraction of organic soluble plant materials.

Approximately eight percent of the soil samples identified low levels of Toluene. Samples range from a low of 1 ppb to a high of 210 ppb.

Ethylbenzene

Ethylbenzene is a colorless liquid with an aromatic odor and limited water solubility (140 mg/l). It is used in synthetic rubber manufacturing, as a solvent, and is component of gasoline. Ethylbenzene was detected in approximately three percent of the soil samples. Concentrations range from 3 ppb - 4100 ppb.

Xylene

Xylene is a clear liquid which consists of a mixture of three (3) isomers: ortho-, meta-, and para-. Xylene is used in the manufacture of a number of consumer products, and is also a component of gasoline and a raw material for synthesis of organic chemicals.

Xylene was detected in four percent of the soil samples. The highest concentrations were found in the soils beneath the cap of the former landfill. The values range from 3 µg/kg to 27,000 µg/kg.

5.2.1.2. Semi-Volatiles in Soils

Although no semi-volatile compounds were confirmed in soils during the Data Validation report three tentatively identified compounds (TIC's) were recognized: disulfoton, chlorobenzilate, and butylphosphorotrithioate. Levels of disulfoton ranged from 60 ppb - 430,000 ppb and were identified in four percent of the soil samples collected. Butylphosphorotrithioate was detected in three samples at a concentrations ranging from 750 to 7900 ppb. Chlorobenzilate was not detected in samples collected by ENSAFE, but was identified in one split sample collected by the EPA oversight contractor. Disulfotone sulfone was identified in one sample at 51 ppb. Disulfoton sulfone is a degradation product of disulfoton.

Disulfoton (a.k.a. Di-syston) is a colorless, oily liquid (in the pure state), and the technical grade is brown in color. It is generally insoluble in most organic solvents. Disulfoton was

produced as an insecticide for mites and aphids on small grains, corn, sorghum, cotton, and other field crops.

Butylphosphorotrithioate is a colorless to pale yellow clear liquid which is insoluble in water. It was produced as a pesticide and cotton defoliant.

Chlorobenzilate (a.k.a. 4,4'-Dichlorobenzilic acid ethyl ester) is a viscous liquid sometimes yellow in color, and is slightly water soluble. It was manufactured as an acaricide. It was approved for use in the USA in 1969 for application on 11 crops which were primarily fruits and vegetables.

5.2.1.3 Pesticides in Soil

Soil samples collected during the RI have indicated a varied distribution of individual pesticide components. Concentrations for total pesticides range from below detection limits to 7170 mg/kg in surface and shallow subsurface soils. For the purpose of total pesticides, the values indicated represent the summation of all pesticide components identified during the RI. The primary pesticide constituents identified were DDT (and its degradation products), toxaphene, and BHC (including isomers). Contaminant distribution data have been generated for the primary constituents identified on the property. Those components comprising a less significant fraction of the total pesticides identified include aldrin, chlordane (including isomers), dieldrin, endrin, endrin ketone, total endosulfans, heptachlor, heptachlor epoxide, and methoxychlor.

The most significant levels of pesticides identified on the site were found immediately north, northwest, and/or east of the north warehouse. The overall levels of contamination generally show a decrease in concentration with depth from the surface to three feet below grade. Isolated "hot spots" however, show an increase in concentrations at the one to two foot interval with subsequent decrease in concentration again with depth. Individual pesticides are further detailed below.

Toxaphene

Toxaphene (a.k.a. chlorinated camphene) is produced as a yellow, waxy solid with a pleasant piney odor. Toxaphene is nearly insoluble in water. It was used as an insecticide for cotton, early stages of vegetables (peas, soybeans, and peanuts), and wheat and other small grains. Current uses are limited to cattle and sheep dipping (under certain provisions), disinfecting buildings, and termite, insect, rodent and other pest control (limited application). Toxaphene has not been produced commercially in the U.S. since 1982.

Toxaphene is generally present at the highest concentration in the pesticide fractions identified at the Site. Toxaphene was identified in 40 percent of the samples collected and concentrations ranged in value from 42 µg/kg (ppb) to 2700 mg/kg (ppm). Toxaphene data from the RI indicate contamination with the highest concentrations is found immediately northwest of the north warehouse, and elevated concentrations were also identified east of the building.

DDT, DDE, and DDD

DDT (a.k.a. 4,4'-Dichlorodiphenyltrichloroethane) was produced as colorless crystals or white/off-white powder. It is odorless or has a slight aromatic odor. DDE and DDD are found as contaminants (minor fraction) in DDT, and may also be produced through degradation of DDT. These compounds are non-systemic contact and stomach insecticides. DDT was used primarily to control insects capable of spreading malaria, typhus, and other insect transmitted diseases. Use of these products has been banned in the U.S.

DDT was detected in approximately 61 percent of the soil samples collected during the RI. The reported concentration of DDT and its degradation products in soils ranged from 2.3 ppb to 2,800 ppm. Contaminant distribution data generated during the RI indicate contamination from DDT is greatest at the surface and decreases with depth.

BHC (Lindane) and Isomers

Lindane is produced as a white crystalline powder, and is only slightly soluble in water (varies between isomers). Lindane is a organochlorine pesticide. Lindane is the gamma isomer of benzene hexachloride (BHC).

All four BHC isomers (alpha, beta, gamma, and delta) were identified in soil samples collected during the investigation. The most frequently detected isomer was beta-BHC which was found in approximately 38 percent of the soil samples. Concentrations of BHC range from 0.1 ppb - 390 ppm. Again, data indicate a decrease in concentration levels with increased depth.

Aldrin

Aldrin is produced as tan to dark brown crystals which are essentially insoluble in water. It was formerly used as an insecticide, and has been registered as a termaticide in the USA. The manufacture and use of aldrin have been banned in the USA.

Aldrin was detected in approximately 17 percent of the soil samples. Values ranged from 1.2 ppb - 800,000 ppb. Predominant soil contamination from aldrin was identified west and northwest of the north warehouse.

Chlordane

Chlordane (pure form) exists as a colorless to amber, odorless, viscous liquid which is insoluble in water. Chlordane was also produced in emulsifiable concentrates, granules, dusts and wettable powders (for termite control). It was formerly used as a fumigant and acaricide, and also as a home and garden pesticide/insecticide. As of 1983, the only approved use of chlordane in the USA is for termite control.

Chlordane (alpha and gamma isomers) was identified in approximately four percent of the soil samples. Chlordane concentrations range from 15 ppb - 58,694 ppb.

Dieldrin

Dieldrin was produced as white crystals or light tan flakes which are odorless and insoluble in water. Dieldrin was formerly used to control soil insects, insects of public health concern and termites. Its use as a broad spectrum insecticide ceased in 1974 when EPA restricted its use to direct soil injection for termite control and non-food seed/plant treatment.

Dieldrin was identified in approximately 36 percent of the soil samples collected during the RI. Dieldrin concentrations range from 4.6 ppb - 96,000 ppb. Soil contamination was identified between the warehouse and the former house and in the low lying areas north and west of the former landfill. Concentrations decrease with depth.

Total Endosulfans

Endosulfan (two (2) isomers) was produced as brown crystals essentially insoluble in water. Its primary application was as an insecticide for vegetables. Endosulfan sulfate is a degradation product of endosulfan.

Endosulfan was detected in approximately 5 percent of the soil samples collected. Endosulfan sulfate was detected in approximately 13 percent of the samples analyzed. Concentrations ranged from 2.1 ppb - 22,000 ppb. The most significant concentrations were identified immediately northwest of the warehouse. Less significant contamination was identified in the low lying area northwest of the landfill. Analytical data indicates that Endosulfan concentrations have decreased with depth.

Endrin

Endrin was produced as water insoluble white crystals dissolved in a liquid carrier (organic solvent). The only uses currently registered in the US are for cotton and bird perches. It is a persistent insecticide used on field crops to control army cutworm,

meadow voles, and grasshoppers under strict adherence to Federal regulations on application. Endrin ketone is an impurity in and degradation product of endrin.

Endrin and Endrin Ketone were identified in soil samples west of the warehouse and west-northwest of the landfill. Concentrations ranged from 0.74 ppb - 9,200 ppb. Approximately 12 percent of the samples collected contained endrin and 16 percent its degradation product endrin ketone. Concentrations appear to decrease with depth with the exception of one anomaly from sample SS-3-3.

Heptachlor

Heptachlor was produced as white to tan, waxy-looking solid crystals which are nearly insoluble in water. It has been used as an insecticide for termite control, and was also formerly used in fieldcrops (including corn, citrus, pineapples, cereal, vegetables sugar beets, nuts and cotton) for pest control (fire ants, boll weevils). Heptachlor epoxide is a degradation product of heptachlor.

Heptachlor was identified in approximately 25 percent of the soil samples. The concentration of heptachlor and its degradation products ranged from 1.0 ppb to 68,000 ppb. The predominant area of contamination was in the low lying area north and west of the landfill with some minor levels of contaminant identified north of the warehouse.

Methoxychlor

Methoxychlor was produced as a white, crystalline solid dissolved in an organic liquid carrier. It is essentially insoluble in water. Methoxychlor has been used as an insecticide for livestock and poultry, alfalfa, citrus, vegetables, soybeans, deciduous fruits and nuts, and other crops as well as home use, garden and ornamental plants, and forests. A common formulation is Methoxychlor with Diazinon (1:2 mix).

Four percent of the soil samples collected contained methoxychlor. Concentrations ranged from 24 ppb - 12,000 ppb. Methoxychlor was identified in the low lying area north of the landfill and northwest of the warehouse.

5.2.2 Ground Water

A total of 22 monitoring wells were installed at the Fairfax site during the RI. Thirteen wells were completed as shallow monitoring wells and nine wells were completed as deep monitoring wells. All wells were completed within the upper Eocene aquifer system. The installation and subsequent sampling of wells during Phase III of

the RI corresponded with the third quarter sampling event of 1991 for the wells installed during Phase II-A.

Chlorinated pesticides and volatile organics were identified in samples collected from on-site shallow monitoring wells. One deep well (MW-3) also indicated low levels of pesticides in ground water. Endosulfan sulfate was detected in MW-5; however, the quantity was "j" flagged. Four metals were detected in various wells at concentrations above their respective MCLs and are discussed below.

The City of Fairfax municipal well (south well) was sampled during Phases II-A and III of the field investigation. Samples were collected both before and after treatment by a chlorination process. No Site-related contaminants were identified in any of the samples collected from the municipal well samples. The north well field, which is located approximately one mile north of the Site, was not sampled.

5.2.2.1 Volatile Organics in Groundwater

Groundwater samples collected throughout the RI have identified low levels of various fractions of the volatile compound list. The most commonly detected were acetone and carbon disulfide; however, data validation suggests that these and other minor constituents are laboratory artifacts. Other constituents identified include benzene, chlorobenzene, chloroform, 1,2-dichloropropane, ethylbenzene, methylene chloride, and xylene were identified.

Acetone

Acetone was identified in groundwater samples from all site monitoring wells except for MW-1, MW-10, 20, 21, 22, 23, and 24. Additionally, acetone was identified in the raw (before chlorination) and finished (after chlorination) water samples collected from the Fairfax municipal well. As mentioned previously acetone is considered to be a lab artifact. Concentrations range from 3 µg/l (ppb) - 150 µg/l (ppb) identified in numerous groundwater samples.

Carbon Disulfide

Groundwater samples from all site monitoring wells except for MW-1 and MW-3 identified varying levels of carbon disulfide. The untreated city water was also positive for carbon disulfide. Concentrations range from 3 ppb - 130 ppb. Carbon disulfide was only detected in eight samples collected during all sampling events subsequent to Phase II-A. Many of the reported concentrations were "j" flagged (estimated values). In addition to the Phase II-A wells, carbon disulfide was identified in monitoring wells MW-18, MW-20 and MW-22 installed during Phase III of the RI.

Methylene Chloride

Methylene chloride was detected in groundwater samples collected from monitoring wells MW-1, MW-2, MW-4, MW-5, MW-8, MW-10, MW-12, MW-14, MW-19 and the finished city water during the investigation. Concentrations range from 1 ppb - 7 ppb. Once again, many of the reported concentrations were "j" flagged.

Benzene

Benzene was identified in groundwater samples collected from MW-12 during Phase II-A, the first quarterly sampling event under Phase II-B, and the December sampling event. Concentrations of benzene varied from 34 ppb to 52 ppb in the three respective sampling events. Benzene was detected in MW-4 during two sampling events at concentrations of 5 and 6 ppb. During Phase III benzene was detected in MW-14 at 37 ppb.

Chlorobenzene

Chlorobenzene was detected in groundwater samples collected from monitoring wells MW-4, MW-6, MW-8, MW-12 and MW-14. Concentrations ranged from 2 ppb - 17 ppb.

Chloroform

The finished water sample collected from the City of Fairfax municipal water well detected chloroform at 2 ppb. This occurrence probably results from the City's water chlorination process. No Chloroform was detected in the municipal well system during Phase III sampling.

1,2-Dichloropropane

1,2-Dichloropropane was detected in samples collected from monitoring wells MW-8, MW-12, and MW-14 in the quarterly sampling events. Concentrations range from 6 ppb to 28 ppb.

Ethylbenzene

Ethylbenzene was detected in samples collected from monitoring wells MW-4, MW-8, MW-12, MW-14, MW-19, MW-22, and MW-24 during sampling events completed to date. Concentrations range from 2 ppb - 190 ppb.

Xylene

Groundwater samples collected from monitoring wells MW-4, MW-6, MW-8, MW-12, MW-14, MW-19, MW-22 and MW-24 exhibited elevated levels of xylenes. Concentrations ranged from 5 ppb - 2000 ppb. Monitoring well MW-4 contained the highest concentration.

5.2.2.2 Semi-Volatiles in Ground Water

Disulfoton was identified in monitoring wells MW-4 and MW-12 during two of the groundwater sampling events. Concentrations of 78 ppb and 110 ppb were reported in MW-4 while concentrations of 3 ppb and 4 ppb were reported for MW-12. Both of the concentration values for MW-12 were reported as estimated concentrations (i.e., "j" flagged). Butyl phosphorotrithioate was identified in MW-15 during Phase III at a concentration of 49 ppb, and was likewise "j" flagged.

5.2.2.3 Pesticides in Groundwater

Monitoring well samples indicate that elevated levels of pesticides exist in shallow groundwater. Contaminants identified appear to consist primarily of toxaphene, DDT (and its degradation products), BHC (including isomers) and dieldrin. Those components comprising a less significant fraction of the total pesticides identified include aldrin, chlordane (including isomers), endrin and endrin ketone, total endosulfans, and heptachlor and heptachlor epoxide. Methoxychlor, which was identified in soil samples, was not identified in groundwater.

Toxaphene

Toxaphene contamination comprises the most significant concentrations of the pesticides fraction identified in groundwater at the Site. Toxaphene was identified in groundwater samples from monitoring wells MW-4, MW-6, MW-8, and MW-10 collected during the Remedial Investigation. Concentrations ranged in value from 9.9 ppb - 120.0 ppb. The laboratory did not identify toxaphene in groundwater samples collected during the March 1991 sampling event; however, toxaphene is believed to be present in MW-4, MW-6, and MW-10. Internal validation and assessment of chromatagrams indicates the probable presence of toxaphene in these wells. Due to severe matrix interferences in these samples, however, toxaphene quantification was not possible. The maximum concentration of toxaphene was detected in MW-8.

The Maximum Contaminant Level (MCL) for toxaphene in groundwater were established at 3.0 ppb.

DDT, DDE, and DDD

DDT, DDE, and DDD were detected in groundwater samples collected from monitoring wells MW-4, MW-6, MW-12, MW-14, and MW-22 during the RI and ranged in value from 0.045 ppb to 2 ppb. An MCL has not been established for DDT, or its metabolites DDE and DDD.

BHC (Lindane)

Lindane and its BHC isomers (alpha, beta, and delta) were identified in groundwater samples collected from monitoring wells MW-3, MW-4, MW-6, MW-8, MW-10, MW-12, MW-14, MW-16, MW-18, MW-22, and MW-24. Concentrations of BHC range from 0.024 ppb - 42.0 ppb. The MCL for lindane has been established at 0.2 ppb.

Dieldrin

Dieldrin was identified in groundwater samples from monitoring wells MW-4, MW-6, MW-8, MW-10, MW-12, and MW-14 in the first quarterly sampling event. Subsequent quarterly sampling events identified dieldrin in monitoring wells MW-6, MW-8, MW-10, MW-12, MW-14, MW-16, MW-18, MW-22, and MW-24. Concentrations range from 0.024 ppb - 5.5 ppb.

An MCL has not been established for dieldrin.

Aldrin

Aldrin was detected in groundwater samples collected from monitoring wells MW-4, MW-6, MW-8, and MW-12. Values ranged from 0.22 ppb - 7.9 ppb. The maximum concentration was detected in MW-4.

An MCL has not been established for aldrin.

Chlordane

Chlordane (alpha and gamma isomers) was identified in groundwater samples collected from monitoring wells MW-4 and MW-12. Chlordane was detected in MW-4 during the Phase II-A sampling events at 1.2 ppb. Chlordane was identified in MW-12 during Phase II-A, and both Phase II-B sampling events at concentrations ranging from 0.31 ppb - 1.3 ppb. The MCL established for chlordane is 2.0 ppb.

Total Endosulfans

Endosulfans were detected in monitoring wells MW-4 and MW-6 during the Phase II-A at concentrations of 1.8 ppb and .021 ppb respectively. Phase III groundwater sampling indicated elevated concentrations of endosulfans from monitoring wells MW-2, MW-5, MW-14, and MW-24. Concentrations ranged from 0.054 ppb to 0.62 ppb.

Endrin

Endrin and endrin ketone were identified in groundwater samples collected from monitoring wells MW-4, MW-6, MW-8, MW-10, MW-12, MW-18, MW-22, and MW-24. Concentrations ranged from 0.3 ppb - 2.1 ppb for endrin, and from 0.064 ppb - 18 ppb for endrin ketone. The MCL for endrin is 2.0 ppb.

Heptachlor

Heptachlor and heptachlor epoxide were identified in monitoring wells MW-6 and MW-12. The concentrations identified were 0.12 ppb for heptachlor and 0.57 ppb for heptachlor epoxide. Groundwater samples collected during Phase III of the RI did not show detectable quantities of heptachlor or heptachlor epoxide.

MCLs have been established at 0.4 ppb and 0.2 ppb, respectively.

5.2.2.4 Metals in Groundwater

The metals analyses conducted during the Phase II-A sampling event did not provide conclusive evidence that metals contamination of ground waters was a result of releases from the Site. Most metals in groundwater were detected at concentrations below detection limits or at levels comparable to background concentrations. During subsequent Phase II-B and Phase III groundwater sampling events beryllium, chromium, cadmium, and lead were detected in samples at levels which exceeded their respective MCLs.

Beryllium

Beryllium was identified in monitoring wells MW-4, MW-8, and MW-20 at concentrations of 6 ppb, 9 ppb, and 5 ppb respectively. The MCL for beryllium is 4 ppb. The detection of beryllium at concentrations above MCLs was a one time occurrence in each of the wells; therefore its presence does not appear to be significant.

Chromium

The presence of chromium was detected in monitoring wells MW-4, MW-6, MW-20, MW-23, and MW-24 at levels which exceeded the MCL of 100 ppb. The maximum concentration reported was 415 ppb which was detected in MW-20.

Cadmium

Cadmium was identified in MW-20 during both the September/October 1991 and December 1991 sampling at a concentration of 10 ppb. The MCL for cadmium is 5 ppb.

Lead

Lead was detected above the action level of 15 ppb in samples collected from monitoring wells MW-12, MW-20, MW-23, and MW-26. Lead was most frequently identified above the action level in MW-12.

Table 5

Table 4-22
Pesticides (Surface Water/Sediment
Phase II-A, II-B, III

PARAMETER	MATRIX	NUMBER OF SAMPLES	NUMBER OF HITS	RANGE(ppb)	MEAN(ppb)
alpha - BHC	Surface Water	2	0	—	—
	Sediment	10	2	0.1-60	30.5
beta - BHC	Surface Water	2	2	0.57-1.2	1
	Sediment	10	3	0.1-500	171.7
gamma - BHC	Surface Water	2	0	—	—
	Sediment	10	2	0.1-67	33.6
delta - BHC	Surface Water	2	1	—	0.28
	Sediment	10	0	—	—
Aldrin	Surface Water	2	0	—	—
	Sediment	10	1	—	990
Dieldrin	Surface Water	2	2	0.41-6.2	3.5
	Sediment	10	1	—	3200
4,4' DDD	Surface Water	2	2	0.045-0.23	0.2
	Sediment	10	9	18-3400	437
4,4' DDT	Surface Water	2	1	—	1.2
	Sediment	10	7	5.3-5700	862.9
4,4' DDE	Surface Water	2	0	—	—
	Sediment	10	8	9.8-280	80
Endrin Ketone	Surface Water	2	2	0.35-1.4	1
	Sediment	10	0	—	—
Heptachlor	Surface Water	2	0	—	—
	Sediment	10	2	2.1-25	13.6
Toxaphene	Surface Water	2	1	—	NOT QUANTIFIED
	Sediment	10	2	78-42000	21039
Gamma Chlordane	Surface Water	2	0	—	—
	Sediment	10	2	18-900.7	459.4
Alpha Chlordane	Surface Water	2	0	—	—
	Sediment	10	1	—	443
Endrin	Surface Water	2	0	—	—
	Sediment	10	1	—	1.6

5.2.3 Surface Water and Sediments

Sediments in the wetland areas located in the northern portion of the Site were found to be contaminated with semivolatile chemicals and pesticides. Table 5 summarizes the findings of the RI with respect to contaminated sediments. There are no chemical-specific ARARs for sediments, but the levels of contamination found in the RI exceed concentrations that have been shown through toxicological research to have an adverse impact to aquatic life due to toxic effects of these contaminants. This research is summarized in the National Oceanographic and Atmospheric Administration (NOAA) publication entitled The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52, August, 1991. The pattern and distribution of contamination in the sediments indicate that the primary source of contamination is the landfill that was placed partially in the jurisdictional wetlands. Sediment contamination also extends into off-site drainage pathways for surface waters. The sediment contamination found in both on-site and off-site locations poses an unacceptable risk to environmental receptors.

On-site surface waters were found to have been contaminated with pesticides at levels which exceed Ambient Water Quality Criteria (AWQC) for the protection of aquatic life. Federal AWQC have been established under the authority of Section 303 of the Clean Water Act for the purpose of establishing protective guidelines for ambient water quality. AWQC as developed by EPA are identified in Section 121 of CERCLA as amended by SARA as chemical-specific ARARs for NPL sites. In addition, the AWQC have been adopted by the State of South Carolina as ambient surface water quality standards, and are therefore ARARs for the Site. Table 5 also summarizes the findings of the RI with respect to surface water contamination at the Helena Chemical Site. The surface water contamination identified as part of the RI also poses an unacceptable risk to environmental receptors in the on-site wetland areas and in drainage pathways leading off-site.

6.0 SUMMARY OF SITE RISKS

A Baseline Risk Assessment was conducted to evaluate the risks presented by the Helena Chemical Superfund Site to human health and the environment, under present day conditions and under assumed future use conditions. Currently, there are no residents living on the Site and only a few residents residing close to the Site. There are no potable water supply wells on the Site, although there is a municipal water supply well located less than one-quarter mile away. Information gathered from census data regarding population trends in Allendale County and surrounding areas suggests that future land use will remain commercial and industrial, with little potential for residential use of groundwater as a potable water

source. The Site was evaluated, however, under residential exposure scenarios, including exposure pathways involving the use of shallow ground water as a potable water supply source. These exposure scenarios correspond to potential future use of the Site for residential development.

Under the current land use scenario, potential human receptors at the Site include residents in the vicinity of the Site who may be occasional Site trespassers, and workers on the Site. The Site is surrounded by residential, agricultural and light industrial areas. Beyond these areas immediately surrounding the Site (including the City of Fairfax), the local area is not densely populated, and consists primarily of agricultural land and forests. The most likely potential human receptors under the current land use scenario are workers and occasional trespassers. No private drinking water wells were identified either on-Site or immediately downgradient from the Site, and no users of surface water for potable water supplies were identified downgradient from the Site. Under current land use, the Reasonable Maximum Exposure (RME) is represented by the individual worker or Site trespasser who may be exposed by direct contact and incidental ingestion of surface soil and stream sediments.

Potential environmental receptors under the current land use scenario include the plants and animals at the Site. Site features, including the small unnamed stream and wetlands adjacent to the Site, and nearby wooded areas and open fields, provide a variety of habitats. No unique or critical habitats have been identified at the Site, and no vegetative stress is evident based upon site visits by regulatory personnel. No threatened or endangered species have been observed at the Site or in adjacent areas.

Future land use for the Site was considered to include potential development of the area as residential property. This potential land use scenario is considered to be that which would result in the greatest degree of risk to human health should the Site remain unremediated. The RME under a residential land use scenario is assumed to be an adult person or child living on the Site property and drinking potable water obtained from a private well drilled into the Barnwell Formation. Under the future land use scenario, environmental receptors would likely be more limited than at present, since residential development of the property would in all likelihood involve the elimination of the wetland and forested areas on and adjacent to the Site.

EPA has determined that the elevated levels of pesticides in the soils and ground waters at the Site pose the primary hazard to human health at the Site. In addition, the elevated levels of pesticides in the sediments and soils located in the wetland areas adjacent to and downstream of the Site pose a hazard to environmental receptors inhabiting those areas. Primary exposure

pathways for humans are incidental dermal contact with and ingestion of contaminated soils, and ingestion of contaminated ground water. Air transport of particulate matter contaminated with Site-related constituents of concern is not considered to be a significant risk to human health because the contaminated soils are generally in vegetated areas and the most heavily contaminated soils have been removed prior to this time. Air sampling results conducted during the Remedial Investigation indicated that airborne contamination was not present above levels that would pose a significant risk to human health.

EPA has established in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, a range of 1 X 10^{-4} to 1 X 10^{-6} as acceptable limits for excess lifetime carcinogenic risks. Excess risk within EPA's acceptable limits means that any individuals exposed to Site conditions under the assumed exposure scenarios will run a one in ten thousand (1 X 10^{-4}) to a one in one million (1 X 10^{-6}) increased chance of developing cancer. Under the "No Action" scenario, (assuming the Helena Chemical Site is left as it is now) the estimated carcinogenic risk for current land use is 8.0 X 10^{-5}. The estimated excess cancer risk calculated for the future land use scenarios at the Site is 2.6 X 10^{-4}. These calculated risks for the future land use scenario exceed the acceptable risk levels established by EPA and are based on the assumption that no cleanup activities will have occurred.

EPA has also established acceptable exposure limits based upon non-carcinogenic health effects. A Hazard Index (HI) of 1.0 or greater has been established by EPA as the criterion defining unacceptable levels of exposure for non-carcinogenic health effects. The HI is the ratio of exposure levels resulting from site conditions to acceptable exposure levels (ie., exposure levels that result in no adverse health affects) for any given contaminant. The HI for potential non-carcinogenic effects under the current land use exposure scenario is 0.3. The associated Hazard Index for non-carcinogenic effects under the future land use exposure scenario is 8.6.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential future threat to the public health, welfare, or the environment.

6.1 CONTAMINANTS OF CONCERN

Numerous chemical contaminants were identified in site media during RI Phases II-A, II-B, and III. Tables 6, 7, 8, 9, and 10 provide a summary of those contaminants which were evaluated or considered for evaluation during the Baseline Risk Assessment process. In Tables 6-10 the term "hit" or "hits" refers to positive results of

Table 6

Table 7-1
Summary of Soil Pesticide Concentrations
HCFSC Site

Parameter	Soil Class	Number of Samples	Number of Hits	Range (ppb)	Mean (ppb)
Aldrin	Total	261	35	1.2 - 800000	27100
	Surface	152	6	1.4 - 8100	1590
alpha-BHC	Total	261	32	2.1 - 390000	12300
	Surface	152	6	4.4 - 1800	530
beta-BHC	Total	261	52	4.9 - 270000	9900
	Surface	152	15	4.9 - 6200	750
delta-BHC	Total	261	22	4.1 - 210000	19000
	Surface	152	4	5 - 1500	380
gamma-BHC	Total	261	19	4.2 - 220000	11700
	Surface	152	4	5 - 67	34
4,4'-DDT	Total	261	124	5.1 - 2800000	31000
	Surface	152	41	8.5 - 220000	19200
4,4'-DDE	Total	261	66	0.74 - 21000	1100
	Surface	152	31	4.5 - 15000	910
4,4'-DDD	Total	261	72	2.3 - 750000	16800
	Surface	152	22	4.0 - 60000	6400
Dieldrin	Total	261	79	3.7 - 96000	3500
	Surface	152	21	4.6 - 44000	2700
Endosulfan II	Total	261	13	23 - 7100	660
	Surface	152	4	23 - 7100	1820
Endosulfan Sulfate	Total	261	33	2.1 - 22000	1040
	Surface	152	16	2.5 - 22000	1920
Endrin	Total	261	26	5.8 - 1600	390
	Surface	152	11	9.1 - 1500	550
Endrin Ketone	Total	261	35	2.1 - 9200	530
	Surface	152	12	5.3 - 1200	220

Table 6 (continued)

Table 7-1 Summary of Soil Pesticide Concentrations HCFSC Site					
Parameter	**Soil Class**	**Number of Samples**	**Number of Hits**	**Range (ppb)**	**Mean (ppb)**
Heptachlor	Total	261	11	6.1 - 68000	9300
	Surface	152	3	19 - 35	26
Heptachlor Epoxide	Total	261	9	2.4 - 29	15
	Surface	152	4	6 - 29	20
Methoxychlor	Total	261	10	24 - 12000	2050
	Surface	152	6	24 - 12000	3300
Toxaphene	Total	261	62	78 - 2700000	66000
	Surface	152	22	78 - 350000	43300
alpha-Chlordane	Total	261	4	15 - 9600	2500
	Surface	152	1	—	15
gamma-Chlordane	Total	261	6	16 - 14000	2600
	Surface	152	4	16 - 66	39

Table 7

Table 7-2
Summary of Soil Semivolatile Concentrations
HCFSC Site

Parameter	Soil Class	Number of Samples	Number of Hits	Range	Mean (ppb)
Disulfoton[a,b]	Total	261	12	60 - 430000	59400
	Surface	152	1	—	97
Tributylphoshoro-trithioate[b]	Total	261	3	750 - 7900	3200
	Surface	152	0	—	—
Chlorobenzilate[b]	Total	261	0	—	—
	Surface	152	0	—	—

Notes: Only disulfoton of the semivolatile SAS compounds (originally Tentatively Identified Compounds) were detected in site surface soils.

a One disulfoton sulfone hit (51 ppb) was identified during Phase II-A. This hit occurred as a Tentatively Identified Compound with estimated ("J" flag) concentration. This hit was not used to compute the average disulfoton concentration.

b Compound identified in a limited area in immediate vicinity of landfill.

Table 8

Table 7-3
Summary of Soil Volatiles Concentrations
HCFSC Site

Parameter	Soil Class	Number of Samples	Number of Hits	Range	Mean (ppb)
Benzene	Total	210	6	3 - 1300	223
	Surface	151	0	—	—
Chloroform	Total	210	5	1 - 11	4
	Surface	151	2	2 - 11	7
Ethylbenzene	Total	210	7	3 - 4100	1260
	Surface	151	0	—	—
Methylene Chloride	Total	210	80	2 - 140	20
	Surface	151	39	2 - 140	30
Toluene	Total	210	17	1 - 120	32
	Surface	151	4	1 - 89	35
Acetone	Total	210	118	2 - 13000	320
	Surface	151	69	2 - 13000	600
2-Butanone	Total	210	31	1 - 36	12
	Surface	151	13	3 - 32	13
Xylenes	Total	210	9	3 - 27000	4250
	Surface	151	1	—	3
Carbon Disulfide	Total	210	4	12 - 48	30
	Surface	151	3	19 - 48	35
Trichloroethylene	Total	210	2	24 - 210	117
	Surface	151	0	—	—
Styrene	Total	210	2	—	2
	Surface	151	0	—	—
1,2-Dichloroethene	Total	210	2	2 - 12	7
	Surface	151	1	—	12
Tetrachloroethene	Total	210	2	11 - 240	130
	Surface	151	2	11 - 240	130
1,2-Dichloropropane	Total	210	2	15 - 75	45
	Surface	151	0	—	—
Chlorobenzene	Total	210	4	5 - 9000	2300
	Surface	151	0	—	—

Table 9

Table 7-4
Summary of Groundwater Contaminants
HCFSC Site

Parameter	CRQL	Sampling Data	Number of Hits	Range (ppb) of Hits	Mean (ppb) of Hits	95% Upper Confidence Limit Mean (ppb)*
Aldrin	0.05	October 91	2	0.88 - 2.3	1.59	0.266
		December 91	2	0.86 - 1.2	0.93	
alpha-BHC	0.05	October 91	9	0.11 - 18	2.78	3.44
		December 91	8	0.17 - 31	6.72	
beta-BHC	0.05	October 91	8	0.26 - 26	5.42	3.74
		December 91	7	0.19 - 26	4.70	
delta-BHC	0.05	October 91	7	0.024 - 5.7	1.25	1.06
		December 91	5	0.094 - 1.2	0.62	
gamma-BHC	0.05	October 91	7	0.12 - 6.6	1.47	0.69
		December 91	6	0.23 - 2.2	0.91	
4,4'-DDT	0.1	October 91	1	—	0.45	0.175
		December 91	1	—	1.2	
4,4'-DDD	0.1	October 91	3	0.045 - 0.65	0.26	0.24
		December 91	1	—	2.10	
4,4'-DDE	0.1	October 91	2	0.051 - 2.0	1.03	0.21
		December 91	0	—	—	
Dieldrin	0.1	October 91	9	0.024 - 3.4	0.99	1.11
		December 91	7	0.23 - 5.5	2.70	
Endosulfan II	0.1	October 91	1	—	0.62	0.13
		December 91	0	—	—	
Toxaphene[b]	1.0	October 91	0	—	—	8.29
		December 91	1	—	36.0	
Endrin	0.1	October 91	0	—	—	0.081
		December 91	1	—	0.3	
Endrin Ketone	0.1	October 91	7	0.064 - 18	6.15	2.98
		December 91	6	0.17 - 11	4.15	

Table 9 (continued)

Table 7-4
Summary of Groundwater Contaminants
HCFSC Site

Parameter	CRQL	Sampling Date	Number of Hits	Range (ppb) of Hits	Mean (ppb) of Hits		95% Upper Confidence Limit Mean (ppb)[a]
Endosulfan Sulfate	0.1	October 91	3	0.054 - 0.12	0.08		0.091
		December 91	0	—	—		
Benzene	5.0	October 91	2	5 - 37	21		5.85
		December 91	1	—	35		
Disulfoton	5	October 91	0	—	—		9.12
		December 91	2	3 - 110	57		
TBPT	10	October 91	0	—	—		10.7
		December 91	1	—	49		
Chromium		October 91	21	3.9 - 415	52.4		69.75
		December 91	14	10.0 - 298	51.9		
Lead		October 91	24	0.7 - 44	8.0		11.5
		December 91	16	1.0 - 38.2	10.8		

Notes: "—" means no applicable value

All data used in developing this table were derived from groundwater results from the 3rd and 4th Quarter 1991 groundwater sampling events.

Heptachlor epoxide was identified in one well during Phase II-A of the RI. It was not identified in subsequent sampling phases and was attributed to a drilling artifact. As a result, heptachlor epoxide is not evaluated further in the BRA for the groundwater pathway.

a 95% UCL means were computed using the average concentration of each parameter from each well. If the compound or element was not detected in the sample, one-half of the sample quantitation limit was used to establish the average in the well for the parameter (per USEPA, RAGS, Volume I, Part A)

b Toxaphene was not originally reported on Form I's for the 3rd Quarter 1991 but was manually computed by the laboratory quality assurance director. Toxaphene was quantitated from relative intensities of characteristic chromatogram peaks (multiple peak pattern). The toxaphene chromatograms did not match the standard peaks with respect to the characteristic peaks generally used for quantitation. As a result, secondary characteristic peaks were chosen in order to quantify toxaphene.

Table 10

Table 7-5 Pesticides (Surface Water/Sediment) Phase II-A, II-B, III					
PARAMETER	MATRIX	NUMBER OF SAMPLES	NUMBER OF HITS	RANGE(ppb)	MEAN(ppb)
alpha - BHC	Surface Water	2	0	—	—
	Sediment	9	1	—	60
beta - BHC	Surface Water	2	2	0.57-1.2	1
	Sediment	9	2	15-500	257.5
gamma - BHC	Surface Water	2	0	—	—
	Sediment	9	1	—	67
delta - BHC	Surface Water	2	1	—	0.28
	Sediment	9	0	—	—
Aldrin	Surface Water	2	0	—	—
	Sediment	9	1	—	990
Dieldrin	Surface Water	2	2	0.41-6.2	3.5
	Sediment	9	1	—	3200
4,4' DDD	Surface Water	2	2	0.045-0.23	0.2
	Sediment	9	9	18-3400	437
4,4' DDT	Surface Water	2	1	—	1.2
	Sediment	9	5	14-5700	1207
4,4' DDE	Surface Water	2	0	—	—
	Sediment	9	8	9.8-280	80
Endrin Ketone	Surface Water	2	2	0.35-1.4	1
	Sediment	9	0	—	—
Heptachlor	Surface Water	2	0	—	—
	Sediment	9	1	—	25
Toxaphene	Surface Water	2	1	—	NOT QUANTIFIED
	Sediment	9	2	78-42000	21039
Gamma Chlordane	Surface Water	2	0	—	—
	Sediment	9	2	18-67	42.5

analyses. Many of the contaminants identified during the RI occurred at low frequency and/or in very low concentrations relative to the practical quantification limit for each compound.

The selection of contaminants that would be fully evaluated during the Baseline Risk Assessment in order to quantify Site risks were selected in accordance with guidance as contained in the document Risk Assessment Guidance for Superfund (RAGS), EPA/540/1-89/002, 12/89. The selection process included the following criteria: (1) the chemical has demonstrated significant toxicity to animal life in published reports, (2) USEPA health-based numbers can be obtained for the chemical, (3) whether its occurrence is significant, based on frequency, concentration and exposure potential, in regard to the total risk posed by the Site. The rationale used for selection of the evaluated contaminants and for eliminating the other contaminants is provided in the following discussions.

The selected contaminants of concern for the baseline risk assessment are shown in Table 4. Pesticides were the primary hazardous contaminants detected. In addition, a limited number of semi-volatile, volatile, and inorganic parameters were identified and will be carried through the baseline risk assessment process as explained below. Only Contract Laboratory Program (CLP) data were used for the evaluation of baseline risk at the Helena Chemical NPL Site.

In soils, DDT (plus DDE and DDD), BHC (all isomers), toxaphene and dieldrin were the most frequently detected and generally were found in the higher concentrations. Aldrin, endosulfan sulfate, endrin and endrin ketone were the next most frequently detected pesticides. Endosulfan, heptachlor, heptachlor epoxide, methoxychlor, and chlordane were the least frequently detected. Disulfoton and tributylphosphoro-trithioate (TBPT, butylphosphorotrithioate) were also detected infrequently, but were nonetheless evaluated as part of the BRA. Due to the low frequency of detection and the relatively low concentrations of heptachlor, heptachlor epoxide and chlordane (both isomers) found in site soils, these compounds were not evaluated as part of the BRA as it was determined that they would not contribute significantly to the overall risk posed by the site. This approach is consistent with the process for eliminating compounds from further consideration as outlined in RAGS. Endosulfan sulfate and endrin ketone are not listed in EPA databases which contain Agency reviewed toxicity data, and as a result the reference doses (RfD's) of their parent compounds (endosulfan and endrin, respectively) were used to compute the risk posed by these compounds. This procedure provided a conservative estimate of risk (or hazard index).

A large number of inorganic parameters were detected in soil samples. No inorganic contamination associated with site activities was found, however, in soils at a frequency and/or

concentration sufficient to warrant consideration as a contaminant of concern.

Site-related contamination was identified in the surface water samples gathered during the RI. An evaluation of this data indicates that pesticides are the only hazardous substances detected at significant concentration and frequency in this medium to warrant further consideration. Due to the intermittent nature of the surface water on-site, this medium was not considered a significant pathway for direct human exposure.

In groundwater, aldrin, BHC (all isomers), DDT (plus DDE & DDD), dieldrin, and endrin ketone were detected in the highest concentration or frequency, and represent the contaminants of concern from the groundwater perspective. Other detected chlorinated pesticide compounds included endosulfan II, endrin, toxaphene, endosulfan sulfate, and heptachlor epoxide. With the exception of heptachlor epoxide, these compounds were also evaluated in the Baseline Risk Assessment (BRA). Heptachlor epoxide was detected in one groundwater sample during Phase II-A. It has not been detected in any other sample during subsequent groundwater sampling events. As a result, heptachlor epoxide was not considered a contaminant of concern for the groundwater pathway. Heptachlor epoxide was therefore not evaluated as part of the BRA process. TBPT was also detected in one groundwater sample during the 3rd Quarter 1991 groundwater sampling event. Disulfoton was detected in two groundwater samples from the 4th Quarter 1991 sampling event and was evaluated as a contaminant of concern in groundwater. Benzene, lead, and chromium were also detected in groundwater samples. The frequency of detection and concentration for these parameters was generally higher than for the pesticide compounds and they were evaluated due to their potential contributions to overall risk (or hazard index).

Carbon disulfide was not consistently detected between RI phases. As a result, carbon disulfide results were attributed to laboratory artifacts, and were not evaluated further. Although bis(2-ethylhexyl)phthalate (BEHP), acetone, methylene chloride, and 2-butanone were identified in a significant number of samples, they were not evaluated as contaminants of concern. These compounds are common exogenous contaminants attributable to sampling methods and/or laboratory artifacts, and are not related to current or former site operations.

Numerous polynuclear aromatic hydrocarbons (PAHs) and phenolic compounds were identified in soil and groundwater during RI Phase II-A. These compounds were detected at low frequencies and at concentrations at or near their respective practical quantitation limits. Subsequent to Phase II-A, the semi-volatile contaminants of concern were limited to tentatively identified compounds (TICs) identified during Phase II-A. The TICs were disulfoton, TBPT, and chlorobenzilate. As a result, the BRA focused on the TICs and

Figure 5

Figure 7.3
Equations for Calculating Oral and Dermal Chronic Exposure Levels from HCFSC Site Soils
Future Site Residents and Current Site Workers

FUTURE SITE RESIDENTS

SOIL INGESTION PATHWAY

Age-adjusted Ingestion Factor ($IF_{soil/adj}$)

$$IF_{soil/adj}\ (\text{mg-yr/kg-day}) = \frac{IR_{soil/age1\text{-}6} \times ED_{age1\text{-}6}}{BW_{age1\text{-}6}} + \frac{IR_{soil/age7\text{-}31} \times ED_{age7\text{-}31}}{BW_{age7\text{-}31}}$$

where:

		Default Values
$IF_{soil/adj}$	age-adjusted soil ingestion factor (mg-yr/kg-day)	109 mg-yr/kg-day
$BW_{age1\text{-}6}$	average body weight from ages 1-6 (kg)	16 kg
$BW_{age7\text{-}31}$	average body weight from ages 7-31 (kg)	70 kg
$ED_{age1\text{-}6}$	exposure duration during ages 1-6 (yr)	6 years
$ED_{age7\text{-}31}$	exposure duration during ages 7-31 (yr)	24 years
$IR_{soil/age1\text{-}6}$	ingestion rate of soil age 1 -6 (mg/day)	200 mg/day
$IR_{soil/age7\text{-}31}$	ingestion rate of soil age 7-31 (mg/day)	100 mg/day
$IF_{soil/adj}$	age-adjusted ingestion factor (mg-yr/kg-day)	109 mg-yr/kg-day

DERMAL CONTACT PATHWAY

Age-adjusted Contact Factor ($CF_{soil/adj}$)

$$CF_{soil/adj}\ (\text{mg-yr/kg-day}) = \frac{SA_{age1\text{-}6} \times AF \times ED_{age1\text{-}6}}{BW_{age1\text{-}6}} + \frac{SA_{age7\text{-}31} \times AF \times ED_{age7\text{-}31}}{BW_{age7\text{-}31}}$$

where:

$CF_{soil/adj}$	age-adjusted contact factor (mg-yr-event/kg-day)	3400 mg-yr-event/kg-day
$SA_{age1\text{-}6}$	skin surface area available for contact (cm^2/event)	2430 cm^2/event
$SA_{age7\text{-}31}$	skin surface area available for contact (cm^2/event)	2300 cm^2/event
AF	soil to skin adherence factor (mg/cm^2)	2 mg/cm^2
$ED_{age1\text{-}6}$	exposure duration during age 1-6 (yr)	6 yr
$ED_{age7\text{-}31}$	exposure duration during age 7-31 (yr)	24 yr

COMBINED DAILY ABSORBED DOSE

Non-Carcinogens
Daily Absorbed Dose =
$((IF_{soil/adj} \times C_s \times 10^{-6}\text{kg/mg} \times EF_R)/AT_{NC}) + ((CF_{soil/adj} \times C_s \times 10^{-6}\text{kg/mg} \times EF_R \times ABS)/AT_{NC})$

Carcinogens
Daily Absorbed Dose =
$((IF_{soil/adj} \times C_s \times 10^{-6}\text{kg/mg} \times EF_R)/AT_C) + ((CF_{soil/adj} \times C_s \times 10^{-6}\text{kg/mg} \times EF_R \times ABS)/AT_C)$

Figure 5 (continued)

Figure 7.3
Equations for Calculating Oral and Dermal Chronic Exposure Levels from HCFSC Site Soils
Future Site Residents and Current Site Workers

where:

		Default Values
C_s	Chemical concentration in soil	chemical-specific
EF_R	Residential exposure frequency	350 days/year
AT_{NC}	Averaging time (non-carcinogen)	10,950 days
AT_C	Averaging time (carcinogen)	25,550 days
ABS	Absorption factor (unitless)	0.01

CURRENT SITE WORKERS

COMBINED SOIL INGESTION AND DERMAL CONTACT PATHWAYS DAILY ABSORBED DOSE

Non-Carcinogens
Combined Chronic Absorbed Dose =

$$((IR_{soil\text{-}worker} \times C_s \times 10^{-6}\ kg/mg \times EF_w \times ED_w)/(BW_w \times AT_{NC\text{-}worker})) +$$

$$((C_s \times 10^{-6}\ kg/mg \times ABS \times AF \times SA_w \times EF_w \times ED_w)/(BW_w \times AT_{NC\text{-}worker}))$$

Carcinogens
Combined Chronic Absorbed Dose =

$$((IR_{soil\text{-}worker} \times C_s \times 10^{-6}\ kg/mg \times EF_w \times ED_w)/(BW_w \times AT_{C\text{-}worker})) +$$

$$((C_s \times 10^{-6}\ kg/mg \times ABS \times AF \times SA_w \times EF_w \times ED_w)/(BW_w \times AT_{C\text{-}worker}))$$

where:

		Default Values
$IR_{soil\text{-}worker}$	Worker soil ingestion rate (mg/day)	100 mg/day
C_s	Soil contaminant concentration (mg/kg)	Chemical-specific
EF_w	Worker exposure frequency (days/year)	250 days/year
ED_w	Worker exposure duration (years)	30 years
BW_w	Worker body weight (kg)	70 kg
$AT_{NC\text{-}worker}$	Worker averaging time-non-carcinogen (days)	10,950 days
$AT_{C\text{-}worker}$	Worker averaging time-carcinogen (days)	25,550 days
ABS	Absorption factor (unitless)	0.01**
AF	Soil to skin adherence factor (mg/cm^2)	2 mg/cm^2
SA_w	Skin surface area available for contact (cm^2/event)	2300 cm^2/event

Figure 6

Figure 7.2
Equations For Calcualtion Of Chronic Exposure
For The Groundwater Pathway[a]

FUTURE SITE RESIDENTS

Non-Carcinogenic

Chronic Absorbed Dose from Groundwater =

$$C_w \times IR_{water} \times EF \times ED/(BW \times AT_{NC})$$

Carcinogenic

Chronic Absorbed Dose from Groundwater =

$$C_w \times IR_{water} \times EF \times ED/(BW \times AT_C)$$

Where:		Default Values
C_w	Groundwater contaminant concentration (mg/liter)	Chemical-specific
IR_{water}	Groundwater ingestion rate (1/day)	2 liter/day
EF	Groundwater exposure frequency (days/year)	350 days/year
ED	Residential exposure duration (years)	30 years
BW	Body weight (kg)	70 kg
AT_{NC}	Averaging time for non-carcinogens (days)	30 years x 365 d/yr = 10,950 days
AT_C	Averaging time for carcinogens (days)	70 years x 365 d/yr = 25,550 days

a - Default exposure assumptions values referenced from USEPA, RAGS, 12/89 and OSWER Directive #9285.6-03.

Note: Assume absorbed dose is equivalent to intake/ingested dose.

Cancer Risk = Carcinogenic Chronic Absorbed Dose x Slope Factor

Hazard Index = Non-Carcinogenic Chronic Absorbed Dose/RfD

eliminated PAHs and phenolic compounds from further considerationon the basis of low detection frequency and low concentration.

6.2 EXPOSURE ASSESSMENT

Contaminated media at the Site include surface and subsurface soil; shallow groundwater; and surface water and sediments in on-Site and adjacent wetlands. Pathways involving air as a medium were not considered due to the extensive grass and vegetative cover at the Site, and the lack of positive results from air monitoring for Site-specific contaminants.

Populations that could potentially be exposed to Site contaminants under current exposure conditions are on-Site workers and occasional trespassers. Potential future land use exposure scenarios include child and adult residents living on the Site, and children and adults living near the Site who might visit or play on the Site.

Based on these potential receptors, three general exposure pathways were selected for numerical risk quantification:

1. Current exposure of adult non-residents (Site workers and trespassers) to contaminants in surface soils through incidental ingestion and dermal contact.

2. Future exposure of on-site adult and child residents to contaminants in shallow soils through incidental ingestion and dermal contact.

3. Future exposure of onsite adult and child residents to contaminants in groundwater through ingestion.

In order to quantify the exposure associated with each pathway, various standard procedures were used to determine key variables in the exposure calculations. These variables include the contaminant level in the medium, usually referred to as the exposure point concentration; and the amount of the chemical taken into the body, or chronic daily intake, which must be calculated using a number of assumptions. Since EPA policy is that exposure estimates must approximate a Reasonable Maximum Exposure (RME) scenario, each of the variables was selected with the goal of producing the maximum exposure that could reasonably be expected to occur. Tables 13 and 14 present the exposure point concentrations calculated for the contaminants of concern in soils and ground water. It should be noted that the mean concentrations for each contaminant detected in the "hot spots" were used as the exposure point concentrations in the RME evaluation.

Calculation of average daily intake requires input of numerous exposure parameters which are usually applicable to a particular

Table 11

Table 7-13
Groundwater Contaminant Levels (ug/L) Yielding 10^{-4} to 10^{-6} Upper Bound Risk Levels for Future Site Residents
Exposure Scenario
HCFSC Site

Parameter	Current 95% UCL Mean (ppm)	Current Upper Bound Cancer Risk	Current Hazard Indices	Concentration (ppb) Required to Obtain		
				10^{-4} Risk	10^{-5} Risk	10^{-6} Risk
Aldrin	0.00027	5.4E-5	0.24	—	0.049	0.0049
alpha-BHC	0.0034	2.54E-4	NA	1.35	0.135	0.0135
beta-BHC	0.0037	7.90E-5	NA	—	0.47	0.047
delta-BHC	0.0011	NA	NA	—	—	—
gamma-BHC	0.00069	1.05E-5	0.063	—	0.66	0.066
DDT	0.00017	7.00E-7	0.0096	—	—	—
DDD	0.00024	6.75E-7	NA	—	—	—
DDE	0.00021	8.31E-7	NA	—	—	—
Dieldrin	0.0011	2.08E-4	0.61	0.53	0.053	0.0053
Endosulfan II	0.00013	NA	0.073	—	—	—
Endrin	0.000081	NA	0.0073	—	—	0.0073
Endrin Ketone	0.0030	NA	0.27	—	—	—
Toxaphene	0.0083	1.07E-4	NA	7.75	0.775	0.078
Endosulfan Sulfate	0.000091	NA	0.050	—	—	—
Disulfoton	0.0091	NA	6.25	—	—	1.5 (HI = 1)
Benzene	0.0059	1.99E-6	NA	—	—	2.94
Lead	0.0115	NA	0.23	—	—	—
Chromium	0.0697	—	8.19E-4	—	—	—

Notes:

The ensuing reduction in contaminant levels would also reduce the Σ Hazard Indices to below unity (1).

Groundwater cleanup goals may be calculated by solving the following:

$$\text{Groundwater Cleanup Goal (ppb)} = \frac{\text{Risk Level Goal} \times \text{Current Groundwater Concentration}}{\text{Current Risk Level}}$$

Table 12

Table 7-12
Soil Contaminant Levels (mg/kg) Yielding 10^{-4} to 10^{-6}
Upper Bound Risk Levels for Future Resident Exposure Scenarios at the HCFSC Site

Potential Future Site Resident					
Contaminant	Current Mean Concentration (mg/kg)	Current Upper Bound Risk Level	10^{-4}	10^{-5}	10^{-6}
Aldrin	1.59	5.3E-5	—	0.3	0.03
alpha-BHC	0.53	6.5E-6	—	—	0.08
beta-BHC	0.75	2.65E-6	—	—	0.28
delta-BHC	0.38	NA	NA	NA	NA
gamma-BHC	0.034	8.68E-8	—	—	—
DDT	19.2	1.28E-5	—	15	1.5
DDD	6.45	3.04E-6	—	—	2.1
DDE	0.91	6.07E-7	—	—	—
Dieldrin	2.69	8.45E-5	—	0.32	0.032
Disulfoton	0.097	NA	NA	NA	NA
Endosulfan	1.82	NA	NA	NA	NA
Endosulfan Sulfate	1.92	NA	NA	NA	NA
Endrin	0.55	NA	NA	NA	NA
Endrin Ketone	0.22	NA	NA	NA	NA
Methoxychlor	3.3	NA	NA	NA	NA
TBPT	0.0	NA	NA	NA	NA
Toxaphene	43.3	9.35E-5	—	4.63	0.463

Notes: No compound presented a hazard index in excess of 1; a linear relationship exists between soil concentration and associated risk levels, therefore the cleanup objectives for each risk level may be computed by determining the following:

X (Soil Cleanup Goal) = Risk Level Goal x Current Soil Concentration/Current Risk Level

NA No Slope Factor for the compound.

— Current contaminant levels in soil do not present a risk in excess of the respective risk levels.

exposure pathway. The exposure parameters used for soils aresummarized in Figure 5. The same parameters for ground-water exposure are shown on Figure 6.

The result of the exposure assessment is a set of tables showing a calculated average daily intake value for each chemical or compound, as well as a summary value for each exposure pathway. Tables 13 and 14 contain these data and summaries.

6.3 TOXICITY ASSESSMENT

In this portion of the Baseline Risk Assessment, the toxic effects of contaminants were investigated and evaluated. The critical variables needed to calculate estimates of risk were obtained from the EPA toxicological databases. Critical toxicity values for Helena Chemical Site contaminants are presented in Table 15.

Slope factors (SFs) have been developed by EPA's Carcinogenic Assessment Group for estimating lifetime cancer risks associated with exposure to potentiall carcinogenic contaminants of concern. SFs, which are expressed in terms of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen in order to provide an upper-bound extimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes under-estimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays; if animal bioassays are used, animal-to-human extrapolation and uncertainty factors are applied to account for the use of animal data to predict effects on humans. The SFs for the carcinogenic contaminants of concern are contained in Table 15.

Reference doses (RfDs) have been developed by EPA for use in indicating the potential for adverse health effects from exposure to contaminants exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals or subpopulations. Estimates intakes of contaminants of concern ingested from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied, to account for the use of animal data to predict effects on humans. The RfDs for the noncarcinogenic contaminants of concern are also contained in Table 15.

Carcinogenic contaminants are classified according to EPA's weight-of-evidence system. This classification scheme is summarized below:

Group A: Known human carcinogen.

Table 13

Table 7-9
Summary of Risks for Future Site Resident Direct Ingestion of Groundwater[a]
HCFSC Site

Parameter	95% UCL[b] (ppb)	Slope Factor (SF)[c]	Reference Dose (RfD)[c]	Upper Bound Cancer Risk[d]	Hazard Index[f]
Aldrin	0.266	17	0.00003	5.32E-5	0.24
alpha-BHC	3.44	6.3	NA	2.54E-4	NA
beta-BHC	3.74	1.8	NA	7.90E-5	NA
delta-BHC	1.06	NA	NA	NA	NA
gamma-BHC	0.69	1.3	.0003	1.05E-5	0.063
DDT	0.175	0.34	0.0005	7.00E-7	0.0096
DDD	0.24	0.24	NA	6.75E-7	NA
DDE	0.21	0.34	NA	8.31E-7	NA
Dieldrin	1.11	16	0.00005	2.08E-4	0.61
Endosulfan II	0.13	NA	0.00005	NA	0.073
Endrin	0.081	NA	0.0003	NA	0.0073
Endrin Ketone	2.98	NA	0.0003[d]	NA	0.27
Toxaphene	8.29	1.1	NA	1.07E-4	NA
Endosulfan Sulfate	0.091	NA	0.00005[d]	NA	0.050
Disulfoton	9.12	NA	0.00004	NA	6.25
TBPT	10.7	NA	NA	NA	NA
Benzene	6.85	0.029	NA	1.99E-6	NA
Lead	11.5	NA	0.0014[e]	NA	0.23
Chromium	69.75	NA	1.0	NA	8.19E-4
Sum of Cancer Risks and Hazard Indices[f]				Σ Risk = 7.1E-4	Σ HI = 7.80

a - assumes consumption of 2 liters/day of contaminated groundwater (at 95% UCL for each parameter) over a 70 year period for carcinogens and a 30 year period for non-carcinogens.

b - *Figure 7-2 provides the equations used to compute chronic daily intake for establishing risk levels and hazard* indices.

c - 95% Upper Confidence Limits means calculated using detected values for hits and one-half the sample quantitation limit for non-hits. Data used was derived from the 3rd and 4th Quarter 1991 Groundwater Sampling Events.

d - RfD for endrin applied to endrin ketone; RfD for endosulfan applied to endosulfan sulfate.

e - The unit risk for lead is calculated from a treatment technology based MCL of 0.015 mg/l. A USEPA approved RfD for lead has not been established.

f - Hazard Indices have been summed as a conservative estimate of non-carcinogenic risk; generally summation of Hazard Indices is appropriate only for contaminants having the same target organ effect (for non-carcinogens).

Table 14

Table 7-10
Summary of Risks for Current Adult Workers and Future Site Residents from Oral and Dermal Exposure to Contaminants in Soil/Sediments HCFSC Site

Concentration of Contaminant (mg/kg)[a]	Contaminant	Future Resident Upper Bound Risk Level[b] (or Hazard Index)	Adult Worker Upper Bound Risk Level[b] (or Hazard Index)
1.59	Aldrin	5.3E-5 (HI=0.0243)	1.56E-5 (HI=0.076)
0.53	alpha-BHC	6.5E-6	2.0E-6
0.75	beta-BHC	2.65E-6	8.3E-7
0.38	delta-BHC	NA	NA
0.034	gamma-BHC	8.68E-8 (HI=0.00052)	2.7E-8 (HI=1.6E-4)
19.2	DDT	1.28E-5 (HI=0.176)	4.0E-6 (HI=0.055)
6.45	DDD	3.04E-6	9.5E-7
0.91	DDE	6.07E-7	1.9E-7
2.69	Dieldrin	8.45E-5 (HI=0.246)	2.6E-5 (HI=0.077)
1.82	Endosulfan	(HI=0.167)	(HI=0.052)
1.92	Endosulfan Sulfate	(HI=0.176)	(HI=0.055)
0.55	Endrin	(HI=0.0084)	(HI=2.6E-3)
0.22	Endrin Ketone	(HI=0.0034)	(HI=1.1E-3)
3.3	Methoxychlor	(HI=0.003)	(HI=9.4E-4)
43.3	Toxaphene	9.35E-5	2.92E-5
0.097	Disulfoton	(HI=0.011)	(HI=0.0035)
0.0	TBPT[c]	NA	NA
Sum of Upper Bound Cancer Risk		2.57E-4	8.0E-5
Sum of Hazard Indices		Sum of HI=.82	Sum of HI=0.32

Notes:

a Mean concentration in soil (95% C.L. was not calculated as the data are not normally distributed). The mean contaminant concentrations in the "hot spots" onsite were assumed to be present over the entire site area. Uniform exposure to all areas onsite was assumed to provide a conservative estimate of exposure. This approach is consistent with USEPA, Region IV guidance for establishing RME levels.

b HI (Hazard Index) of >1 is a cause for concern. Upper bound risk levels of 10^{-4} to 10^{-6} are considered on a case-by-case basis as to their acceptability by the USEPA.

c TBPT was not identified in surface soils onsite.

NA Not applicable

Table 15

Table 7-8
Health-Based Values for Carcinogens (CPF) and Noncarcinogens (RfD) and ARARs for Oral Exposure to Contaminants of Concern at the HCFSC Site

Contaminant	Slope Factor (SF) $(mg/kg/day)^{-1}$	RfD (mg/kg/day)	ARAR (MCL as mg/ℓ)
Chlordane	1.3	0.00006	0.002
Endrin	NA	0.0003	0.002[a]
Heptachlor	4.5	0.0005	0.0004
Heptachlor Epoxide	9.1	0.000013	0.0002
Disulfoton	NA	0.00004	NA
Benzene	0.029	NA	0.005
Aldrin	17	0.00003	NA
α-BHC	6.3	NA	NA
ß-BHC	1.8	NA	NA
gamma-BHC (Lindane)	1.3	0.0003	0.0002
delta-BHC	NA	NA	NA
Dieldrin	16	0.00005	NA
Endosulfan	NA	0.00005	NA
DDD	0.24	NA	NA
DDE	0.34	NA	NA
DDT	0.34	0.0005	NA
Toxaphene	1.1	NA	0.003
TBPT[b]	NA	NA	NA
Methoxychlor	NA	0.005	0.04
Chlorobenzilate	NA	0.02	—
Chromium[d]	NA	1.0	0.1
Lead	NA	0.0014[c]	0.015[c]

a A proposed MCL of 0.002 mg/ℓ
b No verified risk based criteria exist for TBPT.
c The unit risk for lead is calculated from a treatment technology based MCL of 0.015 mg/l. A USEPA approved RfD for lead has not been established.
d based on assumption that all chromium is present in the (III) valence state.
e unit risk computed from MCL
NA Not available or not determined
Slope Factor synonymous to Cancer Potency Factor (CPF)

Group B1: Probable human carcinogen, based on limited human epidemiological evidence.

Group B2: Probable human carcinogen, based on inadequate human epidemiological evidence but sufficient evidence of carcinogenicity in animals.

Group C: Possible human carcinogen, limited evidence of carcinogenicity in animals.

Group D: Not classifiable due to insufficient data.

Group E: Not a human carcinogen, based on adequate animal studies and/or human epidemiological evidence.

6.4 RISK CHARACTERIZATION

It should be noted that there is some degree of uncertainty associated with the calculated numerical estimates of human health risks generated in the Baseline Risk Assessment. This is due to the considerable number of assumptions required to provide variables in the equations, and the specific selections of each variable from a range of possibilities. The potential risk associated with soils and groundwater exposure was quantified through the standard risk assessment scenarios (Tables 13 and 14).

6.4.1 Ground Water

Ground-water risk based upon residential drinking water exposure was evaluated as a potential future risk. Samples from several monitoring wells had at least one contaminant that exceeded the current MCL.

Table 13 presents the individual risks associated with each parameter found in ground water along with total carcinogenic and non-carcinogenic values. The total groundwater risk for future residents consuming water from the surficial aquifer was calculated at 7.1×10^{-4}. The summation of the Hazard Indices for the future groundwater exposure scenario was calculated at 7.8. Toxaphene, dieldrin and alpha-BHC account for 80 percent of the carcinogenic risk. Disulfoton accounts for 80 percent of the non-carcinogenic risk. These values indicate that significant carcinogenic and noncarcinogenic risk may be posed by consumption of contaminated groundwater from a potable water well located onsite. The assumptions upon which these risk levels were based are conservative.

The groundwater risk levels were computed using the 95 percent Upper Confidence Limit of the mean from each well for each parameter. The 95 percent Upper Confidence Limit was computed

using detected values for hits and one-half the sample quantitation limit for non-detects. The mean value for each groundwater monitoring well (for the 3rd and 4th Quarter 1991 sampling events) was used. This more rigorous statistical approach for computing the Reasonable Maximum Exposure (RME) was used due to the greater uncertainty associated with the distribution of contaminants in the groundwater medium.

Under current circumstances, contaminants attributable to the site pose no imminent carcinogenic or non-carcinogenic risk to site workers or area residents through the groundwater exposure pathway. The adjacent municipal potable water well is screened in a deeper saturated zone separated by a possible aquitard from the contaminated aquifer. The municipal well has been tested, and no site constituents have been detected in the potable source. Residences within the groundwater contaminant plume area are connected to the municipal water system rendering private wells unnecessary.

In light of these factors, future resident exposure through the groundwater pathway may be minimized through control of the limited shallow aquifer contamination. Control would serve to reduce contaminant levels in the shallow aquifer (with concurrent reductions in the future resident groundwater onsite exposure risk potential), and would prevent migration of contaminants to the unaffected deep aquifer supplying the nearby municipal well. Surface water is not considered a significant pathway for direct human exposure.

6.4.2 Soils

Direct soil exposure poses a pathway of significant reasonable potential risk (current and future). Upper bound cancer risk and toxicity hazard index values were calculated for the contaminants of concern. A summary of these calculated values is shown in Table 14.

The soil samples indicated that soils had a wide range of contaminant levels with rather defined areas of greater contaminant concentration (north and northeast portions of the Site). The vast majority of Site contamination exists within an area from the north warehouse building onsite to 300 feet north and northwest of this warehouse building. Careful perusal of the data gathered during the RI reveal approximately 30% of the Site's total soil area is contaminated with total pesticide levels greater than 100 ppb.

Volatiles in soils tend to be in these same areas (warehouse and old landfill) but only constituted 20-25% of the total area. Soil contaminant mean concentrations were computed using the 'hot spot' method where only those samples with detectable contaminant concentrations were included in the calculations. The total area

of the 'hot spots' encompasses approximately 30 percent of the entire site area. In order to provide a conservative exposure estimate, the computed mean concentration of each contaminant (from 'hot spots') was assumed to exist over 100 percent of the site. This approach is consistent with EPA guidance for establishing reasonable maximum exposure (RME) levels.

Throughout most of the year, site sediments are not submerged, and as a result, present the same exposure pathways as site soils. Sediment contaminant concentrations were within the range observed in site soils. Therefore, no differentiation was made between soil and sediment for risk computation purposes for the ingestion and dermal contact pathways.

In order to provide a conservative estimate of the potential risk posed by the direct ingestion and dermal contact soil exposure pathways, the following exposure scenario assumptions were applied.

The potential for direct soil ingestion or dermal contact with soils is greatest for those soils closest to ground surface. As a result, the arithmetic mean was computed for each constituent of concern using soil concentrations from samples collected within one foot of ground surface. The distribution of pesticide contaminants indicated that higher concentrations for an area are generally present at the surface. Only positive results were used for the calculation of mean contaminant concentrations in soil. As a result, the mean values calculated (and used for calculation of chronic daily intakes) were biased toward the higher range of all values observed for soils. This approach is consistent with the 'hotspot' approach discussed in USEPA, RAGS, 12/89.

In addition for purposes of calculating carcinogenic risk (or hazard index), it was assumed that the computed average contaminant concentrations were present over 100 percent of the site. It was also assumed that current site workers and future site residents would have uniform exposure to all areas onsite. This assumption is conservative in that current site operations are restricted to approximately 25 percent of the site area. Highly contaminated soils are concentrated north and northeast of the north warehouse. The current operations area is restricted to the southern portion of the north warehouse. Current site workers do not enter other highly contaminated areas over the course of everyday operations.

The relevant current and potential future soil exposure scenarios for this site are considered to be adult workers and future site residents exposed through the combined pathway of ingestion and dermal adsorption of contaminated soil. Trespassers would be expected to spend a minimal amount of time on-site compared to adult workers and therefore should be more than adequately protected based on the occupational risk calculations.

Table 14 summarizes computed risk values (and hazard indices) for

the soil direct ingestion and dermal contact exposure pathway. The combined carcinogenic risk from surface soil contaminants is 8.0 x 10^{-5} for current adult workers and 2.57 x 10^{-4} for future site residents. Aldrin, toxaphene, and dieldrin account for the majority (approximately 85 percent) of the total upper bound cancer risk for onsite surface soils for both current adult workers and future site residents. The sum of hazard indices is less than unity (1) for current adult workers and 1.0 for future site residents, using only soil exposure pathways. It is worth noting, however, that the sum of hazard indices is generally relevant only in instances where the target organ for each contaminant is the same. As a result, the computed sum of hazard indices yields a more conservative assessment of non-carcinogenic risk.

The areas directly north and northwest of the northernmost warehouse represent the area of concern for most surface soil contaminants. It should be noted that each individual surface soil contaminant was assumed to be present over 100 percent of site surface soils (at the mean concentration). In reality, each contaminant is present in a much smaller area. The contamination distribution assumptions and the occupational exposure duration assumptions used in calculating risk are conservative. It should also be noted that occupational exposures are intermittent and not continuous. Again, the conservative assumption of continuous exposure was used.

6.4.3 Surface Water

The surface water identified on-site is intermittent in nature, and only exists after rainfall associated with storm events. Standing water is generally isolated to the densely vegetated area along the north property line. This area is not subject to recreational use, and site workers do not have occasion to enter this area during normal site operations. As a result, surface water is not considered a viable exposure pathway.

6.5 ENVIRONMENTAL (ECOLOGICAL) RISKS

Surface water and sediment samples were gathered during the RI from on-Site areas and in drainage pathways leading from the Site into local surface water streams. These samples were shown to be contaminated with Site-specific pesticides at levels which present an unacceptable level of risk to environmental receptors.
Surface water samples were contaminated with pesticides at concentrations which exceed ARARs, namely Federal Ambient Water Quality Criteria (AWQC) and State of South Carolina ambient standards for surface waters. The AWQC and state standards have been established based upon protection of aquatic life from adverse effects of exposure to toxics, and it is presumable that concentrations which exceed these criteria and standards will have

an unacceptable adverse impact on environmental receptors.

Sediment samples were also found to be contaminated with Site-specific pesticides. There are no promulgated standards or criteria for sediment quality at either the State or Federal level, so no ARARs exist for sediment quality. Considerable research has been conducted, however, on the environmental effects of exposure to contaminated sediments. This research has been compiled by the National Oceanographic and Atmospheric Administration (NOAA), in the document entitled The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA 52, August, 1991. The levels of sediment contamination found at this Site exceed the levels cited in this document as being likely to contribute to adverse impacts to biological receptors.

7.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

The Feasibility Study (FS) considered a wide variety of general response actions and technologies for remediating soil and groundwater. Based on the FS, Baseline Risk Assessment, and Applicable or Relevant and Appropriate Requirements (ARARs), the remedial action objectives (RAOs) listed below were established for the Site. Alternatives were developed with the goal of attaining these objectives:

Groundwater - EPA believes that active remediation of groundwater (such as a groundwater pump and treat system) in the Barnwell formation underlying the Site is a practicable and appropriate response. The Barnwell Formation is classified under the EPA Guidelines for Ground-Water Classification as a Class IIB ground water, ie., a potential source of potable water supply. These ground waters also are classified as Class GB waters of the State. The contamination at the Site has resulted in impairment of the ground-water resource as a potential drinking water source due to unacceptable risks to human health. In addition, the likelihood of a hydraulic connection between the Barnwell Formation and the underlying McBean/Santee Formation exists; the nearby municipal supply well draws water from the McBean/Santee Formation. In order to prevent migration from the existing contaminant plume into the underlying drinking water supply aquifer, ground-water extraction is warranted.

The remedial action objective for contaminated ground water is to restore the affected aquifer to a condition that renders it suitable for use as a potable water supply. Criteria based upon protection of human health via drinking water exposure for site-specific contaminants of concern are listed in Table 6. These criteria constitute the remedial goals for ground water at the Helena Site.

Given the likelihood of a hydraulic connection between the Barnwell and the McBean/Santee formations, and the inconclusive nature of the pump test conducted as part of the RI, EPA anticipates that effective implementation of the ground-water remediation at this Site will include another pump test. The purpose of such a pump test will be to determine the degree of interconnection between the formations mentioned above. The exact means by which this pump test will be conducted will be determined during remedial design activities.

Surface and Subsurface Soils - Soils on the Site, both at the ground surface and at depths grater than one foot, are contaminated at levels which exceed criteria protective of human health under an exposure scenario which assumes unrestricted land use, including residential development, and which exceed concentrations that are likely to continue to leach contaminants to ground water. The overall remedial action objective for the surface and subsurface soils is to remove and remediate contaminated soils to such a degree that both ground-water quality (in conjunction with ground-water extraction and treatment) and human health are protected. The RI identified soil remediation goals for both of these purposes. Table 7 presents a comparison of these remedial goals as developed in the RI. EPA review of the remedial goals developed in the RI for the protection of ground water revealed, however, that the technical basis for these goals was inadequate. EPA therefore conducted an independent analysis of soil contamination levels and has determined that a soil remediation goal of 50 ppm total pesticides is protective of human health and the environment, and will result in the removal of 90% of the total pesticide mass that exists at the site.

The evaluation performed by EPA was based upon contaminant distribution data provided in the RI. EPA used this contaminant distribution data to calculate the contaminant mass associated with the soils at the Site as it is related to contaminant concentrations. Contaminants migrating from a relatively concentrated source area via soils or ground water tend to be logarithmically distributed. By determining the concentration at which the bulk of contaminant mass will be removed and optimizing this concentration with relation to the volume of soil requiring treatment (i.e., by avoiding a situation whereby the law of diminishing returns is created), the appropriate soil remediation goal can be estimated.

The proposed remedial action would then consist of treating the soils by a combination of bioremediation and hydrolytic/photolytic dechlorination (HPD), and replacement of the treated soils in the on-site excavations, followed by covering the backfilled material with one foot of clean soils. The performance standards for treatment of the soils would satisfy the Land Disposal Restrictions (LDRs) found in 40 CFR Part 268, promulgated under the authority of the Resource Conservation and Recovery Act (RCRA). This proposal

is based partly upon the concept that ground-water quality can be protected by treatment of soils in these source areas in combination with extraction and treatment of contaminated ground water. The removal and treatment of soils in the source areas is also protective of human health via direct contact and incidental ingestion.

Wetlands and Contaminated Sediments - The placement of fill material in jurisdictional wetlands, and the contamination of the sediments in the wetlands that resulted from this placement, have resulted in an unacceptable level of risk to environmental receptors. The remedial action objective for the fill and the contaminated sediments is to mitigate for the impacts that have resulted in these unacceptable levels of risk to environmental receptors. Mitigation will comply with the requirements of Section 404 of the Clean Water Act, and specific mitigative measures will be determined in accordance with the criteria and guidelines established under Section 404(b)(1) of that Act. These regulations are relevant and appropriate to the circumstances of the release of contaminants from the landfill placed in jurisdictional wetlands.

The following section provides a summary of the six (6) alternatives developed in the FS Report to address the contamination of soils, sediments and ground water at the Helena Chemical NPL Site. The primary objective of the FS was to determine and evaluate alternatives for the appropriate extent of remedial action to prevent or mitigate the migration or the release or threatened release of hazardous substances from the Site. With the exception of the No-Action alternative, all alternatives include the same provision for extraction, treatment and proper disposal of contaminated ground water. Likewise, all alternatives with the exception of No Action have the same provision for mitigation of the adverse effects associated with pesticide contamination in the wetlands adjacent to the Site. While wetlands mitigation is not discussed in the FS as a component of any of the alternatives, EPA has determined that unacceptable levels of risk to environmental receptors have resulted from the release of site-specific contaminants into jurisdictional wetlands. Mitigation for these releases has been determined to be relevant and appropriate to the circumstances of the release under the criteria for such determinations contained in the NCP. Alternatives 2 through 6 (Alternative 1 being the No-Action alternative) differ only in the technologies to be applied for the remediation of contaminated soils.

The following descriptions of remedial alternatives are summaries of more complete descriptions found in the FS report. The FS report contains a more detailed evaluation of each alternative and is available for review in the Administrative Record for the Site. All costs are based upon capital costs plus the present worth of annual operation and maintenance costs.

7.1 ALTERNATIVE 1 - NO ACTION

By statute, EPA is required to evaluate a "No Action" alternative to serve as a basis against which other alternatives can be compared. Under the No Action Alternative, no remedial response would be performed on any of the media of concern (surface soil, ground water or sediments) at the Site. This alternative does not reduce the risk calculated by the Baseline Risk Assessment. The No Action Alternative results in an excess cancer risk of 8.0×10^{-5} and a Hazard Index for non-carcinogenic effects of 0.3 for current land use exposure scenarios, and an excess cancer risk of 2.6×10^{-4} and a Hazard Index for non-carcinogenic effects of 8.6 for potential future land use scenarios.

The estimated present worth cost for the no-action alternative is $480,000. This cost is for monitoring of ground water and soils for thirty years.

7.2 ALTERNATIVE 2 - DEMOLISH FORMULATION BUILDINGS; CONSOLIDATE CONTAMINATED SOILS AND DEBRIS IN ONSITE LANDFILL; GROUND-WATER EXTRACTION, TREATMENT AND DISPOSAL; AND WETLANDS MITIGATION

All alternatives, excluding No Action, include ground-water containment by means of extraction, treatment and appropriate disposal. The installation of ground-water extraction wells will prevent the migration of contaminants beyond the present extent of the contaminant plume, and will over time remove contaminants from the ground water lying beneath the Site. At present, the extent of contaminated ground water is confined to the shallow aquifer (the Barnwell Formation) and does not appear to extend laterally to off-site areas.

Extracted ground water will be treated to criteria appropriate for the final means of disposal. At present, it is planned that the extracted ground water will be treated and discharged to the local sanitary sewer system, also known as a POTW. Pretreatment requirements will be set by the owner/operator of that sanitary sewer system in order to insure that the discharge permit for the system will not be violated. It is possible, based upon initial estimates of ground-water quality, that no pretreatment will be necessary; for the purposes of preliminary cost estimates, however, it is assumed that some degree of pretreatment for extracted ground water will be required. The actual technologies to be employed will be based upon the pretreatment criteria established by the owner/operator of the POTW.

Extraction of contaminated ground water will continue until the ground-water remediation goals are met throughout the extent of the plume. Should it prove to be technically impracticable to achieve these remedial goals, EPA will amend the ROD to reflect any changes in remediation criteria.

All alternatives, with the exception of No-Action, also include the demolition of on-site buildings as necessary to remove contaminated soil for treatment. Testing of the demolished buildings will be conducted during remedial design in order to determine the appropriate methods of disposal for demolition debris. It is likely that the demolition debris will not be significantly contaminated, so that no special handling will be required, allowing disposal of the demolition debris as non-hazardous solid waste.

All alternatives, with the exception of the No-Action Alternative, also include mitigation for contaminated soils and sediments in the wetland areas adjacent to the Site and downstream can be accomplished in a number of ways under the regulations, guidelines and criteria established under Section 404(b)(1) of the Clean Water Act, which is an ARAR for the remedial action at this Site. The exact form of mitigation that will satisfy the requirements of this ROD will also conform with the Memorandum of Agreement (MOA) between the Corps of Engineers and EPA which took effect on February 7, 1990. This MOA is a criterion "to be considered" in the determination of remedial actions for the Site. Removal of the fill placed in the affected wetlands, accompanied by removal of the contamination that has resulted from transport of toxic materials from that fill, is one potential method. Another would be the restoration of degraded wetlands at some off-site location. Another possibility is the acquisition of unaffected wetlands that are currently threatened by development or other destructive activities and placing those wetland areas in a protected status. A number of factors will be used to determine the most cost-effective and environmentally sound manner in which compliance with the mitigation guidelines will be achieved.

Alternative 2 calls for the demolition of the former formulation buildings on the Site, excavation of contaminated soils and disposal of contaminated soil in an on-site landfill constructed especially for this purpose. All soils exceeding 50 ppm total pesticides would be placed in the landfill. The landfill would be constructed to meet all applicable technical requirements regarding design of such landfills, including top and bottom liners to prevent infiltration of rainfall and also to prevent any further contamination of ground water. Long-term maintenance of the landfill would be required as part of the implementation of this alternative.

The estimated cost for this alternative is $5.5 million.

7.3 ALTERNATIVE 3 - DEMOLISH FORMULATION BUILDINGS, EXCAVATION AND ON-SITE BIOLOGICAL TREATMENT OF CONTAMINATED SOILS, GROUND-WATER EXTRACTION, TREATMENT AND DISPOSAL, AND WETLANDS MITIGATION

The ground water and wetlands portions of this alternative are

identical to those described under Alternative 2. They will consist of ground-water extraction, treatment and disposal (preferably in the local sanitary sewer), and mitigation of wetlands impacts. Demolition of Site buildings will also be as described under Alternative 2.

Under this alternative, contaminated soils containing greater than 50 ppm total pesticides would be treated on-site by means of biological degradation. Biological degradation would take place in treatment cells constructed on-site that would be lined to prevent any leaching of contaminants to ground waters underlying the Site.

Biological treatment cells would consist of lined pits into which the contaminated soils would be placed. Once placed into the cells, moisture content, temperature and nutrient levels would be adjusted and maintained to maximize the rate of biological activity. Both aerobic and anaerobic conditions are envisioned in order to maximize the effect of biological degradation. Anticipated treatment would consist of anaerobic treatment, particularly for soils contaminated with DDT, followed by aerobic treatment. Some of the Site soils may require aerobic treatment alone.

Treatability studies would be conducted to determine if this alternative can achieve the remedial goals, but preliminary data indicate that significant reductions in concentration of many site-specific contaminants can be achieved by biological degradation. Once soils are treated to the remedial goals, they would be replaced in the on-site excavations from which they were removed. The performance standard for treatment would be based upon the LDRs for site-specific contaminants.

The estimated cost for this alternative is $8.0 million

7.4 ALTERNATIVE 4 - DEMOLITION OF FORMULATION BUILDINGS, EXCAVATION AND HYDROLYTIC/PHOTOLYTIC DECHLORINATION OF CONTAMINATED SOILS, GROUND-WATER EXTRACTION, TREATMENT & DISPOSAL, AND WETLANDS MITIGATION

The ground water and wetlands portions of this alternative are identical to those described under Alternative 2. They will consist of ground-water extraction, treatment and disposal (preferably in the local sanitary sewer), and mitigation of wetlands impacts. Demolition of Site buildings will also be as described under Alternative 2.

Under this alternative, contaminated soils containing greater than 50 ppm total pesticides from the Site would be treated by means of hydrolytic/photolytic dechlorination (HPD) of the pesticide contaminants. This process would be implemented at Helena Chemical by mixing contaminated soils with chemical reagents and exposing

them to heat and ultraviolet (UV) radiation. The mixing process is necessary to distribute the reagents (usually hydrated lime, possibly supplemented by sodium hydroxide) throughout the mass of contaminated material. The mixed material/reagent mass is then placed in thin layers in cells similar to those proposed for biological treatment in order for the soils to be exposed to heat and UV energy from the sun. The soil mass would also be kept moist in order to enhance biodegradation of any organic end products resulting from the hydrolytic/photolytic dechlorination process. Soils would be periodically "turned over" to maximize contaminant exposure to UV radiation. The performance standard for the treatment process would be the LDRs for site-specific contaminants.

Treatability studies would also be required to determine if this technology would be capable of achieving the required performance standards.

The estimated cost for this alternative is $7.2 million.

7.5 ALTERNATIVE 5 - DEMOLISH FORMULATION BUILDINGS, EXCAVATION, HYDROLYTIC/PHOTOLYTIC DECHLORINATION AND BIOLOGICAL TREATMENT OF SOILS ON-SITE, GROUND-WATER EXTRACTION, TREATMENT AND DISPOSAL, AND WETLANDS MITIGATION

This is the preferred alternative for remediation of the Helena Site.

The ground water and wetlands portions of this alternative are identical to those described under Alternative 2. They will consist of ground-water extraction, treatment and disposal (preferably in the local sanitary sewer), and mitigation of wetlands impacts. Demolition of Site buildings will also be as described under Alternative 2.

Under this alternative, the two technologies discussed under Alternatives 3 and 4 above would be combined in order to take advantage of the particular benefits of each. Past studies and experience with biological treatment have indicated that biological treatment alone is effective for many of the site-related soil contaminants at Helena (notably DDT and its metabolites). Biological treatment alone, however, is less effective for toxaphene, which is another Site contaminant found in significant concentrations, likewise contributing significantly to the risk associated with Site exposure. HPD, on the other hand, has been shown in pilot-scale studies to be effective in the destruction of toxaphene. The two technologies would be combined in a treatment-train mode, with HPD treatment followed by biological treatment. In addition to biological treatment of site-specific contaminants other than toxaphene, the second step of the treatment train would also serve to further degrade the breakdown products produced by the initial HPD step.

Otherwise, the treatment processes would be as described under Alternatives 3 and 4, above. The soil remediation goal would remain at 50 ppm total pesticides, and the treatment performance standard would be based upon the LDRs for site-specific contaminants. The estimated cost for this alternative is $3.9 million.

7.6 ALTERNATIVE 6 - DEMOLISH FORMULATION BUILDINGS, EXCAVATION AND LOW TEMPERATURE THERMAL DESORPTION OF SOILS ON-SITE, GROUND-WATER EXTRACTION, TREATMENT AND DISPOSAL, AND WETLANDS MITIGATION

The ground water and wetlands portions of this alternative are identical to those described under Alternative 2. They will consist of ground-water extraction, treatment and disposal (preferably in the local sanitary sewer), and mitigation of wetlands impacts. Demolition of Site buildings will also be as described under Alternative 2.

Under this alternative, contaminated soils exceeding 50 ppm total pesticides from the Site would be treated on-site by means of low temperature thermal desorption (LTTD). This process involves processing contaminated soils through a rotary dryer or kiln. The soil mass is heated to a temperature level that is sufficient to drive the contaminants off of the soil matrix, but not high enough to actually incinerate or destroy the contaminants. Soil contaminants are volatilized from the solids and purged from the kiln or dryer by means of an inert purge gas. After the purge gas leaves the desorption unit, it is treated by an off-gas treatment system that prevents the soil contaminants from being released into the environment. Typical air pollution control equipment (such as cyclonic precipitators and baghouses) are also used to protect air quality during operation of desorption units.

LTTD typically concentrates the Site contaminants into a low-volume, highly concentrated waste stream that must in turn be disposed of in a manner that complies with all environmental regulations. This residual waste stream would be disposed of either by incineration or by transport to an approved waste disposal facility.

Numerous vendors for this type of treatment system exist, and EPA has experienced good success with its use on soils contaminated with pesticides at other Superfund sites. Treatability studies would likewise be necessary in order to assess the suitability of this technology for application at the Helena Chemical Site. The performance standard for this treatment system would likewise be the LDRs for site specific contaminants.

The estimated cost for this alternative is $4.4 million.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives for Site remediation were evaluated based on the nine criteria set forth in the NCP (40 CFR § 300.430(e)(9)). In the sections which follow, brief summaries of how the alternatives were judged against these criteria are presented.

8.1 CRITERIA FOR COMPARATIVE ANALYSIS

8.1.1 Threshold Criteria

Two threshold criteria must be achieved by a remedial alternative before it can be selected.

1. Overall protection of human health and the environment addresses whether the alternative will adequately protect human health and the environment from the risks posed by the Site. Included in judgement by this criterion is an assessment of how and whether the risks will be properly eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

2. Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether an alternative will meet all of the requirements of Federal and State environmental laws and regulations, as well as other laws, and/or justifies a waiver from an ARAR. The specific ARARs which will govern the selected remedy are listed and described in Section 9.0, Selected Remedy.

8.1.2 Primary Balancing Criteria

Five criteria were used to weigh the strengths and weaknesses among alternatives, and to develop the decision to select one of the alternatives. Assuming satisfaction of the threshold criteria, these are the main considerations in selecting an alternative as the remedy.

1. Long term effectiveness and permanence refers to the ability of the alternative to maintain reliable protection of human health and the environment over time, once the remediation goals have been met.

2. Reduction of toxicity, mobility, or volume addresses the anticipated performance of the treatment technologies that an alternative may employ. The 1986 amendment to CERCLA, the Superfund Amendments and Reauthorization Act (SARA), directs that, when possible, EPA should choose a treatment process that permanently reduces the level of toxicity of site contaminants, eliminates or reduces their migration away from the site, and/or reduces their volume on a site.

3. Short-term effectiveness refers to the length of time needed to achieve protection, and the potential for adverse effects to human health or the environment posed by implementation of the remedy, until the remediation goals are achieved.

4. Implementability considers the technical and administrative feasibility of an alternative, including the availability of materials and services necessary for implementation.

5. Cost includes both the capital (investment) costs to implement an alternative, plus the long-term O&M expenditures applied over a projected period of operation.

8.1.3 Modifying Criteria

State acceptance and community acceptance are two additional criteria that are considered in selecting a remedy, once public comment has been received on the Proposed Plan.

1. State acceptance: The State of South Carolina concurs with this remedy.

2. Community acceptance was indicated by the verbal comments received at the Helena Chemical NPL Site Proposed Plan public meeting, held on May 27, 1993. The public comment period opened on May 18, 1993, and closed on June 17, 1993.

Written comments received concerning the Helena Chemical NPL Site, and those comments expressed at the public meeting, are addressed in the Responsiveness Summary attached as Appendix A to this ROD.

8.2 COMPARISON OF ALTERNATIVES

All alternatives, except Alternative 1, provide adequate protection of human health and the environment. All alternatives, again with the exception of Alternative 1, achieve all identified ARARs. With respect to short-term effectiveness and implementability, Alternatives 2-6 are all are comparable. Treatment Alternatives 3 through 6 achieve overall protectiveness and risk reduction by permanently treating the waste and using the treated materials to prevent contact with less affected soils beneath the treatment areas. Landfill Alternative 2 achieves similar risk reductions, but does not satisfy the statutory preference for reducing the toxicity and volume of the waste, although the mobility of Site contaminants would be greatly reduced. Therefore, Alternatives 3-6 are preferable to Alternative 2.

Neither Alternative 3 nor Alternative 4 (biological treatment alone or HPD alone) has been shown to be fully effective for the entire range of pesticide contaminants found at the Site. The long-term

effectiveness of Alternatives 3 and 4 is therefore less assured than that for Alternatives 5 and 6. Alternative 6, treatment of soils by LTTD, would make use of a proven treatment technology that could reasonably be expected to achieve the remedial goals specified in this ROD. Preliminary studies regarding the proposed technology described under Alternative 5 (combining biological treatment with HPD) indicate that remedial goals for all Site contaminants are likely to be achievable.

Alternatives 5 and 6, therefore, are those that best meet the statutory preference for permanent solutions that reduce the toxicity, mobility and volume of waste materials while using technologies that can reasonably be expected to achieve the remedial goals determined to be protective of human health and the environment, and to achieve ARARs. They also fulfill the other criteria regarding long- and short-term effectiveness and implementability. The projected cost for Alternative 5 is significantly less than that for Alternative 6. Given that Alternative 5 can be implemented at significantly less cost than could Alternative 6, Alternative 5 is the preferred alternative.

EPA recognizes, however, that the preferred remedy includes a soil treatment technology (HPD/biological treatment) that is an innovative technology that has not been demonstrated capable of achieving performance standards specified in Section 9, below. EPA therefore will retain Alternative 6 as a contingency remedy to be implemented should treatability studies of HPD/biological treatment prove that this technology is incapable of achieving the performance standards for this Site. The only difference between Alternative 5 and Alternative 6 is the soil treatment technology to be employed. Alternative 6 contains low temperature thermal desorption (LTTD) as the soil treatment technology.

9.0 THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, EPA has selected a remedy that includes source control, ground-water remediation, and mitigation for wetlands impacts for this Site. At the completion of this remedy, the residual risk associated with this Site will fall within the acceptable range mandated by CERCLA and the NCP of 10^{-6} to 10^{-4} which is determined to be protective of human health. The unacceptable level of risk posed to environmental receptors will also be adequately addressed. The total present worth cost of the selected remedy, Alternative 5, is estimated at $3.9 million.

9.1 DESCRIPTION OF SELECTED REMEDY

9.1.1. Source Control

Source control will address the contaminated soils and waste materials at the Site. Source control shall include excavation of contaminated soils and waste materials, on-Site treatment by means of combined hydrolytic/photolytic dechlorination (HPD) and biological degradation, and placement of the treated soils and waste materials back into on-Site excavations. The treated soils will then be covered by a minimum of one foot of clean backfill.

The major components of source control to be implemented include:

9.1.1.1. Excavation

Excavation of materials contaminated with greater than 50 ppm of total pesticides at the Site. Excavation will be limited to the uppermost three feet of soils at the Site in order to prevent creation of a preferential flow path for infiltration of rain water into the shallow aquifer.

9.1.1.2. Treatment of Excavated Soils

Treatment of all excavated materials by means of a combination of hydrolytic/photolytic dechlorination and biological degradation.

Contaminated soils and waste materials containing greater than 50 ppm total pesticides from the Site would be treated by means of hydrolytic/photolytic dechlorination (HPD) of the pesticide contaminants. This process would be implemented at Helena Chemical by mixing contaminated soils with chemical reagents and exposing them to heat and ultraviolet (UV) radiation. The mixing process is necessary to distribute the reagents (usually hydrated lime, possibly supplemented by sodium hydroxide) throughout the mass of contaminated material. The mixed material/reagent mass is then placed in thin layers in cells similar to those proposed for biological treatment in order for the soils to be exposed to heat and UV energy from the sun. The soil mass would also be kept moist in order to enhance biodegradation of any organic end products resulting from the hydrolytic/photolytic dechlorination process. Soils would be periodically "turned over" to maximize contaminant exposure to UV radiation.

Contaminated soils containing greater than 50 ppm total pesticides would also be treated on-site by means of biological degradation subsequent to the HPD process steps. Biological degradation would take place in treatment cells constructed on-site that would be lined to prevent any leaching of contaminants to ground waters underlying the Site. Treatability studies would be conducted to determine if this alternative can achieve the remedial goals, but

preliminary data indicate that significant reductions in concentration of many site-specific contaminants can be achieved by biological degradation. Once soils are treated to the remedial goals, they would be replaced in the on-site excavations from which they were removed, and covered by a minimum of one foot of clean fill. The performance standard for the combined treatment process would be based upon the LDRs for site-specific contaminants.

Biological treatment cells would consist of lined pits into which the contaminated soils would be placed. Once placed into the cells, moisture content, temperature and nutrient levels would be adjusted and maintained to maximize the rate of biological activity. Both aerobic and anaerobic conditions are envisioned in order to maximize the effect of biological degradation. Anticipated treatment would consist of anaerobic treatment, particularly for soils contaminated with DDT, followed by aerobic treatment. Some of the Site soils may require aerobic treatment alone.

The final element of the source control portion of the overall remedy will be to grade the Site and construct any structures or appurtenances necessary so that the Site complies with all regulations regarding storm water run off from industrial facilities. This will prevent any further non-point source contribution from future Site activities to contamination in adjacent waters of the United States.

9.1.2. Ground Water Remediation

Groundwater remediation will address the contaminated groundwater at the Site. Groundwater remediation will include extraction of contaminated groundwater, treatment, and discharge to the local Publicly Owned Treatment Works (POTW).

The major components of groundwater remediation to be implemented include:

Extraction from the surficial aquifer by means of pumping wells and treatment by standard treatment technologies generally available to achieve pre-treatment requirements imposed by the POTW; and

Discharge of treated water to the nearest access point into the sanitary sewer collection system serving the local POTW.

The installation of ground-water extraction wells will prevent the migration of contaminants beyond the present extent of the contaminant plume, and will over time remove contaminants from the ground water lying beneath the Site. At present, the extent of contaminated ground water is confined to the shallow aquifer (the Barnwell Formation) and does not appear to extend to any significant degree laterally to off-site areas, although one well

located off the Site property (MW-18) was contaminated during the RI.

Extracted ground water will be treated to criteria appropriate for the final means of disposal. At present, it is planned that the extracted ground water will be treated and discharged to the local sanitary sewer system, also known as a POTW. Pretreatment requirements will be set by the owner/operator of that sanitary sewer system in order to insure that the discharge permit for the system will not be violated. It is possible, based upon initial estimates of ground-water quality, that no pretreatment will be necessary; for the purposes of preliminary cost estimates, however, it is assumed that some degree of pretreatment for extracted ground water will be required. The actual technologies to be employed will be based upon the pretreatment criteria established by the owner/operator of the POTW.

Extraction of contaminated ground water will continue until the ground-water remediation goals are met throughout the extent of the plume. Should it prove to be technically impracticable to achieve these remedial goals, EPA will amend the ROD to reflect any changes in remediation criteria.

9.1.3 Wetlands Mitigation

Mitigation for contaminated soils and sediments in the wetland areas adjacent to the Site and downstream can be accomplished in a number of ways under the regulations, guidelines and criteria established under Section 404(b)(1) of the Clean Water Act, which is an ARAR for the remedial action at this Site. These guidelines and criteria include the MOA between EPA and the Corps of Engineers, effective date February 7, 1990, concerning the determination of mitigation. Removal of the fill placed in the affected wetlands, accompanied by removal of the contamination that has resulted from transport of toxic materials from that fill, is one potential method. Another would be the restoration of degraded wetlands at some off-site location. Another possibility is the acquisition of unaffected wetlands that are currently threatened by development or other destructive activities and placing those wetland areas in a protected status. A number of factors will be used to determine the most cost-effective and environmentally sound manner in which compliance with the mitigation guidelines will be achieved.

The exact form of mitigation for the effects of contaminated sediments will be based in part upon the consideration that, although the sediments are contaminated to a level that is expected to adversely impact flora and fauna normally found in such a habitat, and that therefore pose an unacceptable level of risk to environmental receptors, the habitat function has not been completely destroyed. In addition, other valuable wetland

functions remain intact and could conceivably be physically destroyed by an active removal of contaminated sediments. Physical reconstruction of wetland areas damaged by such physical disruptions is theoretically possible, but EPA's experience with reconstructed wetlands as part of regulatory actions taken under the authority of Section 404 of the Clean Water Act has been that limited success can be expected from such projects. Also, reasonable estimates of the time required to achieve full restoration of the existing wetlands under this approach may be similar to that required for natural attenuation and biodegradation of site-related contamination to insignificant concentrations. Finally, it is possible that other sources of pesticide contamination exist that will not be addressed as part of the remedy for the Helena Chemical Site, since those sources are not related to the Site or activities that took place at the Site. Even should a successful reconstruction of contaminated wetlands be achieved, it is possible that these other sources would re-contaminate the wetland areas adjacent to the Helena Site, rendering the reconstruction ineffective in the long term.

Executive Order 11990, and regulations related to that Order found at 40 CFR Part 6, will also be considered in determining the most effective means by which the mitigation will be accomplished. These regulations require EPA to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists. Mitigative measures consistent with these requirements will therefore be given preference in determining specific actions to be required as part of the remedial action.

By insuring that adequate habitat for indigenous species potentially found in the wetlands associated with the Site will be made available by the mitigative measures proposed, the adverse impacts to the habitat function of the Helena wetlands can be remedied. While individuals of these species may under some mitigative options continue to be impacted by toxic effects of contaminants in the sediments at the Site, the viability of the various species populations in the area will be protected and enhanced by the long-term stability and availability of suitable habitat provided for by mitigation as part of the remedy.

9.1.4. Compliance Testing

Monitoring of groundwater (both in situ and after extraction and treatment), excavated soils, and treated soils shall be conducted as part of this remedial action. After demonstration of compliance with Performance Standards, Site ground water shall be monitored for five years. If monitoring indicates that the Performance Standards set forth below are being exceeded at any time after pumping has been discontinued, extraction and treatment of the

ground water will recommence until the Performance Standards are once again achieved.

Compliance testing of the residual soils that have been subjected to treatment will also be performed, to insure compliance with the LDR requirements established as performance standards for the soil treatment technology.

9.1.5 Contingency Remedy

Should treatability studies demonstrate that the selected remedy described above, HPD/biological treatment, cannot achieve performance standards established for the Site, the treatment technology used for soil remediation at the Site will be low temperature thermal desorption (LTTD) in lieu of HPD/biological treatment. LTTD has been successfully used at other NPL sites with similar soil contaminants and levels of contamination, and therefore can be expected to satisfactorily achieve performance standards at this Site.

Using this technology, contaminated soils exceeding 50 ppm total pesticides from the Site would be treated on-site by means of low temperature thermal desorption (LTTD). This process involves processing contaminated soils through a rotary dryer or kiln. The soil mass is heated to a temperature level that is sufficient to drive the contaminants off of the soil matrix, but not high enough to actually incinerate or destroy the contaminants. Soil contaminants are volatilized from the solids and purged from the kiln or dryer by means of an inert purge gas. After the purge gas leaves the desorption unit, it is treated by an off-gas treatment system that prevents the soil contaminants from being released into the environment. Typical air pollution control equipment (such as cyclonic precipitators and baghouses) are also used to protect air quality during operation of desorption units.

Numerous vendors for this type of treatment system exist, and EPA has experienced good success with its use on soils contaminated with pesticides at other Superfund sites. Treatability studies would likewise be necessary in order to assess the suitability of this technology for application at the Helena Chemical Site. The performance standard for this treatment system would likewise be the LDRs for site specific contaminants.

9.2. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

9.2.1. Applicable Requirements

The remedy will comply with all applicable portions of the following Federal and State regulations:

40 CFR Part 6, Subpart C, promulgated under the authority of the National Environmental Policy Act. Specifically:

Section 6.302(a), governing protection of wetlands, including referenced Appendix A to 40 CFR Part 6. These regulations incorporate Federal Executive Order 11990 into Federal regulation.

40 CFR Part 122, promulgated under the authority of the Clean Water Act. Specifically:

Section 122.26, governing storm water discharges from industrial sites.

Section 122.50, governing discharges to publicly owned treatment works (POTWs).

40 Part 136, promulgated under the authority of the Clean Water Act. These regulations govern the water quality testing of discharges associated with NPDES-related activities. For this Site they are applicable to testing of waters discharged to a POTW and to the testing of storm water discharges.

South Carolina Code of Regulations (SCCR) Chapter 61-72, governing the discharge of storm waters from industrial sites. Specifically:

Section 72.307, containing design criteria for storm water discharge facilities.

SCCR Chapter 61-69, governing ambient water quality standards for surface and ground waters. Specifically:

Section 61-68(C), establishing applicability of state water quality standards.

Section 61-68(E), establishing minimum criteria for all state waters.

Section 61-68(F), establishing ambient standards for surface waters.

Section 61-68(G), establishing ambient standards for ground waters.

9.2.2. Relevant and Appropriate Requirements

40 CFR Part 141, promulgated under the authority of the Safe Drinking Water Act. Specifically:

Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) promulgated under the authority of the

Safe Drinking Water Act are specifically identified in the National Contingency Plan (NCP) as remedial action objectives for ground waters that are current or potential sources of drinking water supply. The ground waters underlying this Site are classified as Class IIA ground waters under the EPA Guidelines for Ground-Water Classification. Ground-water extraction and treatment is included in this remedy in order to satisfy EPA's stated goal of returning usable ground waters to their beneficial uses within a reasonable time frame (see FR Vol. 53, no. 245, p 51433, and Section 300.430(a)(1)(ii)(F) of the NCP). MCLs and MCLGs are therefore relative and appropriate for use as remedial action objectives for the remedial action at this Site.

Maximum Contaminant Level Goals (MCLGs) are found in 40 CFR Part 141, Subpart F.

Maximum Contaminant Levels (MCLs) are found in 40 CFR Part 141, Subparts B and G.

40 CFR Part 230, Subparts B and H, promulgated under the authority of the Clean Water Act. These regulations govern the mitigation of impacts to jurisdictional wetlands associated with the placement of fill material in waters of the United States and any secondary adverse impacts resulting from that placement.

Since the solid waste on-Site is not hazardous waste, but contains hazardous constituents, the following regulations established under the authority of RCRA are relevant and appropriate to the circumstances of the release, but are not directly applicable. This includes regulations found at 40 CFR Parts 261-268 cited below.

40 CFR Part 261, Subpart B. These regulations establish methods for the testing of hazardous materials at RCRA-regulated facilities. They will be used to guide testing procedures established as part of the compliance monitoring portion of this remedy.

40 CFR Part 264, Subpart B, established under the authority of RCRA. Specifically:

Section 264.14, establishing criteria for Site security.

Section 264.15, establishing criteria for inspection of the Site by the owner/operator.

Section 264.16, establishing criteria for training of personnel who will be involved in Site remediation.

40 CFR Part 264, Subpart D, which requires the development of a contingency and emergency procedures plan for the Site.

40 CFR Part 264, Subpart F, which governs releases from solid waste management units. Specifically:

Section 264.95, which requires the establishment of a point of compliance for ground-water protection standards. The performance standards established in this ROD for ground-water remediation will serve as the ground-water protection standards. A point of compliance will be established at the downgradient boundary of the final disposal site for treated soils and waste materials.

Section 264.97, which establishes requirements for a ground-water monitoring program. These requirements will be used to establish a ground-water monitoring program for the purpose of evaluating releases from the final disposal site for treated soils and waste materials.

Section 264.98, which established requirements for a detection monitoring program. This detection monitoring program will be used to evaluate potential releases from the final disposal site for treated soils and waste materials.

40 CFR Part 264, Subpart G, which governs closure of solid waste management units. Specifically:

Section 264.111, which sets forth closure performance standards.

Section 264.112, which requires the submission of a closure plan for review and approval.

40 CFR Part 268, Subpart D, which establishes treatment standards which must be achieved prior to land disposal of hazardous wastes. These regulations will establish the performance standards for treatment of contaminated soil and waste materials excavated from the Site.

Federal Ambient Water Quality Criteria (AWQC) established under the authority of Section 304(a) of the Clean Water Act.

These criteria are specifically identified in Section 121(d)(2)(A) of CERCLA as amended by SARA to be ARARs for CERCLA remedial actions. AWQC are developed as guidance for the States to develop ambient surface water quality standards that will be fully protective of human health and the environment. As such, AWQC are relevant and appropriate to the selected remedial action. Discharge of the treated effluent from this site must not result in ambient surface water concentrations that exceed chemical-specific AWQC.

SCCR Chapter 61-79, which contain the State of South Carolina regulations governing the management, treatment, storage and

disposal of hazardous wastes. These regulations are, in a manner analogous to Federal RCRA regulations, relevant and appropriate to the circumstances of the releases from this Site without being directly applicable. In addition, since the South Carolina regulations simply incorporate verbatim the Federal RCRA regulations, the sections of SCCR Chapter 61-79 corresponding to the Federal RCRA sections cited above are hereby incorporated into this ROD as relevant and appropriate requirements.

9.2.3 Criteria "To Be Considered"

CERCLA guidance recommends the identification of criteria that may be relevant and appropriate to the circumstances of the release at a site, but which do not meet the statutory definition of an ARAR. To be defined as an ARAR, a standard or criterion must be a requirement or regulation promulgated under Federal or state authority, and must be of general applicability. Other standards or criteria, known as criteria to be considered or TBCs, may be necessary in order for the remedy to be fully protective of human health and the environment. These TBCs may include EPA reference doses, cancer potency factors, drinking water health advisories or other health-based criteria.

A number of TBC criteria have been identified for ground-water remediation at the Helena Chemical NPL Site. They are based upon protection of human health via drinking water exposure, using data contained in EPA data bases regarding toxicity and/or carcinogenicity of these compounds, and also using standard assumptions regarding intake and exposure via drinking water.

The following TBC criteria have been developed based upon an incremental carcinogenic risk of 1 X 10^{-6}:

Aldrin	0.002 parts per billion (ppb)
alpha-BHC	0.006 ppb
beta-BHC	0.020 ppb
delta-BHC	0.006 ppb
Dieldrin	0.002 ppb
DDT	0.100 ppb
DDD	0.100 ppb
DDE	0.100 ppb

The following TBC criteria are based upon non-carcinogenic toxicity (hazard index less than 1):

Disulfoton	1.400 ppb
Endrin Ketone	2.000 ppb
Lead	15.000 ppb

In addition, the Memorandum of Agreement between EPA and the U.S. Army Corps of Engineers concerning the determination of mitigation

under the Clean Water Act Section 404(b)(1) guidelines ia also a TBC criterion for remedial actions related to wetlands mitigation at this Site.

9.3. PERFORMANCE STANDARDS

The Performance Standards for this component of the selected remedy include the following:

9.3.1. Excavation Standards

Excavation shall continue until the remaining soil and materials are contaminated at a concentration of no more than 50 parts per million (ppm) total pesticides. Total pesticides shall be determined by summing the concentrations of all pesticides found in any soil sample analyzed for the pesticides fraction of the Hazardous Substances List (HSL). Testing methods approved by EPA shall be used to determine if the allowable pesticide concentration levels have been achieved.

9.3.2. Treatment Standards

Since the remedy also specifies land disposal of the treated waste, the LDR-based ARARs are also performance standards for the residue left after treatment of the soils and waste. These performance standards are found in 40 CFR Part 268, Subpart D, Section 268.43. They are:

From Table CCW[1]:

Aldrin	66 parts per billion (ppb)
BHC, all isomers, total	660 ppb
Chlordane, total	130 ppb
Dieldrin	130 ppb
Disulfoton	100 ppb
DDT, DDE, DDD, total	87 ppb
Endrin	130 ppb
Endosulfan, all isomers, total	66 ppb
Endosulfan sulfate	130 ppb
Heptachlor	66 ppb
Heptachlor epoxide	66 ppb
Methoxychlor	180 ppb
Toxaphene	1300 ppb

Note 1: Compliance to be determined by grab samples of treatment residue.

9.3.3. Ground-Water Remediation Standards

Groundwater shall be extracted until the following Maximum Concentration Levels (MCLs) are attained at the wells designated during remedial design by EPA as compliance points.

Aldrin	0.002	parts per billion (ppb)
Benzene	5.0	ppb
alpha-BHC	0.006	ppb
beta-BHC	0.02	ppb
delta-BHC	0.006	ppb
Chlordane	2.0	ppb
Chromium	100.0	ppb
Dieldrin	0.002	ppb
DDT	0.1	ppb
DDD	0.1	ppb
DDE	0.1	ppb
Endrin	2.0	ppb
Lead	15.0	ppb
Lindane	0.2	ppb
Toxaphene	3.0	ppb
Heptachlor	0.4	ppb

9.3.4 Storm Water Discharges

Final Site grading and drainage shall comply with the substantive design criteria contained in SCCR Chapter 61-72, Section 72.307.

9.3.5 Wetlands Mitigation

Wetlands mitigation actions taken as part of this remedy shall comply with the substantive requirements of 40 CFR Part 230, Subparts B and H, promulgated under the authority of the Clean Water Act. These regulations govern the mitigation of impacts to jurisdictional wetlands associated with the placement of fill material in waters of the United States and any secondary adverse impacts resulting from that placement. Quantitative performance standards shall be established as part of remedial design activities.

Mitigation activities shall also comply with the requirements of 40 CFR Part 6, Subpart C, promulgated under the authority of the National Environmental Policy Act. Specifically:

> Section 6.302(a), governing protection of wetlands, including referenced Appendix A to 40 CFR Part 6. These regulations incorporate Federal Executive Order 11990 into Federal regulation.

10.0 STATUTORY DETERMINATIONS

The selected remedy for this Site meets the statutory requirements set forth at Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1). This section states that the remedy must protect human health and the environment; meet ARARs (unless waived); be cost-effective; use permanent solutions, and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and finally, wherever feasible, employ treatment to reduce the toxicity, mobility or volume of the contaminants. The following sections discuss how the remedy fulfills these requirements.

Protection of human health and the environment: The selected soil remedy will remove the human health risks from dermal contact and incidental ingestion of contaminated Site soils. The groundwater remediation system will extract and treat contaminated groundwater, thereby reducing and eventually removing the future risks to human health which could result from ingestion of or contact with groundwater, and the environmental risks which could result from continued discharge of contaminants to adjacent jurisdictional waters.

In addition, the remedy selected to address the contamination of surface waters and sediments in the on-Site and adjacent wetlands (mitigation as per CWA Section 404 guidelines) will be protective of the environment.

Compliance with ARARs: The selected remedy will meet ARARs, which are listed in Section 9.2 of this ROD.

Cost effectiveness: The selected soil remedy component is the most cost effective of the alternatives considered. Among the alternatives that are protective of human health and the environment and comply with all ARARs, the selected alternative is the most cost-effective choice because it uses a treatment method for which costs can be reliably predicted and because the use of the POTW option is the most cost-effective means to dispose of the treated groundwater.

Utilization of permanent solutions, and alternative treatment technologies or resource recovery technologies to the maximum extent practicable: The selected remedy represents the maximum extent to which permanent solutions and treatment can practicably be used for this action. All of the selected remedy components are considered permanent solutions.

Among the alternatives that are protective of human health and the environment and comply with all ARARs, EPA and the State of South Carolina have determined that the selected remedy achieves the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction of toxicity/mobility/volume, short-term

effectiveness, implementability, and cost. The selected groundwater action is more readily implementable than the other alternatives considered, and utilizes the most cost-effective option for disposal of treated water. The selected soil remedial action achieves the best compliance with the five balancing criteria described in the NCP.

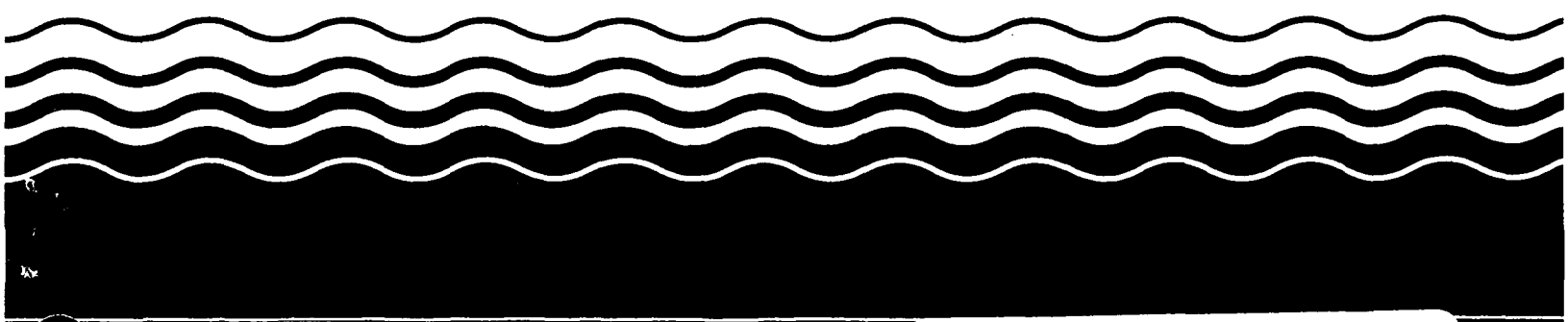
Preference for treatment as a principal remedy element: The proposed groundwater remediation system will fulfill the preference for treatment as a principal element, through extraction and treatment of contaminated groundwater until the remedial goals are achieved.

The soil remedial action will also satisfy the preference, due to the treatment of soils by the selected technology, HPD/biodegradation. Likewise, the contingency remedy fully satisfies this preference.

PB94-964070
EPA/ROD/R04-93/144
February 1995

EPA Superfund Record of Decision:

Hercules 009 Landfill Site, (O.U. 1) Brunswick, GA 3/25/1993



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REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R04-93/144	2.	3. Recipient's Accession No.

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SUPERFUND RECORD OF DECISION
Hercules 009 Landfill, GA
Second Remedial Action - Final

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PB94-964070

16. Abstract (Limit: 200 words)

The 16.5-acre Hercules 009 Landfill site is an inactive industrial landfill located in Brunswick, Glynn County, Georgia. Land use in the area is predominantly commercial and residential, with a shopping mall, bank, and restaurant located approximately 1,000 feet north of the site. From 1948 to 1980, Hercules manufactured toxaphene, an agricultural pesticide used to control boll weevils, ticks, and mites on cattle. Under a State permit, Hercules used seven acres at the northern end of the site, known as the 009 landfill, to dispose of approximately 33,000 yd^3 of wastewater sludge from the production of toxaphene, empty toxaphene product drums, and toxaphene-contaminated glassware, rubble, and trash. The landfill was constructed as six cells, which reportedly were lined with a soil bentonite clay mixture across the bottom and along the bermed walls. The thickness of the toxaphene sludge disposed of in these cells was reported to be six to seven feet. Typically, the wastewater sludge was disposed of directly in the landfill; however, occasionally it was staged near the southeast corner of the landfill prior to disposal. In 1980, as a result of a State investigation which revealed toxaphene in soil and water samples from the drainage ditches around the site, Hercules' permit was canceled, and the State ordered the landfill to be closed. In

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Hercules 009 Landfill, GA
Second Remedial Action - Final
Contaminated Media: soil, sludge, gw, sw
Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (dioxin, pesticides), metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 72
	20. Security Class (This Page) None	22. Price

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Second Remedial Action - Final

Abstract (Continued)

1982, EPA banned the use of toxaphene and site operations ceased. A 1991 ROD addressed an interim action for ground water by extending the existing municipal water lines, as OU2. This ROD provides a final remedy for the site and addresses contaminated soil, debris, sludge, ground water, and surface water, as OU1. The primary contaminants of concern affecting the soil, sludge, ground water, and surface water are VOCs, including benzene, TCE, toluene, and xylenes; other organics, including dioxin and pesticides; and metals, including arsenic, chromium, and lead.

The selected remedial action for this site includes conducting a field-scale treatability study; excavating and transporting the subsurface soil, sludge, and related material in the staging area with levels exceeding 76 mg/kg of toxaphene, and the surface soil in the staging area with levels exceeding 0.25 mg/kg of toxaphene to the landfill area; treating the consolidated surface soil, subsurface soil, and sludge using in-situ stabilization as an innovative application to treat organics; covering treated soil and sludge using a clay multi-media cover; backfilling excavated areas with two feet of clean native fill; providing for a contingency remedy to treat the soil and sludge by dewatering the soil and sludge, onsite ex-situ chemical extraction, with onsite disposal of the treated material, based on the results of a treatability study; monitoring ground water, surface water, sediment, and air; providing for a contingency remedy to extract and treat contaminated ground water onsite using granular activated carbon or another treatment, followed by onsite or offsite discharge to a POTW, and offsite disposal of the spent granular activated carbon, if toxaphene or other chemicals are shown to be migrating offsite or from their current positions, or contaminants of concern begin to increase over 50% of their current value, or it does not seem feasible that the ground water will naturally attenuate over time; operating and maintaining the cover for a minimum of 30 years and possibly abandoning onsite private wells; and implementing institutional controls, including deed restrictions. The estimated present worth cost for this remedial action is $9,900,000, which includes an estimated annual O&M cost of $104,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific soil excavation goals are based on attaining the baseline risk equal to or less than $1x10^{-6}$ for toxaphene, and include surface soil 0.25 mg/kg and subsurface soil 76 mg/kg. Chemical-specific surface soil goals are based on the risk assessment of $1x10^{-6}$ for future land use, and include alpha-BHC 0.044 mg/kg; arsenic 5 mg/kg; acetone 360 mg/kg; benzene 10 mg/kg; beryllium 0.15 mg/kg; bis (2-ethylhexyl) phthalate 20 mg/kg; cadmium 41 mg/kg; carbon tetrachloride 2.1 mg/kg; chlorobenzene 720 mg/kg; chloroform 45 mg/kg; chromium (III) 56 mg/kg; copper 3,300 mg/kg; dioxin/furans (TEF) 0.001 mg/kg; Endosulfan II 1.8 mg/kg; ethylbenzene 3,600 mg/kg; lead 500 mg/kg; manganese 4,900 mg/kg; mercury 26 mg/kg; methylene chloride 37 mg/kg; nickel 310 mg/kg; toluene 7,200 mg/kg; TCE 25 mg/kg; toxaphene 0.25 mg/kg; vanadium 600 mg/kg; xylenes 70,000 mg/kg; and zinc 17,000 mg/kg. Chemical-specific subsurface soil goals are based on the risk assessment of $1x10^{-6}$ for future land use, and include acetone 1 mg/kg; alpha-BHC 0.01 mg/kg; arsenic 3,400 mg/kg; benzene 0.06 mg/kg; beryllium 61 mg/kg; bis (2-Ethylhexyl) phthalate 46 mg/kg; cadmium 11,000 mg/kg; carbon tetrachloride 0.07 mg/kg; chlorobenzene 1.7 mg/kg; chloroform 0.4 mg/kg; chromium (III) 1,000,000 mg/kg; copper 420,000 mg/kg; dioxin/furans (TEF) 0.14 mg/kg; Endosulfan II 0.29 mg/kg; ethylbenzene 13 mg/kg; lead 500 mg/kg; manganese 1,000,000 mg/kg; mercury 3,400 mg/kg; methylene chloride 0.03 mg/kg; nickel 220,000 mg/kg; TCE 0.08 mg/kg; toluene 30 mg/kg; toxaphene 76 mg/kg; vanadium 79,000 mg/kg; xylenes 80 mg/kg; and zinc 1,000,000 mg/kg. Chemical-specific ground water goals for natural attenuation are based on SDWA MCLs, and include benzene 0.005 mg/l; cadmium 0.005 mg/l; chromium 0.1 mg/l; manganese 0.05 mg/l; nickel 0.1 mg/l; toluene 1 mg/l; toxaphene 0.003 mg/l; and xylenes 10 mg/l.

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

HERCULES 009 LANDFILL SITE

OPERABLE UNIT ONE

BRUNSWICK, GLYNN COUNTY, GEORGIA

PREPARED BY

U. S. ENVIRONMENTAL PROTECTION AGENCY

REGION IV

ATLANTA, GEORGIA

DECLARATION
of the
RECORD OF DECISION
OPERABLE UNIT ONE

SITE NAME AND LOCATION

Hercules 009 Landfill Site
Brunswick, Glynn County, Georgia

STATEMENT OF BASIS AND PURPOSE

This decision document (Record of Decision), presents the selected remedial action for Operable Unit One for the Hercules 009 Landfill Site, Brunswick, Georgia, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) 42 U.S.C. Section 9601 et seq., and to the extent practicable, the National Contingency Plan (NCP) 40 CFR Part 300.

This decision is based on the administrative record for the Hercules 009 Landfill site ("the Site").

The State of Georgia has concurred with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the Hercules site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare or the environment.

DESCRIPTION OF SELECTED REMEDY

This operable unit is one of two for this Site. This alternative calls for the design and implementation of response measures which will protect human health and the environment. Operable unit one, which is enumerated by this Record of Decision, addresses the source areas, surface water, and groundwater at the Site. Operable unit two was enumerated in an Interim Action ROD that was signed by EPA on June 27, 1991. Operable unit two addressed the off-site threat of future groundwater contamination by extending the existing municipal water lines in the City of Brunswick, Georgia to residents that live adjacent to this Site.

The major components of the selected remedy for operable unit one include:

- Conducting a field-scale treatability study and implementation of

in-situ stabilization of subsurface soils and consolidated surface soils. This remedy is an innovative application of this technology since EPA has minimal information on stabilization of manufactured pesticides;

- Implementation of an *ex-situ* chemical extraction technology on the soils and sludges at the Site (with onsite disposal of the treated material) in the event the treatability study concerning the stabilization of Site soils and sludges fails to met the required standards and therefore will not be effective if implemented;

- Construction of a cover over the treated soils to reduce rainwater infiltration and direct contact with the treated soil. In addition, areas excavated for consolidation of surface soil would be graded and covered with two feet of clean, compacted, native fill;

- Long-term monitoring of groundwater, as well as surface water and sediment in the onsite pond and the adjacent drainage ditch, with the contingency implementation of a pump and treat system in case any of the following occurs: toxaphene begins to migrate off the Hercules property; if the other contaminants of concern are shown to be migrating from their current positions; if any levels of the contaminants of concern begin to increase over fifty percent of their current value; or in case it becomes apparent that onsite levels of contaminants in the groundwater will not naturally attenuate below MCLs over time;

- Operation and maintenance of the cover for a minimum of thirty years; and

- Institutional controls for land use and groundwater use restrictions.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy satisfies the preference for treatment that reduces toxicity, mobility, or volume as a principal element. Finally, it is determined that this remedy utilizes a permanent solution and alternative treatment technology to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Patrick M Tobin

PATRICK M. TOBIN, ACTING REGIONAL ADMINISTRATOR

3-25-93

DATE

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Decision Summary
Record of Decision
Operable Unit One

Hercules 009 Landfill Site
Brunswick, Georgia

1.0 SITE LOCATION AND DESCRIPTION

The Site is located in the eastern portion of Glynn County, Georgia, approximately two miles south of Interstate 95 and one-half mile north of the City of Brunswick as shown on Figure 1-1. Figure 1-2 is a map of the Site. The Site is a 16.5 acre property that is bordered by Georgia State Highway 25 (Spur 25) on the west; an automobile dealership on the north; a juvenile slash pine forest on the east; and several homes, a church, a school, and a strip shopping center to the south/southeast of the property. A shopping mall, built in 1985, a bank, and a restaurant are located approximately 1,000 feet north of the landfill. The property is fenced and has only one entrance through a locked gate.

Seven acres on the north end of the property were operated as an industrial landfill by Hercules between 1976 and 1980 under a permit by the Georgia Environmental Protection Division (GaEPD). The permit allowed for the disposal of wastewater sludge generated from the production of toxaphene at the Hercules Brunswick Plant. Six disposal cells were constructed at the northern end of the property to receive sludge for disposal. During its years of operation, the 009 Landfill was monitored by the GaEPD.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

Hercules began manufacturing toxaphene, an agricultural pesticide, in 1948 and continued production through 1980. Toxaphene received widespread use in the southeastern United States to control boll weevils as well as mites and ticks on cattle, until EPA banned its use in 1982. The Site had been used by the State as a borrow pit for soil during the construction of Spur 25. Hercules was issued a permit in 1975 by the GaEPD to use seven acres at the northern end of the property as a landfill to dispose of wastewater sludge generated during the manufacturing processes.

The 009 Landfill was constructed at the northern end of the property as six cells, each approximately 100 to 200 feet wide (north-south direction) and 400 feet long (west-east direction). The thickness of the toxaphene sludge in the cells was reported to be six to seven feet. Individual cells were reported to be lined with a

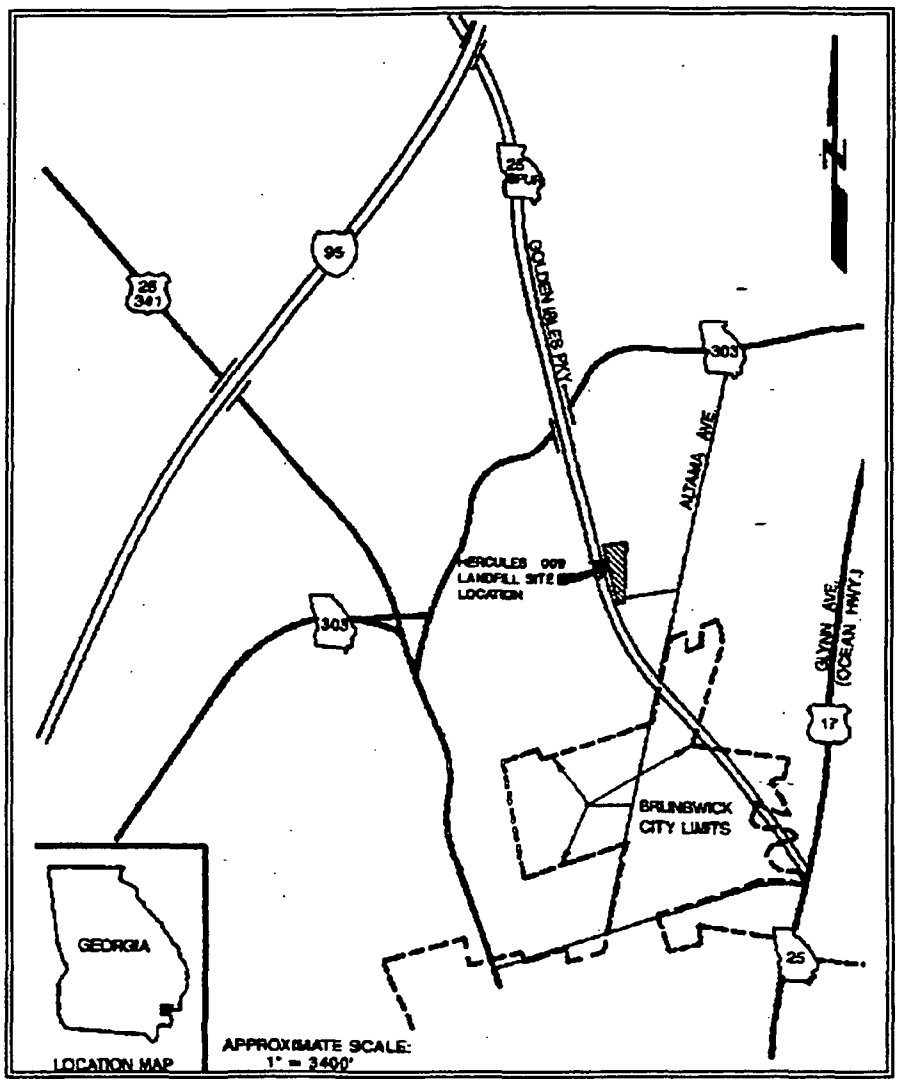

Figure 1-1
Area Map for Brunswick, Georgia

soil/bentonite clay mixture across the bottom of the cell and along the bermed walls.

The sludge deposited in the 009 Landfill consisted of very fine calcareous particulate, diatomaceous earths and finely crushed limestone material. Toxaphene adsorbed to this material during neutralization of by-product hydrochloric acid. Reportedly, the wastewater treatment sludge consisted of about one percent toxaphene by weight and 50 percent solids by weight. The sludge was transported to the landfill in bulk by truck. Trucks hauling material to the Site reportedly entered the landfill through two entrances, one from Benedict Road (south side), the other located along Spur 25 (west side). Typically the sludge was placed directly into the landfill. However, sludge was occasionally staged near the southeastern corner

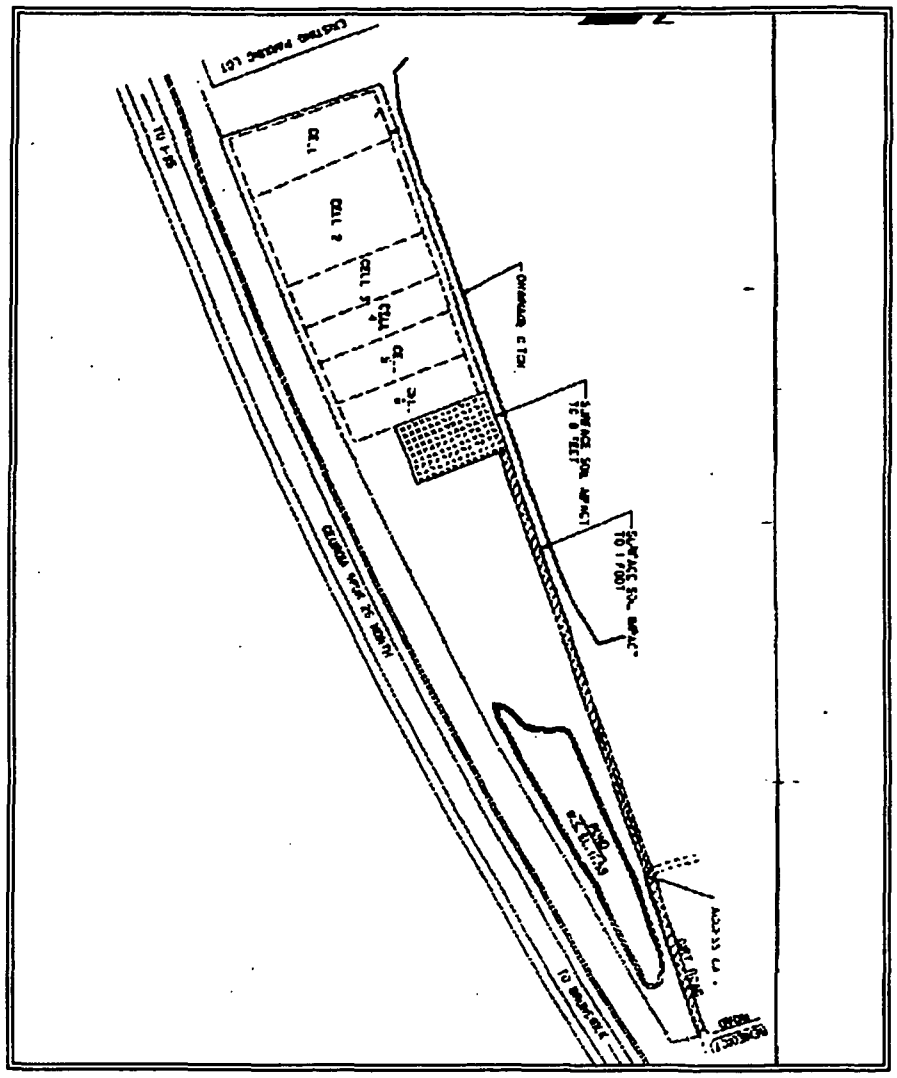

Figure 1-2
Site Map for the Hercules 009
Landfill Site

of the 009 Landfill prior to placement.

In addition to the sludge, the 009 Landfill was also used for disposal of empty toxaphene product drums, and toxaphene contaminated glassware, rubble, and trash. Disposal of this material was primarily limited to Cell 1. Hercules estimated that approximately 33,000 cubic yards of sludge had been disposed of in the landfill. The cells were covered with a 24 to 30 inches of "stump dirt" mixed with boiler ash. The term "stump dirt" refers to soil that was entrained on pine stumps purchased by the Hercules Brunswick Plant for the extraction of resins and essential oils.

All cells in the landfill were closed prior to 1983 in accordance with existing GaEPD Solid Waste Management Regulations. The final contour of the top of the landfill has a slope of approximately one percent to prevent pooling and to minimize infiltration of precipitation. The sides of the unit have a slope of about ten percent. To control erosion, the earthen cover was seeded with grasses that have proven to grow well in the Brunswick area.

A drainage ditch is located adjacent to the landfill at the eastern edge. To control surface runoff from the surrounding area, Glynn County periodically excavates the sediments from this ditch to ensure adequate drainage capacity. Prior to 1988, sediments from the ditch were stockpiled on the eastern bank of the ditch, but in early 1988, these sediments were removed.

During its operation, the landfill was inspected by GaEPD. In March 1980, GaEPD collected soil and water samples from drainage ditches around the Site. The samples contained toxaphene. As a result, GaEPD canceled Hercules' permit and the 009 Landfill was closed under a plan approved by GaEPD.

EPA calculated a Hazard Ranking Score for the closed landfill. In 1984, the landfill was placed on the National Priority List (NPL). As of July 1, 1991, the Hercules 009 Landfill Site ranked 152 out of 1072 on the NPL (excluding federal facilities). GaEPD began negotiations with Hercules to perform an RI/FS and initiated Site investigation activities under State Superfund authority, then withdrew as lead agency in 1987. EPA assumed primary control of the Site investigation and related activities at the end of 1987. Hercules and EPA entered into an Administrative Order on Consent in July 1988. The Consent Order required Hercules to perform a Remedial Investigation /Feasibility Study (RI/FS) of the Site.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The main branch of the Brunswick-Glynn Regional Library at 208 Gloucester Street in Brunswick, Georgia was chosen as the local information repository for the Site. A public comment period for the proposed plan for operable unit #2 (concerning extension of the municipal water lines) was held from May 13, 1991 to June 12, 1991 with a public meeting being held on May 15, 1991.

The public comment period on the proposed plan preceding this ROD (operable unit #1) was held August 27, 1992 through October 27, 1992. A public meeting was held on Thursday, September 10, 1992 where representatives from EPA answered questions from approximately 150 people regarding the Site and the proposed plan under consideration. The administrative record was available to the public at both the information repository maintained at the Brunswick-Glynn Regional Library and at the EPA Region IV Library at 345 Courtland Street in Atlanta, Georgia. The notice of availability of these documents was

published in the Brunswick News-Herald on August 24, and September 4, 1992. EPA received numerous oral and written comments during the comment period. Responses to the significant comments received are included in the Responsiveness Summary, which is part of this ROD and designated Appendix A.

This decision document presents the selected remedial action for operable unit one of the Hercules site, chosen in accordance with CERCLA, as amended by SARA and to the extent practicable, the NCP. The decision for this Site is based on the administrative record. The requirements under Section 117 of CERCLA/SARA for public and state participation have been met for this operable unit.

4.0 SCOPE AND ROLE OF OPERABLE UNITS

EPA has organized the work at this Superfund Site into two operable units (OUs). These units are:

- OU one: The source area at the Site, including the landfilled sludge, the soils in the sludge-staging area, and the Benedict Road/Nix Lane area. Contamination in the groundwater, surface water, sediment, and soils are addressed in OU #1. Proper abandonment of the private wells replaced during OU #2 is included in OU #1 if the owners will allow abandonment.

- OU two: The extension of municipal water lines to residents adjacent to the Site was specified in OU #2 to address the threat of a groundwater plume that could affect residential drinking wells downgradient of the Site.

OU #1 addresses both the source of contamination in the soils as well as the groundwater contamination underneath the Site. The purpose of this operable unit is to monitor groundwater restoration, treat the source areas at the Site, prevent current or future exposure to the contaminated soils and groundwater, and reduce contaminant migration. OU #1 will be consistent with the actions taken during OU #2, to the extent practicable. The Record of Decision (ROD) governing OU #2 dated June 27, 1991 erroneously was titled OU #1. However, the ROD dated June 27, 1991 documents the remedial action selection for OU #2. This ROD documents the remedial action selection for OU #1.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 GEOLOGY/SOILS

The results of the RI led to the following findings and conclusions:

- The Site lies in the Atlantic Coastal Plain province of Georgia. Surface sediments are described as relatively thin layers of sands, gravels, and clays of Pleistocene age. These sediments, generally less than 150 feet thick, represent the surficial layer.

Beneath the surficial layer are Miocene sediments which are represented by the Hawthorn formation. The Hawthorne contains several clay units and is a confining zone between the surficial water-bearing unit and the deeper Floridan aquifer. The Floridan aquifer, at an approximate depth of 500 feet, is separated from the surficial water-bearing unit by approximately 400 feet of the Miocene sediments. The Floridan aquifer is the primary aquifer in the area for large irrigation and municipal supplies, while shallower wells are used for small domestic supplies.

- Soils at the Site consist of coarse to clayey sands, sandy silts, and sandy to silty clays. The soils can be grouped into three distinct hydrogeologic components. From land surface to depths of 25 to 45 feet below land surface is a zone composed of silty sands and sandy silts. Underlying this zone is a clayey sand and sandy clay interval ranging in thickness from 10 to 25 feet. The clayey interval may possibly act as a semi-confining unit within the surficial layer dividing the silts and sands into shallow and deep zones beneath the Site; however, the continuity of this unit to the west side of the landfill is not completely defined due to limited drilling on the upgradient (west) side of the landfill. The material that immediately underlies the clayey zone, representing the third unit, is composed of sands and silty sand to approximately 85 feet below land surface, where a change to a coarse sand containing gravel is noted.

- Site-specific permeability values ranged from 4×10^{-5} centimeters per second to 9×10^{-5} centimeters per second and correspond to the shallow zone of the surficial water-bearing unit.

- Toxaphene concentrations in the soils surrounding the landfilled sludge ranged from below the detection limit to 4,900 ppm. Concentrations of toxaphene were generally highest in the vicinity of the landfill cells and decreased with distance from the cells. An exception was an area near the Benedict Road/Nix Lane entrance to the Site. Toxaphene concentrations of 26 ppm to 92 ppm in this area may be the result of sludge transportation to the landfill.

- Toxaphene was detected in landfilled sludge samples at concentrations ranging from 850 to 15,000 ppm. The average sludge concentration of toxaphene is 6,000 ppm.

- Acetone, carbon tetrachloride, chlorobenzene, chloroform, and xylenes were detected in the landfilled sludge samples, but were not consistently present. No volatile organic constituents (VOCs) were detected in samples from cells 3, 4, and 6. One or more VOCs was detected in samples from cells 1, 2, and 5.

- Arsenic, chromium, copper, lead, manganese, nickel, vanadium, and zinc were detected in sludge samples. Of these metals, only copper and lead exceeded typical background concentration ranges.

- Dioxins and furans were detected in all of the sludge samples.

When evaluated based on the Toxicity Equivalence Factor (TEF), by which the concentrations of all isomers are adjusted by their toxicity relative to the 2,3,7,8-TCDD isomer, the concentrations ranged from 3.2×10^{-5} to 3.9×10^{-4} ppm. These concentrations exceeded background concentrations, but were less than the action level of 1×10^{-3} ppm.

5.2 Hydrogeology

- Groundwater in the shallow zone of the surficial water-bearing unit flows toward the east at a seepage velocity of 60 to 90 feet per year. Groundwater in the lower zone flows toward the southeast at a seepage velocity of 45 to 65 feet per year.

- Surface elevations at the Site range from 13 to 26 feet mean sea level (MSL). Water table elevations at the site range from 14 to 17 feet MSL.

- Interpretation of data obtained during the drilling of boreholes into the landfill and from piezometer water levels suggest the following: water is perched above the sludge; saturated sludge exists within the landfill cells; and there is an unsaturated zone beneath the sludge at least part of the year in portions of the landfill. Figure 5-1 illustrates a typical landfill cell cross-section. The saturated conditions within the sludge are due to the absence of a clay cap on the landfill, the low permeability (7×10^{-7} cm/sec) of the sludge material, and the bentonite layer beneath the sludge.

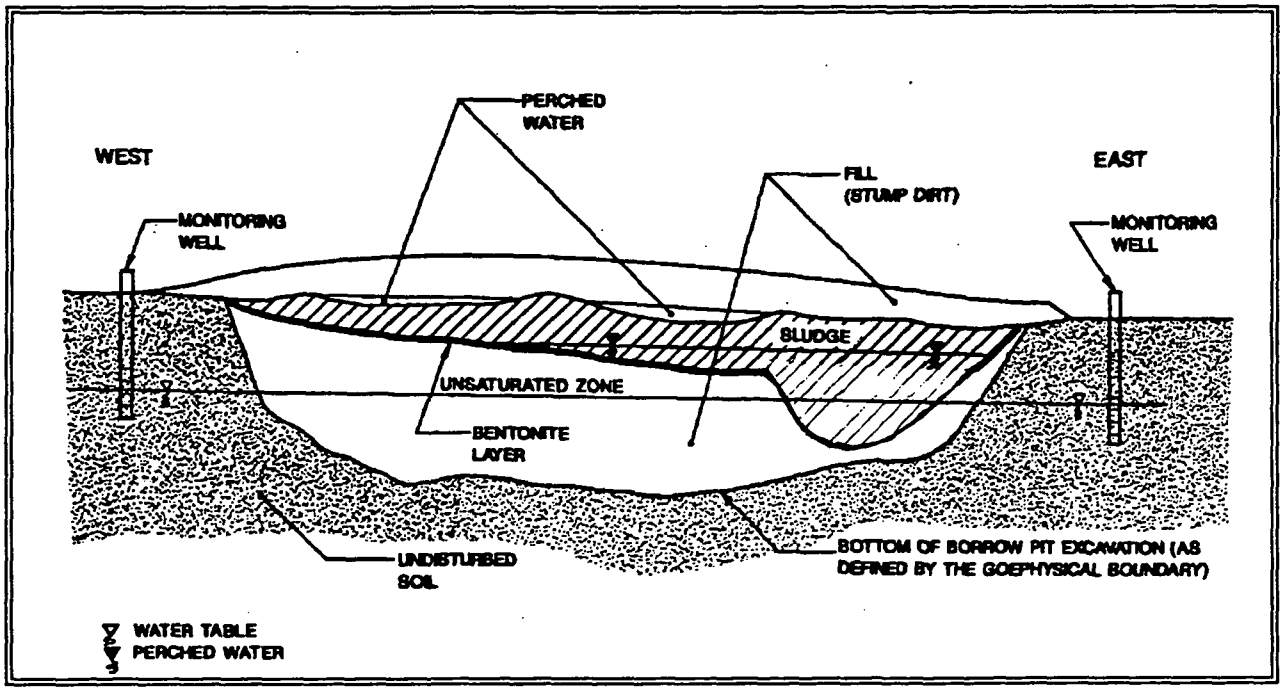

Figure 5-1
Cross-Section of a Typical Landfill Cell at the Site

- Private water supply wells located near the Site have been sampled annually by Hercules since 1985. Toxaphene has not been detected above instrumentation quantification limits in the private wells.

- Groundwater elevations at the Site exhibit minor cyclical fluctuations that may be attributable to the tidal cycle. However, tidal influences are insufficient to affect basic groundwater flow patterns.

- Toxaphene has been detected in four monitoring wells all located at the southeastern corner of the landfill at concentrations ranging from 0.0056 ppm to 0.076 ppm. During the latest round of sampling, only one well indicated toxaphene contamination, measured at 0.069 ppm.

- Both nickel and benzene have been detected above MCLs in groundwater samples collected adjacent to the landfill.

5.3 Surface Water

- Surface drainage occurs by overland flow at the Site. The flow at the Site is divided by the crest of the landfill with both westward flow toward Highway Spur 25 and eastward flow toward the drainage ditch located immediately east of the Site. The drainage along Spur 25 flows through a 36-inch culvert which connects to the drainage ditch on the eastern side of the Site. This culvert transverses the Site immediately south of the landfill cells.

- Surface drainage from the Glynn Place Mall (approximately 1000 feet north of the Site) enters the east drainage ditch upstream of the Site. The pond at the southern end of the Site receives runoff only from the immediate area surrounding the pond, and has no permanent surface inflow or outflow. This onsite pond is believed to have been formed during the construction of Spur 25 as a borrow pit.

- The water table is generally close to the bottom of the drainage ditch, and groundwater flow from underneath the landfill may seasonally discharge into the drainage ditch. The water table configuration is, however, based on a single set of water table elevations from a single date. Nevertheless, this data indicates that the water table would provide only minor discharge to the drainage ditch located immediately east of the Site.

- Surface water and sediment samples were collected in the onsite pond and in the off-site drainage ditch. Samples in the drainage ditch were collected both alongside the Site and over a mile away from the Site in the estuary. Toxaphene was not detected in any surface water samples. However, toxaphene was detected at a maximum of 0.86 ppm in two sediment samples adjacent to the Site.

United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R04-90/065
June 1990

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Superfund Record of Decision:

Harris/Palm Bay Facility, FL

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(G)

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U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered 800/000

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 345-acre Harris/Palm Bay Facility site is an electronics manufacturing company in Palm Bay, Brevard County, Florida. Surrounding land use is commercial, residential, and industrial. The site overlies an unconsolidated aquifer, which is used by a public wellfield located south of and downgradient of the site. From the 1950s to 1967, the site was operated by an electronics firm when Harris Corporation purchased the facility. Current facility operations are subdivided into the Government Systems operations area and the Semiconductor Complex area. In 1981, EPA identified VOCs in ground water wells located south of the Government Systems facility. Ground water contamination was attributed to several onsite incidents at the Government Systems plant including two fires, which resulted in the dumping of chemical vats, a broken acid/solvent line, and spillage at drum storage areas. Seepage from two former treatment lagoons may also be a source of a shallow contaminant plume. In 1985, Harris constructed a treatment facility to implement an onsite ground water treatment and monitoring program which is still in operation. This Record of Decision (ROD) addresses ground water contamination at the Government Systems facility. A subsequent

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Harris/Palm Bay Facility, FL
First Remedial Action
Contaminated Medium: gw
Key Contaminants: VOCs (TCE), metals (chromium, lead), other inorganics

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 110
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

Abstract (Continued)

ROD will address the contaminated ground water at the Semiconductor Complex and all of the contaminated onsite soil. The primary contaminants of concern affecting the ground water are VOCs including TCE; metals including chromium and lead; and other inorganics including fluoride.

The selected remedial action for this site includes continued ground water pumping and treatment using air stripping to remove VOCs; using the treated ground water as industrial process water then reinjecting the treated ground water onsite into a deep aquifer; and evaluating and modifying the existing ground water monitoring program to fully characterize onsite contamination. The estimated present worth cost for this remedial action is $1,430,000, which includes a total O&M cost of $950,000 for five years.

PERFORMANCE STANDARDS OR GOALS: The goal of this remedial action is to restore the aquifer to its beneficial use. Cleanup standards were chosen as the more stringent of State or Federal SDWA standards. Chemical-specific ground water goals include TCE 5 ug/l (MCL), chromium 50 ug/l (MCL), and lead 15 ug/l (proposed MCL).

RECORD OF DECISION
DECLARATION

Site Name and Location:

Harris Corporation/Palm Bay Facility
Palm Bay, Brevard County, Florida

Statement and Basis of Purpose:

This decision document represents the selected remedial action for the Harris Corporation/Palm Bay Facility site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based upon the contents of the administrative record for the Harris Corporation/Palm Bay Facility site.

The United States Environmental Protection Agency and the State of Florida agree on the selected remedy.

Assessment of the Site:

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present a current or potential threat to public health, welfare, or the environment.

Description of Remedy:

The first operable unit defined for this site is the contaminated groundwater associated with the Harris Corporation Government Systems facility. Through treatment and engineering controls, this operable unit remedy eliminates or reduces the risks associated with the site due to exposure to contaminated groundwater via the public water supply.

The major components of the selected remedy include:

- continued operation of the existing extraction, treatment, and disposal system:
  - extraction of contaminated groundwater from the surficial aquifer

- treatment of the extracted groundwater by air stripping the volatile organic compounds

- injection of the treated groundwater into the deep Floridan Aquifer, which is not a source of potable water in the area

- a design analysis to determine the effectiveness of the existing system for plume containment and treatment

- modification of the system based on results of the design analysis

- continued sampling in order to monitor progress of the cleanup

- a review of the site within five years after initiation of remedial action in order to ensure protectiveness of the remedy

Statutory Determinations:

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principle element. As this remedy will initially result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Greer C. Tidwell, Regional Administrator

JUN 2 8 1990

Date

Record of Decision

The Decision Summary

Harris Corporation/Palm Bay Facility

NPL Site

Palm Bay, Brevard County, Florida

Prepared by:
U.S. Environmental Protection Agency
Region IV
Atlanta, Georgia

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RECORD OF DECISION

THE DECISION SUMMARY

HARRIS CORPORATION/PALM BAY FACILITY

OPERABLE UNIT I

PALM BAY, BREVARD COUNTY, FLORIDA

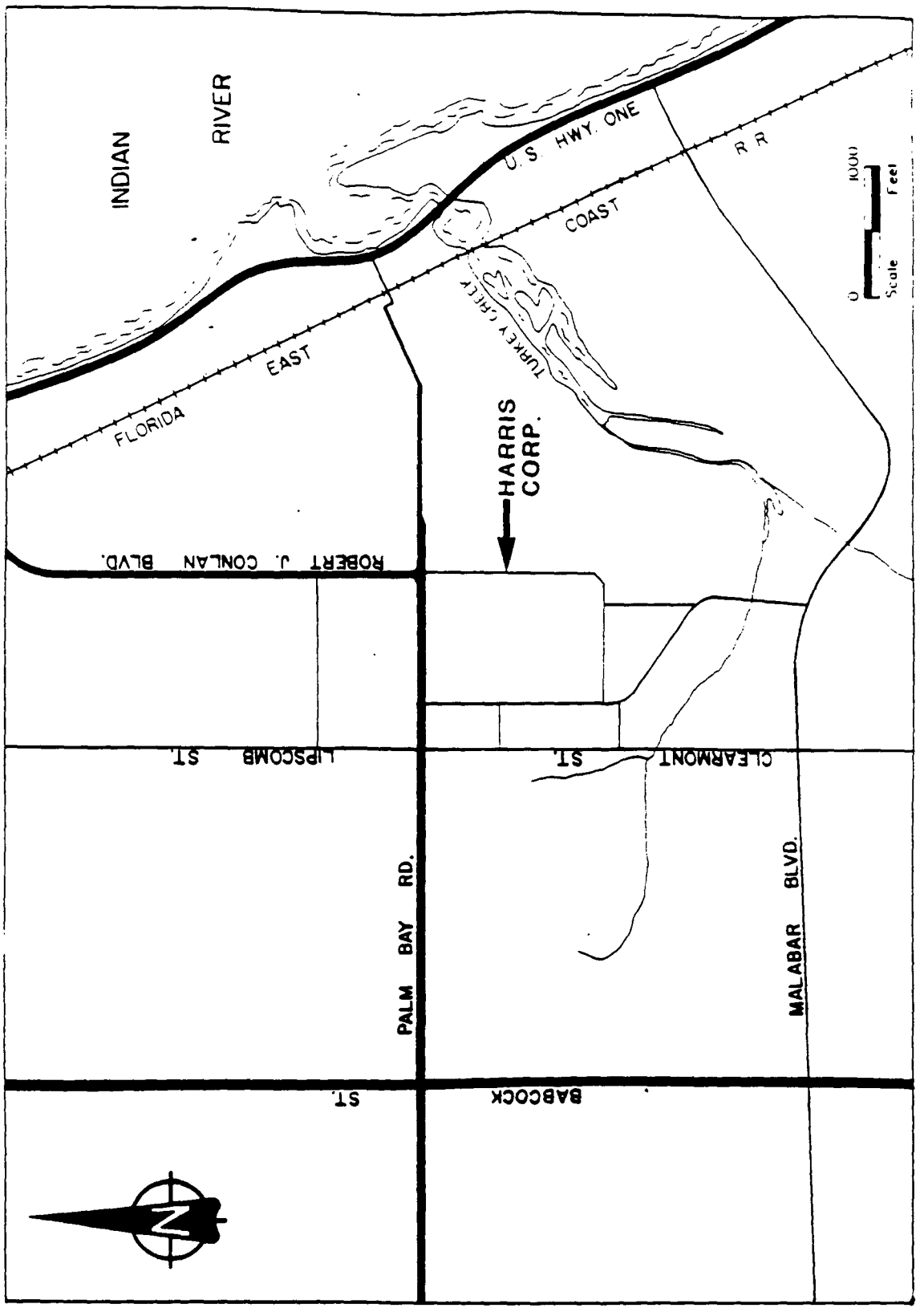
1.0 Introduction

The Harris Corporation (Harris) site was proposed for inclusion on the National Priorities List (NPL) in April 1985. The Harris site has been the subject of numerous investigations performed by the responsible party, Harris Corporation, under an Administrative Order on Consent with the State of Florida that was signed in December 1983. These previous investigations include: 1) studies of affected groundwater, including geologic and hydrogeologic studies; 2) studies of affected soils; 3) evaluation of methods of remediation and treatability; and 4) investigations assessing the ongoing remediation program.

1.1 Site Name, Location, and Description

The Harris Corporation/Palm Bay Facility site is located on 345 acres along Palm Bay Road in Palm Bay, Brevard County, Florida [Figure 1]. The site consists of groundwater and soils contamination associated with Harris Corporation including the groundwater plumes extending from Harris onto the adjacent property owned by General Development Utilities (GDU).

Harris Corporation manufactures electronic components as well as communication and information processing equipment. There are two major



SITE LOCATION MAP

Figure 1

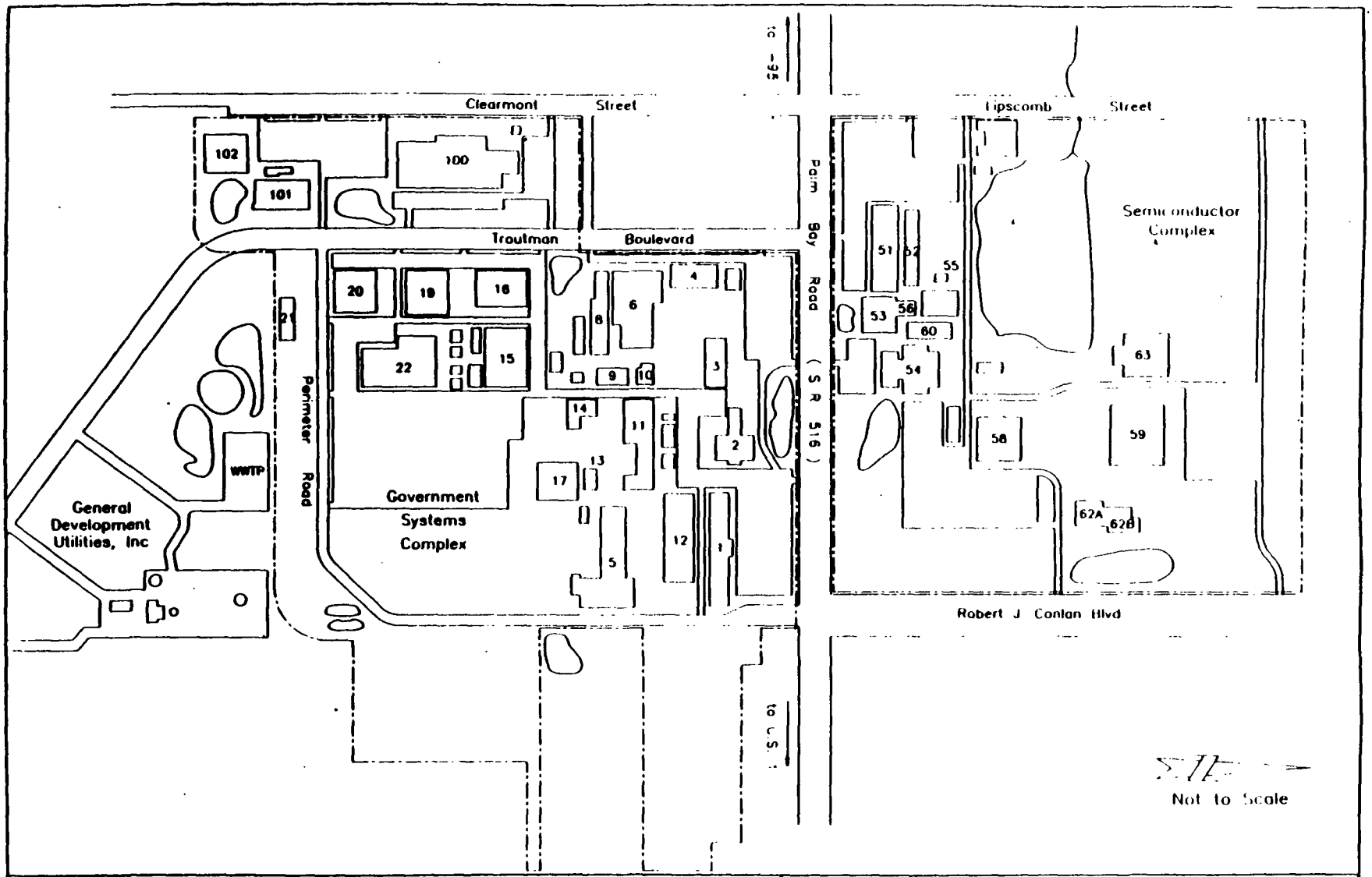
operating divisions, the Government Systems (now called Electronic Systems) and the Semiconductor Complex. Harris acquired a third area, Building 100, in 1970.

GDU, a subsidiary of General Development Corporation, provides the public water supply and sewage treatment and disposal for at least 33,000 residents of Palm Bay. The GDU well field consists of 25 producing wells. A number of these wells are located directly south of, and downgradient from, the Government Systems facility.

Harris Corporation has been operating the Government Systems facility in Palm Bay since 1967. Harris purchased Radiation Corporation, an electronics firm supporting the space industry, which operated at the site from the 1950's to the early 1960's. All expansion from the original buildings has been onto undeveloped property with the exception of Building 100. Two previous manufacturing firms (Sorban and Mohawk Data Services) operated at Building 100 and used the site for painting operations, a chromium plating operation, a machine shop, and a drum storage area.

The Harris site is surrounded to the east, west, and north primarily by commercial and other industrial-zoned properties which in turn are bounded by residential properties. A municipal park, known as Knecht Park, lies east of the site. Site usage is not expected to change.

The significant surface features present include several small bodies of water on the Harris property, a pond in Knecht Park, and Turkey Creek [Figures 1 & 2]. The Harris ponds are primarily used for stormwater retention, although some are used for irrigation. The site is within the drainage basin of Turkey Creek and its tributaries which lie to the southwest, south, and southeast. Stormwater runoff that is not retained on-site is discharged to the municipal stormwater drainage system and eventually into Turkey Creek.



HARRIS CORPORATION
SUPERFUND SITE
Palm Bay, Brevard County, Florida

SITE LAYOUT MAP

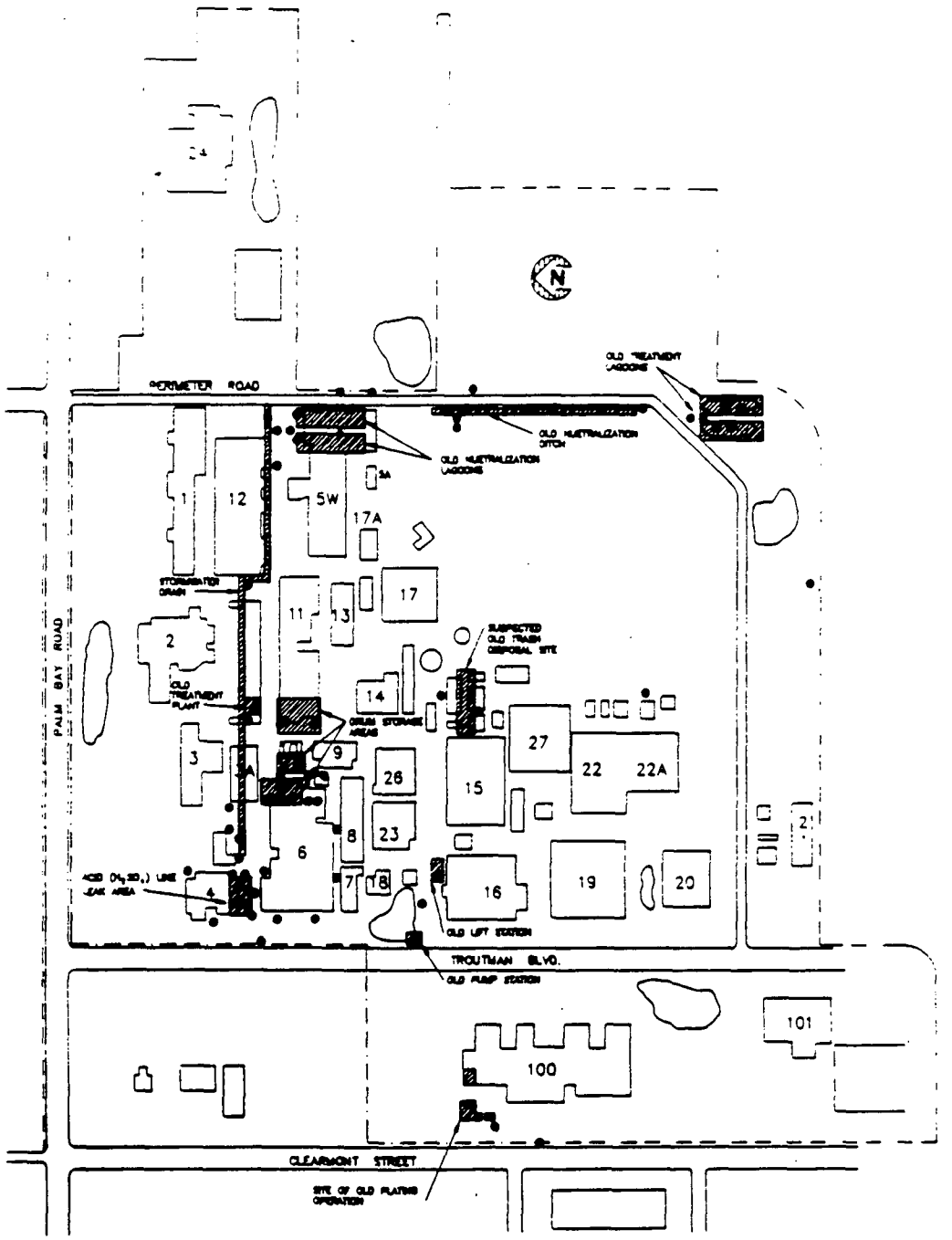
Figure 2

1.2 Site History and Enforcement Activities

In 1981, the EPA sampled GDU production wells which lie south of Harris Government Systems facility as part of a nationwide survey of groundwater quality. In March 1982, the EPA reported to the Florida Department of Environmental Regulation (FDER) that numerous volatile organic compounds (VOCs) were detected in six GDU production wells. Harris confirmed the presence of VOCs in monitor wells on the Government Systems property in 1982. Harris entered into a Consent Order with FDER (OGC Case No. 82-0582) in December 1983 with Amendments in January, 1984 and October, 1984. Harris agreed to conduct a groundwater investigation to determine the extent of chemical impacts and to develop and implement a groundwater restoration program. Since entering into this agreement, Harris, with FDER oversight, has conducted numerous investigations, installed 134 wells at Government Systems, and conducted groundwater sampling.

Although not all incidents involving the release of hazardous substances have been identified, some contributing events are known. Two fires occurred in the northeast corner of Building 6, one in 1967 and another in 1974. Chemical vats were dumped by the fire department and flushed out through holes which were broken into the floor of the building. The volume of chemicals released in these two incidents is unknown.

Several possible source areas have been identified at Harris based on knowledge of past operating and handling practices. The volume of materials released is not known. From 1968 to 1970, storage drums containing paints, solvents and similar materials were stored in the area of the northeast corner of Building 6 and along the western sides of Buildings 10 and 11. In the late 1960's an acid and solvent line between Building 6 and a metal-finishing waste treatment plant apparently leaked. As a result, source areas may include the stormwater drain extending from this area eastward to the drainage swale along Perimeter Road and to two former treatment lagoons located in the southeast corner of the site [Figure 3].



LEGEND

- SOIL SAMPLE LOCATIONS
- SUSPECTED POSSIBLE CHEMICAL SOURCE LOCATION

0 200 400
SCALE FEET

SUBJECT:

GOVERNMENT SYSTEMS SOIL SAMPLE LOCATIONS

Figure 3

In addition, Building 5 is located on the former site of two neutralization lagoons that were cleaned out in 1980. A neutralization ditch was located south of these lagoons which conveyed water to the two treatment lagoons already mentioned. East of Building 15 is an area suspected to be the location of an old trash site. The old pump and lift stations are also potential sources of contamination. More recently, Harris documented a 1986 acid line leak in the area of Building 4.

The estimated VOC plume configurations indicate that the major source area is probably near Building 6. Therefore, the major sources may be the fires, broken solvent line, and drum storage areas near Building 6. The treatment lagoons previously located near Building 5 may be a source for the shallow plume in that area.

The Harris Corporation site was proposed for the National Priorities List (NPL) on April 1, 1985, and became a final NPL site on July 1, 1987. EPA issued a general notice letter to Harris Corporation on April 6, 1989, notifying Harris of its potential liability under the Comprehensive Environmental Response and Liability Act of 1980 (CERCLA). This notice letter was issued pursuant to Section 104 and other provisions of CERCLA as amended by the Superfund Reauthorization Act (SARA). In this notice letter, EPA recognized the remedial efforts taken by Harris Corporation at the site in compliance with the Consent Order executed between Harris and the State of Florida.

FDER elected to assume management of enforcement activities at the site due to this existing agreement. EPA has provided technical support by reviewing site documents including the sampling and analytical results.

Previous investigations conducted by both Harris and GDU have included studies assessing the nature and extent of chemical impacts on the groundwater and soils, methods of remediation, and assessments of the ongoing remedial action. Appendix A lists the reports for studies that have been conducted to perform Contaminant Assessment Plan and Feasibility Study activities.

1.3 Community Participation

The EPA Proposed Plan for the Harris Corporation site was released to the public in March, 1990. This Proposed Plan, along with technical reports prepared by Harris relating to Contaminant Assessment Plan and Feasibility Study activities, was placed in the Administrative Record. The decision for this site is based on documents found in the Administrative Record. The Administrative Record is located in an information repository maintained in each of two locations: the EPA Records Center in the Region IV office in Atlanta, Georgia, and the Palm Bay Public Library in Palm Bay, Florida. The notice of availability for these documents was published in the Florida Today newspaper on March 18, 1990. EPA mailed a fact sheet on March 16 to each person on the site-related mailing list. On March 23, EPA issued a press release announcing the public meeting, comment period, and document availability.

A 30 day public comment period was held from March 18, 1990 through April 17, 1990. In addition, a public meeting was held on March 27, 1990 in Palm Bay. At this meeting, representatives from EPA and FDER presented information and answered questions about the problems at the site and the actions taken to date. EPA responses to the comments received during this period are included in the Responsiveness Summary, which is part of this Record of Decision.

1.4. Scope and Role of Operable Units

As with many Superfund sites, the problems at the Harris Corporation site are complex. Therefore, EPA has divided the Harris site into a minimum of two operable units (OUs) for better management of the response activities. These operable units are:

OU One: Contaminated groundwater associated with Government Systems

OU Two: Contaminated groundwater at the remainder of the site (including the Semiconductor Complex and Building 100) as well as contaminated soils at the entire site

This Record of Decision addresses only Operable Unit One, contaminated groundwater associated with the Government Systems facility. Under oversight from FDER, this operable unit is currently in remediation using a groundwater treatment system.

Remediation of the groundwater at the Semiconductor Complex is scheduled to begin in late 1990, also under FDER oversight. Additional soil sampling to identify contaminant source locations along with treatability studies may be necessary as part of Operable Unit Two. Any interim actions will be consistent with any planned future actions.

2.0 Summary of Site Characterization

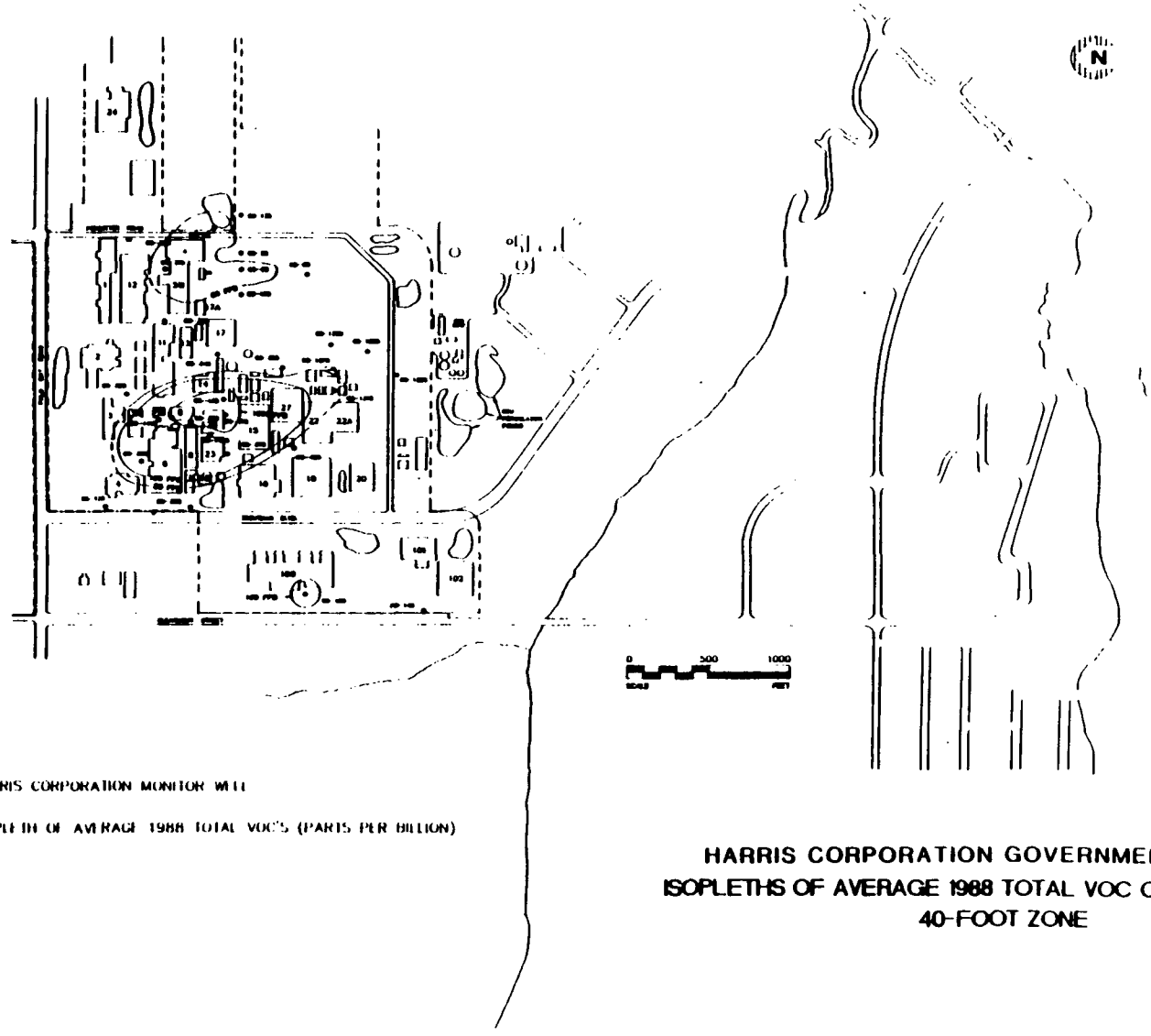
The chemical characterization of groundwater for Operable Unit One at the site has been studied and monitored since 1984. Appendix A lists the studies conducted by both Harris and GDU which provide documentation concerning the nature and extent of chemical impacts upon the aquifer.

2.1 Site Contaminants

Contaminants identified at the Government Systems facility can be divided into four categories: volatile organic compounds (VOCs), acid extractable organics (AEOs), metals, and fluoride. These contaminants are associated with processes conducted at Government Systems.

VOCs

The contamination has been approximated vertically and horizontally and is tracked by a network of monitor wells. Two significant, affected groundwater zones have been identified in the Government Systems area: the 40-foot zone and the 80-foot zone. There are two VOC plumes identified in the 40-foot zone [Figure 4]. One plume lies near Building 5 at the eastern edge of the site in the vicinity of the old stormwater drain outfall and treatment lagoons. The other plume is located near



HARRIS CORPORATION GOVERNMENT SYSTEMS
ISOPLETHS OF AVERAGE 1988 TOTAL VOC CONCENTRATIONS
40-FOOT ZONE

Figure 4

Building 6. The VOC plume in the 80-foot zone of the leaky artesian aquifer extends from the area near Building 6, and continues south-eastward toward and across the southeast boundary of the Harris property [Figure 5].

AEOs

Harris conducted testing for acid extractable organics (AEOs) in groundwater from 90 wells across the site after trace levels of phenols were detected. Subsequent analyses showed the level of AEOs to be below detection limits except for a phenol concentration of 20 ug/l in a sample taken in 1986 from Well GS-37S, one of the Harris extraction wells.

Metals

Metals above the EPA and Florida Maximum Contaminant Levels (MCLs) were detected in some shallow well-point samples collected during reconnaissance testing in 1986 around Building 6. Chromium and lead were the metals of primary concern. Subsequent groundwater sampling of permanent monitor wells at Harris shows these and other metals (cadmium, silver, and mercury) to be below detection limits. As a result, monitoring wells are no longer routinely sampled for metals.

Fluoride

Shallow well-point samples delineated an area of elevated fluoride immediately west and south of Building 4. Harris performed a follow-up study which found one well (GS-M14) with significantly high fluoride levels (6.64-6.68 mg/l). In order to detect any migration of fluoride, monitoring for this compound also occurs in the surrounding wells. Fluoride has been detected in groundwater only at the 15-foot depth, not the 40- and 80-foot depths. There is insufficient evidence to conclude that fluoride is moving laterally or vertically with the groundwater.

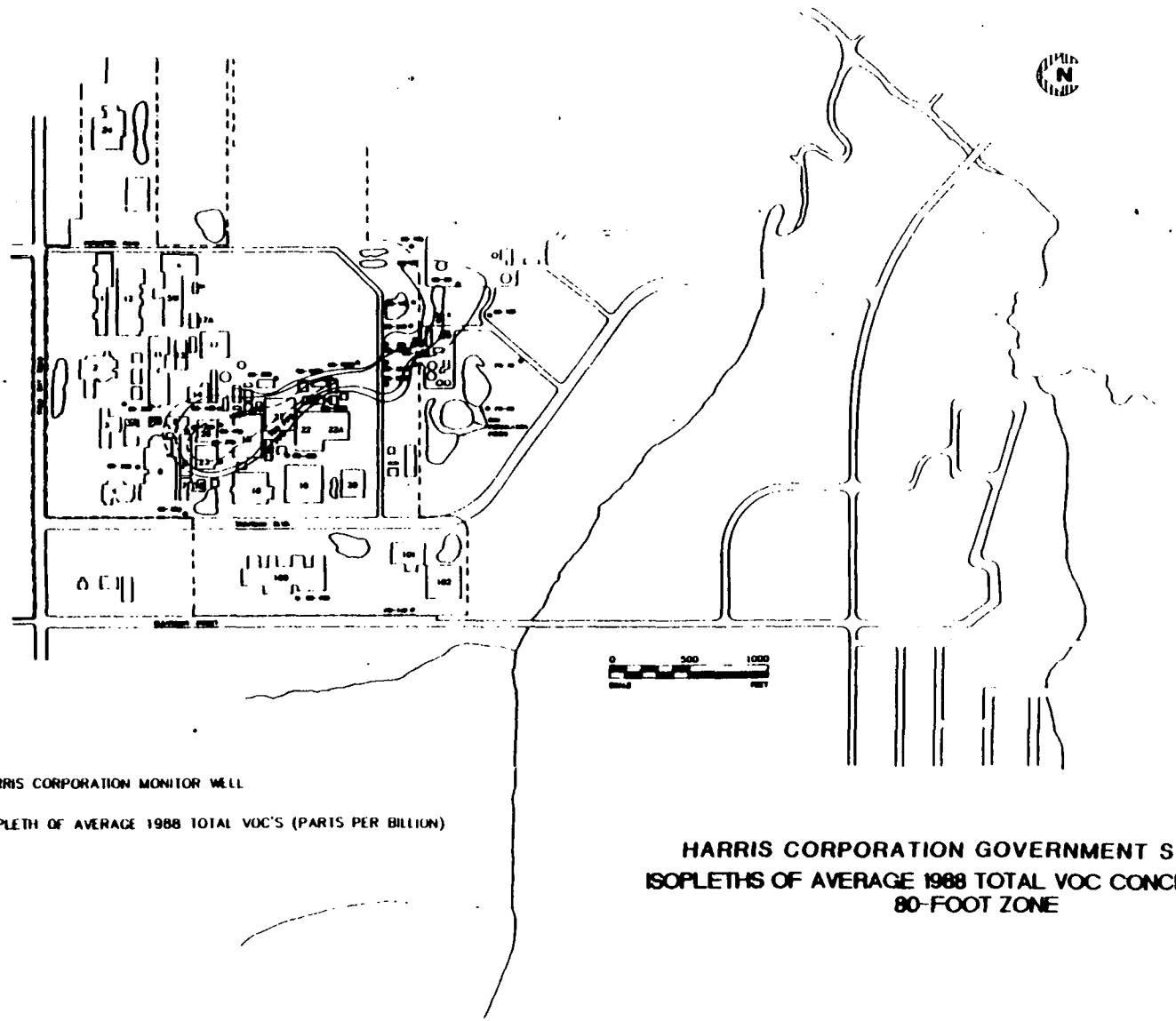

N
0
500
1000
LEGEND
HARRIS CORPORATION MONITOR WELL
ISOPLETH OF AVERAGE 1988 TOTAL VOC'S (PARTS PER BILLION)
HARRIS CORPORATION GOVERNMENT SYSTEMS
ISOPLETHS OF AVERAGE 1988 TOTAL VOC CONCENTRATIONS
80-FOOT ZONE

Figure 5

2.2 Geology

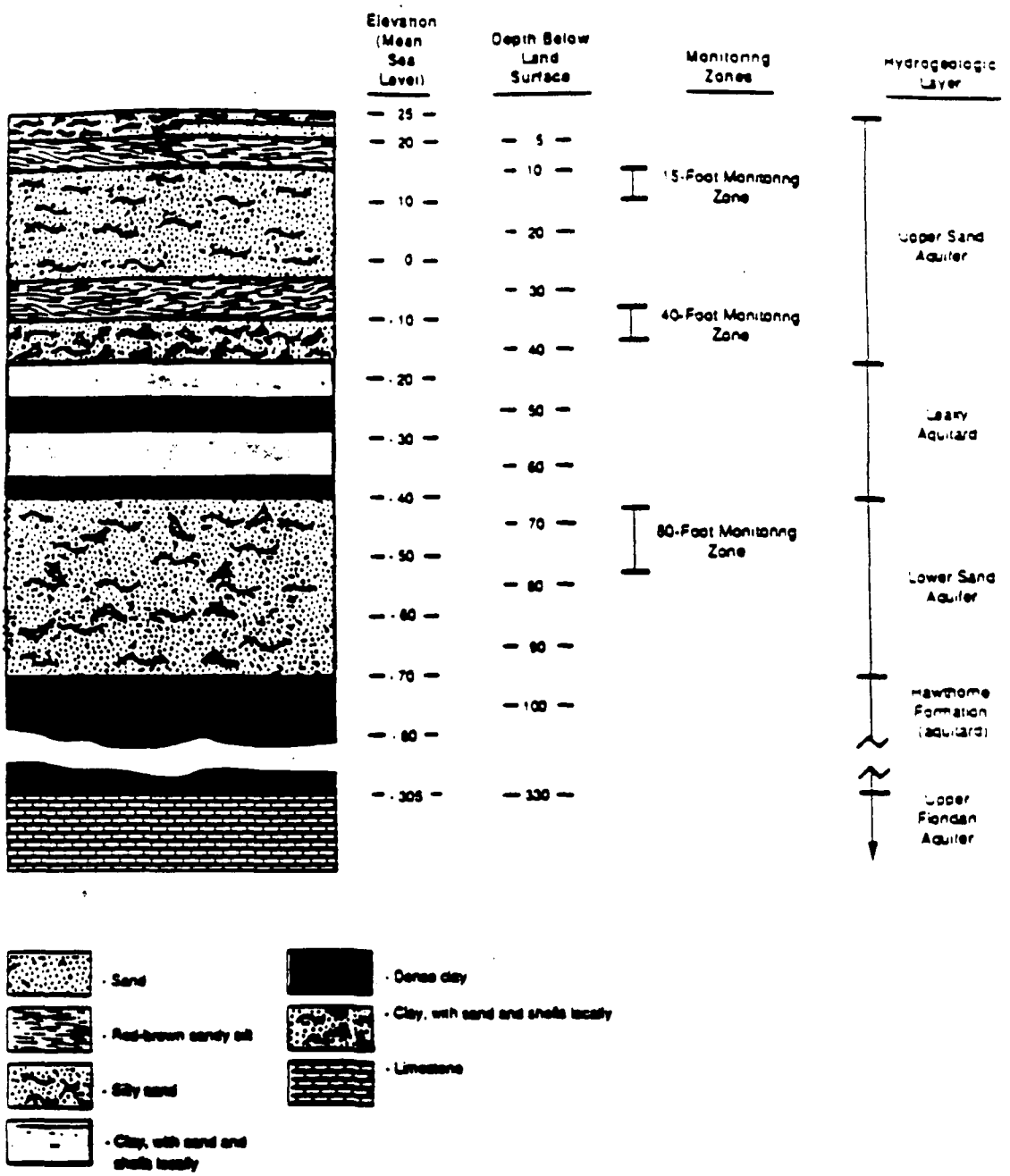
Physiographically, the Harris site is on the Atlantic Coastal Ridge, part of the Pamlico Terrace. This surface is a relict beach ridge thought to have formed about 125,000 years ago (late Pleistocene) when sea level was approximately 25 to 30 feet above the present level. Land surface elevation at Harris is approximately 19-22 feet above sea level.

The subsurface geology of coastal Brevard County is relatively uniform. The Harris site is located in an area where the surficial deposits are unconsolidated sediments approximately 110 feet deep. These deposits are comprised (in descending order) of undifferentiated Holocene sediments, the Fort Thompson and Anastasia Formations of Pleistocene age, and Tamiami Formation of Pliocene age. These sediments are relatively flat-lying, fine to medium grained sand layers containing variable amounts of clay, shell fragments, carbonate and organic material. The clay layers are discontinuous and occur intermittently. Several distinct layers of reddish-brown, sandy silts are found in the upper 40 feet of sediments. At depths between 4 and 12 feet, a hardened silt layer is found that has been referred to as a "hardpan".

Underlying the upper surficial deposits, starting at about 90 to 110 feet, are clay layers of the Miocene age Hawthorn Formation. This formation is comprised of clayey silts and sands, phosphatic sediments and limestone, and is between 100 and 200 feet in total thickness. Below the Hawthorn Formation, from about 330 to 1920 feet below land surface, the stratigraphic section is dominated by interbedded limestones and dolomites of the Eocene age Ocala Limestone, Avon Park Formation and Lake City Limestone. Underlying this section is the Oldsmar Formation of Lower Eocene age extending to a depth of approximately 2640 feet which is also dominated by limestone and dolomite units. Figure 6 shows a generalized geologic column for the site.

2.3 Hydrogeology

Both Harris and GDU have completed studies on the characterization of the



SOURCE
Compiled from Post, Buckley, Schuh and Jernigan Inc., December 1983; Geraghty & Miller, Inc., November 1987; and Geraghty & Miller, Inc., July 1987.

	HARRIS CORPORATION GROUNDWATER PROGRAM	GENERALIZED GEOLOGIC COLUMN

Figure 6

hydrologic properties of the subsurface sediments. These studies include direct measurement of hydrologic conductivity by laboratory analysis of water flow through core samples as well as indirect calculation of the estimated permeability based on particle size analysis. Harris conducted aquifer tests at Government Systems in addition to the aquifer tests performed as part of the development of the GDU wellfield. Geophysical investigations of the permeability and stratigraphy of subsurface layers have been completed using electro-magnetic, resistivity, and ground-penetrating radar surveys. Pump tests show how the pumping at GDU affects the aquifer. In addition, several studies characterize the potentiometric surface from water level measurements.

An unconfined water table aquifer lies in the upper portion of the surficial unconsolidated deposits to a depth of approximately 40 to 60 feet. At that depth, a relatively low-permeability (3 gpd/ft^2) dominant clay layer containing fine sand and shell separates it from a lower, leaky artesian aquifer. This lower artesian aquifer extends to a depth of approximately 90 to 110 feet and is underlain by impermeable clay layers of the Hawthorn Formation.

The transmissive aquifer layers are dominated by shell hash containing variable amounts of sand and clay [Figure 6]. The estimated average transmissivity of the unconfined water table aquifer is 3420 gpd/ft. The clay layer lying between the two aquifers has an estimated average transmissivity of only 24 gpd/ft. This clay layer acts as an aquitard for downward migration of groundwater. (Estimated transmissivities of the lower zone of high permeability leaky artesian aquifer range from 7600 to 15800 gpd/ft in this area.) The lower zone of high permeability is about 20 to 40 feet thick and lies at depths of about 80 feet. This zone is the principal water-producing zone from which water supplies are drawn by GDU. Below the lower shallow aquifer are impermeable clay layers of the Hawthorn Formation which form an aquiclude below the production zone and separate this shallow aquifer from the confined Floridan Aquifer below.

The Floridan Aquifer exists under artesian conditions in the area with potentiometric levels above land surface. As a result, there is no

recharge to the Floridan Aquifer from the surficial aquifer. The Floridan Aquifer lies within the limestones and dolomites of the Ocala Group, Avon Park Formation and the Oldsmar Formation. Water level measurements in wells completed in the surficial aquifer (including the water table and leaky artesian aquifers) establish that the potentiometric surface (water level contour) is at shallower depths on the north side of Harris than on the south side. Based on these water level measurements, a hydraulic gradient exists across the Harris site toward the south and southeast [Figures 7 & 8].

Field tests done with GDU wells pumping and then with the wells turned off demonstrate that the potentiometric surface and hydraulic gradient are significantly influenced by pumpage of the GDU production wells located south and southeast of the site. Under static conditions (i.e., GDU production wells turned off), the hydraulic gradient in the production zone (leaky artesian aquifer, 80-foot zone) was estimated to be about 0.004 ft/ft (about 20 ft/mile). With the GDU wells pumping, the hydraulic gradient averages 0.01 ft/ft (about 50 ft/mile) which is greater than two times the static gradient. The hydraulic gradient at the southeast corner of the site is calculated to be 0.0035 ft/ft. During another investigation, the gradient was calculated to be 0.0094 ft/ft. The groundwater gradient is much steeper in the 80-foot zone than in shallower zones due to the influence of the GDU wellfield. As a result, this gradient creates a potential for the downward movement of groundwater from shallower zones. Using the estimated hydraulic conductivities and porosities of the transmissive layers, groundwater flow rates are estimated for the 15-foot, 40-foot, and 80-foot zones to be 16, 77 and 273 ft/year, respectively.

The climate in the Palm Bay area is subtropical humid, with the winter months being generally dryer than the summer months. As part of the modeling of the hydrologic regime at the site, Harris Corporation researched a number of the parameters related to the climate of the area. Average rainfall in this area is about 56 inches per year. Adjusting for evapotranspiration and surface runoff, the estimated effective recharge of the shallow aquifer is 36 inches per year.

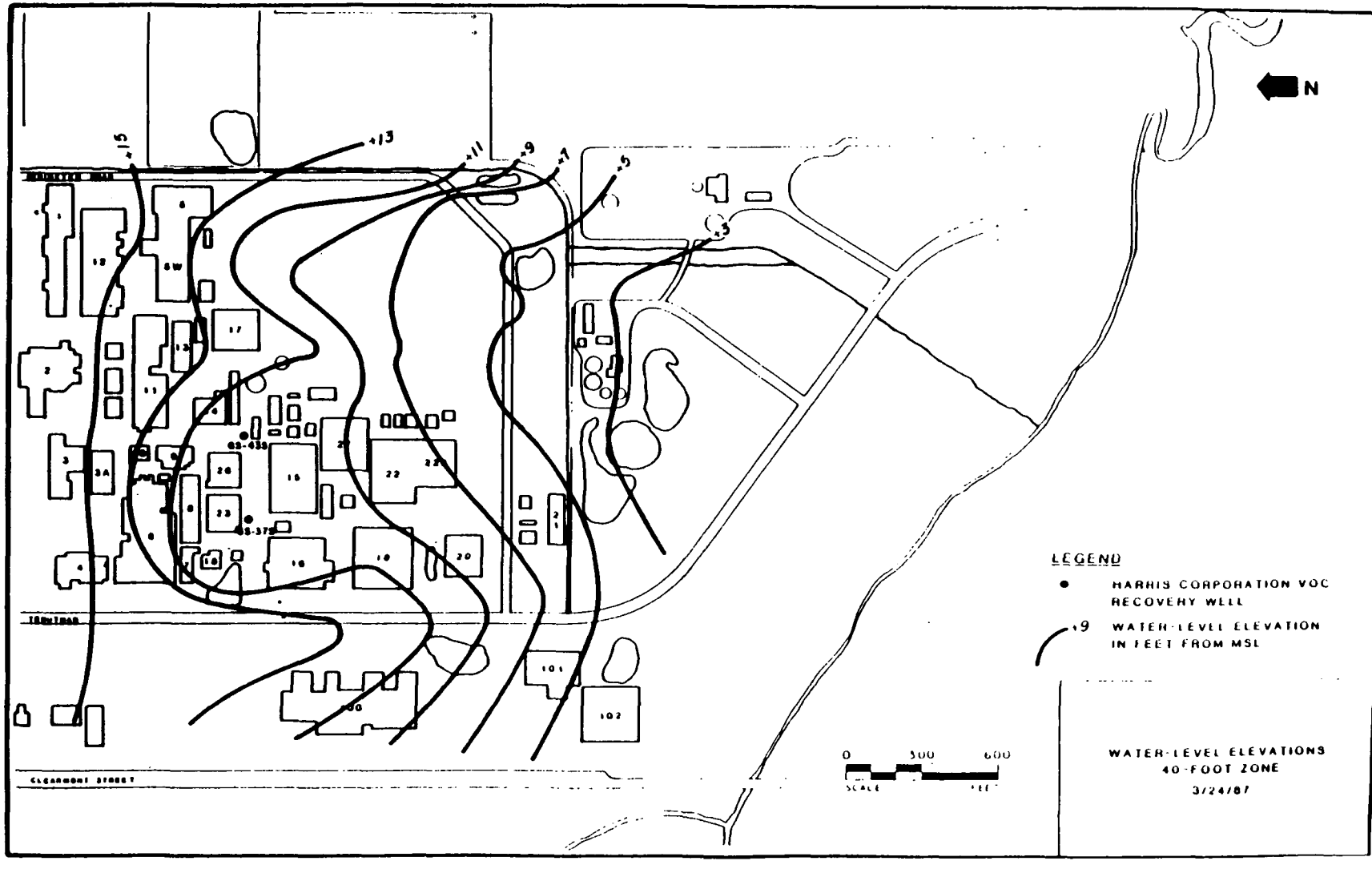

+15
+13
+11
+9
+7
+5
+3
N
LEGEND
HARRIS CORPORATION VOC RECOVERY WELL
+9 WATER-LEVEL ELEVATION IN FEET FROM MSL
0 500 600
SCALE FEET
WATER-LEVEL ELEVATIONS
40-FOOT ZONE
3/24/87
101
102
CLEARMONT STREET

Figure 7

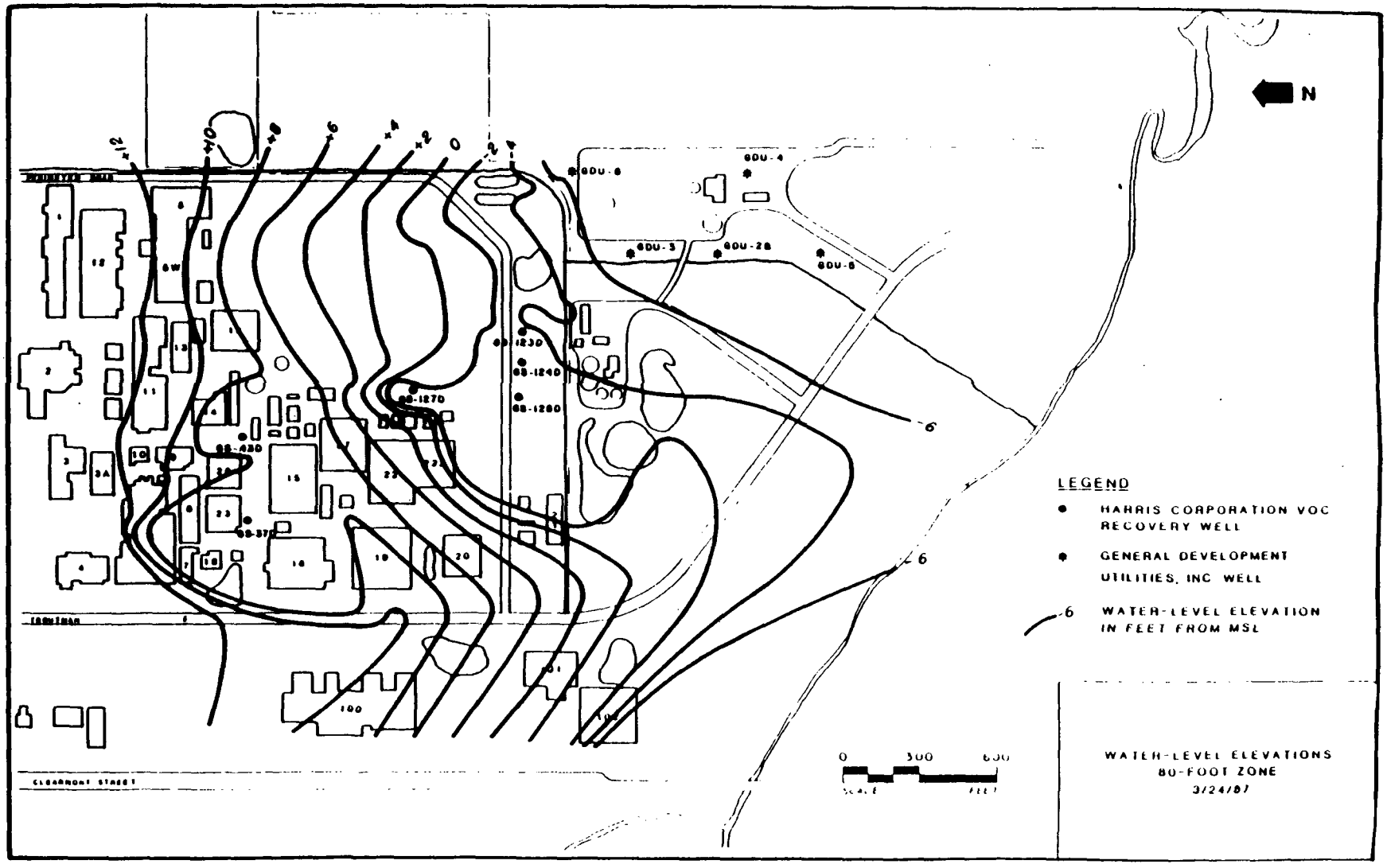

N
LEGEND
HARRIS CORPORATION VOC RECOVERY WELL
GENERAL DEVELOPMENT UTILITIES, INC WELL
-6 WATER-LEVEL ELEVATION IN FEET FROM MSL
WATER-LEVEL ELEVATIONS
80-FOOT ZONE
3/24/87
0 300 600
SCALE FEET
GDU-6
GDU-4
GDU-3
GDU-2B
GDU-5
GS-1230
GS-1240
GS-1280
GS-1270
GS-430
GS-370
+12
+10
+8
+6
+4
+2
0
-2
-4
-6
-6
100
101
102
CLEARMONT STREET

Figure 8

3.0 Summary of Site Risks

EPA performed an evaluation of the baseline public health and environmental risk associated with the Harris site. This baseline evaluation helps determine whether or not a remedial action is necessary by identifying the risk posed by the site if no remedial action is taken. The baseline assessment also provides the framework for developing the preliminary remediation goals for the site.

EPA has determined that actual or threatened releases of hazardous substances from this site may present an imminent and substantial endangerment to public health, welfare, or the environment. In order to address this potentially imminent and substantial endangerment, EPA recommends the implementation of the response action selected in this ROD.

3.1 Identification of the Contaminants of Concern (Indicator Chemicals)

Groundwater is the media of concern for Operable Unit One. The contaminants of concern are primarily volatile organic compounds (VOCs), but also include acid extractable organics (AEOs) and inorganic compounds. These contaminants have been selected based on site-specific data collected by Harris as part of initial sampling efforts as well as the ongoing monitoring program at the Government Systems facility. The identified contaminants of concern consist of compounds which are the most toxic, mobile, and presently persistent chemicals related to this operable unit.

The indicator chemicals for this site were based on an analysis of the compounds identified in groundwater sampling conducted by Harris. The analysis for VOC contamination involved data from a 1989 sampling event. The analyses for metals and fluoride utilized less recent data because sampling for these compounds has been less frequent than for VOCs. Data from wells where no contaminants of concern were detected have been excluded. In calculating the averages across all wells sampled, one-half the detection limit was used for those contaminants not detected (if at least one contaminant of concern was detected in that well).

Table I shows the concentrations for groundwater contaminants of concern based on samples collected from monitoring wells at Government Systems and GDU. These groundwater samples contained elevated concentrations of the following nine VOCs: 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethylene (1,1-DCE), methylene chloride (MC), trichloroethylene (TCE), vinyl chloride (VC), chlorobenzene (CB), 1,2-dichlorobenzene (1,2-DCB), 1,2-dichloroethylene (1,2-DCE), and ethyl benzene (EB). In addition, metals (chromium, lead, and copper) as well as fluoride were reported as present in the groundwater associated with Government Systems.

Chromium, lead, and copper as well as other metals had previously been detected beneath the Harris facility at levels above water quality standards. Subsequent sampling by Harris showed steadily declining levels of these metals. In addition, the most recent data analyzed by EPA indicates that chromium was detected in only one well and copper is not found at levels of concern. Analyses for metals at GDU indicate that metals are not detected at levels above drinking water standards. FDER conducted split sampling at Harris in 1985. The results of this sampling were used to confirm the methodology and quality assurance of the Harris sampling procedures as well as the analytical results obtained.

3.2 Exposure Assessment Summary

This ROD addresses the groundwater exposure pathway. The potential human exposure pathway of primary concern is ingestion. Other water use pathways include dermal contact and inhalation.

The preliminary classification for the contaminated groundwater aquifer is class II, a potential or existing drinking water source. Class II aquifers should be remediated to levels that are protective of human health.

GDU is located directly south of the Harris facility. Groundwater flow at the site is to the south, southeast towards the GDU facility which provides the public water supply for Palm Bay. Therefore, the potential receptors of contaminated groundwater in the absence of groundwater

Table I

Sampling Data for
Groundwater Contaminants of Concern at Government Systems

Carcinogens	Maximum Concentration (ug/l)	Mean (ug/l)[a]	Number of Samples	Frequency of Detection
1,1-Dichloroethane	1790	123	29	22
1,1-Dichloroethylene	671	50	29	8
Methylene Chloride	26	5	29	3
Trichloroethylene	1860	311	29	16
Vinyl Chloride	2280	323	29	18
Noncarcinogens[b]				
VOCs				
1,1-Dichloroethane	1790	123	29	22
1,1-Dichloroethylene	671	50	29	8
Methlyene Chloride	26	5	29	3
Chlorobenzene	16	3	29	10
1,2-Dichlorobenzene	19	5	29	8
1,2-Dichloroethylene	240	84	29	24
Ethyl Benzene	76	13	29	5
Metals				
Chromium	30	c	8	1
Lead	80	56	9	7
Copper[d]				
Mercury	e	e	12	0
Fluoride	8580	3181	15	11

a - This concentration represents the 95 percent upper confidence limit on the arithmentic average.

b - This category includes carcinogens which are also considered to have noncarcinogenic toxic effects.

c - Chromium was only detected at one sampling location.

d - Copper was not detected at levels of concern.

e - Mercury was not detected. However, the detection limit that was used is 2.5 times greater than the EPA required quantitation limit.

remediation are the Palm Bay residents. If the remediation program is discontinued, the contaminated groundwater will migrate further into the GDU well field. Also, groundwater from the shallow zone of the aquifer could potentially discharge to Turkey Creek which runs south of the facility. In that event, the creek could become a human health and/or environmental exposure pathway.

Another potential human exposure pathway of concern is the inhalation of off-gassing from the air stripping system. During pilot testing of the air stripping tower at Harris, FDER analyzed projected air emissions. This analysis indicated that the volume of emissions is not high enough to present an unacceptable health risk. EPA performed a similar analysis in February, 1990 to confirm these results. However, since the FDER analysis, exposure limits for some volatile organic compounds, including vinyl chloride, have been reduced by the Occupational Safety and Health Administration (OSHA) and the American Conference of Governmental and Industrial Hygienists (ACGIH). Therefore, the health risks associated with the air stripper emissions should be reviewed based on these new limits.

The risk calculations for the ingestion of groundwater are based on the exposure point concentrations which represent the upper (95 percent) confidence limit on the arithmetic average. The arithmetic average is based on sampling data collected from wells in the area of the groundwater contamination. The exposure assumption used in the risk assessment is that an exposed individual consumes two liters of the untreated water daily for 70 years.

3.3 Toxicity Assessment Summary

Cancer potency factors (CPFs) have been developed by the EPA Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are

expressed in units of $(mg/kg\text{-}day)^{-1}$ are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimating the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied [Table II].

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur [Table II].

Hexavalent chromium is a human carcinogen when inhaled. However, oral and dermal exposure have not been identified as carcinogenic. The volatile organic contaminants of concern in the groundwater at the Harris facility which are considered to be carcinogens from oral exposure are 1,1-DCA; 1,1-DCE; MC; TCE; and VC. The inorganic constituents in the site groundwater are not considered to be carcinogenic from the oral exposure route. Therefore, the hazards associated with these constituents are lower than for the five potential carcinogenic VOCs.

3.4 Risk Characterization

A hazardous waste risk assessment considers the likelihood that adverse effects will occur as a result of exposure to chemicals released into the

Table II

Reference Doses (RfD) and Cancer Potency Factors (q*)
for Constituents Detected at Government Systems

Constituent	Reference Dose Oral (mg/kg/day)	Cancer Potency Factor Oral (mg/kg/day)	EPA Classi-fication
Organics			
Trichloroethylene	---	0.011	B2
Vinyl Chloride	---	2.3	A
1,1-Dichloroethane	0.12	0.091	B2
1,1-Dichloroethylene	0.009	0.6	C
Methylene Chloride	0.060	0.0075	B2
Chlorobenzene	0.027	---	D
1,2-Dichlorobenzene	0.089	---	D
t-1,2-Dichloroethylene	0.020	---	D
Ethyl Benzene	0.10	---	D
Inorganics			
Mercury	0.0003	---	D
Chromium	0.0050	---	D(oral)
Copper	---	---	D
Fluoride	0.060	---	D
Lead	0.0014	---	B2

A = Human Carcinogen (sufficient evidence in humans)
B1 = Probable Human Carcinogen (limited evidence in humans)
B2 = Probable Human Carcinogen (limited evidence in animals)
C = Possible Human Carcinogen (limited evidence in animals)
D = Inadequate evidence of animal or human carcinogenicity
--- = Agency verified toxicity number is not available

environment. The risk assessment includes carcinogenic as well as noncarcinogenic effects.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$ or 1E-6). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. The Agency considers individual excess cancer risks in the range of $1x10^{-4}$ to $1x10^{-6}$ as protective. However, the $1x10^{-6}$ level is generally used as the point of departure for setting cleanup goals at Superfund sites. Table III contains the concentrations that are equivalent to a $1x10^{-6}$ risk level.

Table III also contains the excess cancer risks associated with a groundwater exposure level representing the 95 percent upper confidence limit of the mean. This mean value, shown in Table I on page 21, is based on an analysis of Harris sampling data. Therefore, a potential source of uncertainty in this risk assessment is based on the methodology (discussed in Section 3.1) used to determine the mean values for contaminants in the groundwater.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the hazard quotients for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index can be generated. The hazard index provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. EPA has not prepared a hazard index for this site. However, Table III contains the hazard quotients for the mean (upper 95 percent confidence limit) groundwater concentration for the noncarcinogens. This table also contains the concentration that is equivalent to the reference dose.

Table III

Risk Characterization for Groundwater Contaminants
at Government Systems

Carcinogens	Groundwater Risk Level Maximum/Average	10^{-6} Excess Cancer Risk Concentration (ug/l)
1,1-Dichloroethane	$4.6 \times 10^{-3}/3.1 \times 10^{-4}$	0.39
1,1-Dichloroethylene	$1.1 \times 10^{-2}/8.3 \times 10^{-4}$	0.06
Methlyene Chloride	$5.5 \times 10^{-6}/1.1 \times 10^{-6}$	4.80
Trichloroethene	$5.7 \times 10^{-4}/9.6 \times 10^{-5}$	3.20
Vinyl chloride	$1.5 \times 10^{-1}/2.1 \times 10^{-2}$	0.02

Noncarcinogens[a]	Hazard Quotient Maximum/Average	Concentration Equivalent to RfD (ug/l)[b]
1,1-Dichloroethane	$4.3 \times 10^{-1}/2.9 \times 10^{-2}$	700
1,1-Dichloroethylene	$2.1 \times 10^{0}/1.6 \times 10^{-1}$	63
Methylene Chloride	$1.2 \times 10^{-2}/2.5 \times 10^{-3}$	420
Chlorobenzene	$1.6 \times 10^{-2}/3.6 \times 10^{-3}$	140
1,2-Dichlorobenzene	$6.2 \times 10^{-3}/1.6 \times 10^{-3}$	630
1,2-Dichloroethylene	$3.4 \times 10^{-1}/1.2 \times 10^{-1}$	140
Ethyl Benzene	$2.2 \times 10^{-2}/3.8 \times 10^{-3}$	700
Mercury	c	2
Chromium[d]	1.7×10^{-1}	35
Copper	e	---
Fluoride	$4.1 \times 10^{0}/1.5 \times 10^{0}$	420

a This category includes carcinogens which are also considered to have noncarcinogenic toxic effects. Hazard values were not quantified for lead since there are no current agency verified toxicity values for lead.

b This concentration represents the groundwater concentration equivalent to the RfD and a 20% relative source contribution.

c Mercury was not detected. However, in some cases, the detection limit used is 2.5 times greater than the CLP required quantitation limit.

d Chromium was detected above the detection limit in only one well. The maximum hazard quotient was based on the data from this well and the RfD for hexavalent chromium.

e The Hazard Quotient was not calculated because there is no RfD.

3.5 Environmental Risks

Under natural conditions, shallow groundwater discharges to Turkey Creek which runs south of the facility. At present, due to the pumping by GDU and the Harris groundwater extraction system, groundwater is reportedly not discharging to Turkey Creek. However, if the pumping is discontinued prior to complete remediation, terrestrial and aquatic organisms could be exposed via contaminated surface water. Discharge to surface waters via stormwater run-off is another potential environmental risk.

The National Oceanic and Atmospheric Administration (NOAA) review of site conditions identifies Turkey Creek as the principal area of either surface discharge or groundwater discharge. Future work on the remaining operable unit(s) should include sampling of the creek sediments in order to verify that past releases did not leave potentially toxic levels of contaminants in Turkey Creek.

4.0 Description of Alternatives

EPA considered six alternatives for the remediation of the groundwater associated with Government Systems. All of these alternatives are based on the use of the existing aeration treatment system operating at Government Systems.

In order to document all remedial alternatives considered at the site, this Record of Decision includes options eliminated early in the evaluation process. These options were reviewed by Harris prior to selecting the existing system and are presented here as Alternatives 4, 5, and 6. The comparison of all alternatives is based on a maximum system throughput of 750,000 gpd.

4.1 Alternative 1 - No Action

The Superfund Program requires that the "no-action" alternative be considered at every site. Under the "no-action" alternative, EPA would take no further action at the site to control or treat the source of

contamination. The "no-action" alternative serves as a baseline with which other alternatives can be compared. "No action" would involve shutting down the existing groundwater extraction and treatment system on each of the Harris and GDU properties. While this alternative does include groundwater monitoring, the only reduction of contaminant levels would be via natural processes such as dispersion. Potential health risks would remain from ingestion of, or dermal contact with, untreated groundwater. Furthermore, discharges into Turkey Creek could potentially result in a threat to terrestrial and aquatic organisms there.

The present (1990) value cost of this alternative is approximately $355,000. This estimated cost includes shutting down the existing treatment system at $50,000 and groundwater monitoring for five years at $61,000 per year.

4.2 Alternative 2 - Continued Operation of the Groundwater Extraction and Treatment System with Deep Well Injection

Alternative 2, Continued Operation of the Groundwater Extraction and Treatment System with Deep Well Injection, is currently being performed at the site pursuant to a Consent Order with the State of Florida. Table IV lists the aquifer cleanup levels specified in the FDER/Harris Consent Order.

Groundwater withdrawal is accomplished with a combination of 11 wells, six in the 80-foot zone and five in the 40-foot zone. VOCs are then removed and treated by a relatively simple multistage air stripping process. The treated water is currently used in a manufacturing process before being injected approximately 2500 feet deep into the lower Floridan Aquifer. The Floridan Aquifer is saline and nonpotable in the area. This injection process is regulated by FDER and EPA through an Underground Injection Control (UIC) permit for a Class I non-hazardous industrial well.

The existing system was implemented in three stages as described beginning on page 30.

Table IV

Aquifer Cleanup Levels Specified
in the FDER/Harris Consent Order

Consent Agreement Constituent	Design Specification (ug/L)
Trichloroethylene	<5*
1,1-Dichloroethylene	<5
Cis-1,2-Dichloroethylene	<5
Trans-1,2-Dichloroethylene	<5
Vinyl Chloride	<5*
1,1,1-Trichloroethane	<5
1,1-Dichloroethane	<5
Methylene Chloride	<25*
Ortho-Dichlorobenzene	<25
Chlorobenzene	<25
Ethyl Benzene	<25
Toluene	<25

* This concentration is higher than the current MCL or pMCL.

Stage 1:

To create a hydraulic capture zone on the southern boundary of the Harris Corporation Government Systems facility, Harris instituted an extraction program involving three wells (GS-123D, GS-124D, and GS-125D). These well positions allow for interception of contaminated water from the deep zone of the main VOC plume. The three wells create a cone of depression upgradient from the GDU production wells. The planned pumping rate of each of the hydraulic barrier wells was 25 gpm each. Field checks by Harris in 1985 indicated the following production rates for the hydraulic barrier wells:

Well	Rate
GS-123D	40 gpm
GS-124D	53 gpm
GS-125D	52 gpm

Stage 2:

Another deep extraction well (GS-127D) and 10 well points in the shallow zone were added during Stage 2, in order to initiate remediation activities in two areas. These areas were: (1) the highly contaminated shallow zone near Building No. 5 and (2) the southern part of the deep zone contaminant plume in the Government Systems parking lot. Well GS-127D is identical in construction to the three barrier wells used in Stage 1 and is equipped with a 50-gpm (nominal) submersible pump discharging to a header that transmits contaminated groundwater to the groundwater treatment system. Well GS-127D produced 50 gpm during continuous pumping of Stage 1 and Stage 2 wells in 1985. The well point system installed as part of Stage 2 allowed for the extraction of groundwater from contaminated areas of the shallow zone. These well points were designed to have a jetting shoe below the screen to allow installation by jetting. Two well point pumps provided the vacuum to run the system. The combined pumping rate of the 10 well points during Stage 1 and Stage 2

operation was about 30 gpm (measured at the groundwater treatment system). These well points were eventually replaced with two permanent wells, GS-44S and GS-18S.

Stage 3:

Implementation of Stage 3 allowed for the extraction of the most highly contaminated portion of the plume, in the vicinity of Building 6. Six additional wells were added during this stage: GS-35S (shallow or 40-foot zone), GS-35D (deep or 80-foot zone), GS-37S, GS-37D, GS-43S, and GS-43D. These wells are grouped in three pairs, with each pair consisting of a shallow zone and a deep zone well. All six wells are equipped with 50-gpm (nominal) submersible pumps. The shallow and deep zone extraction wells are operated at the pumping rates of 25 and 50 gpm respectively.

Treatment System Description:

The extracted groundwater flows through a network of pipes to a treatment system which removes VOCs by a packed column air stripping tower. The packed column aeration system is widely used for the removal of VOCs from contaminated drinking water. Contaminated groundwater is delivered from the extraction wells to a 20,000-gallon raw water holding tank. The raw water is pumped to the top of the 6-foot diameter tower and distributed over the packing media by a weir-trough distributor. The water cascades over 25 feet with counter-current air flow supplied by a forced draft centrifugal blower. The stripping tower is mounted on top of the 20,000-gallon treated water holding tank. Tower effluent flows by gravity into the holding tank and is then pumped to a water reuse system on the site.

The treated groundwater is used for process water under a Consumptive Use Permit issued by the St. Johns River Water Management District. After use as process water, the treated groundwater is disposed of by deep well injection into the lower Floridan Aquifer. This injection process utilizes a Class I non-hazardous well with an Underground Injection Control (UIC) permit monitored by FDER. The Floridan Aquifer is not

considered to be a potable water source in this area due to high Total Dissolved Solids (TDS) and chloride concentrations.

In addition to the system operating on the Harris facility, there is a groundwater extraction and treatment system ongoing at the GDU facility. Water from seven production wells is pumped to an air stripper. The stripper effluent is mixed with water from other GDU production wells before undergoing the standard water purification process prior to public consumption. The construction and monitoring of this system has been funded by Harris. An informal agreement exists between Harris and GDU such that GDU is to provide Harris six months advance notice in the event that GDU sells its property.

The existing treatment, disposal, and monitoring system has been implemented in stages since 1984. Alternative 2 would involve the continued use of this existing system for at least another three years. The present value (1990) cost of Alternative 2 is estimated to be $792,000. This cost includes operation and maintenance of the existing system and groundwater monitoring for three years at a total of $264,000 per year.

4.3 Alternative 3 - Modification of the Groundwater Extraction and Treatment System

Alternative 3 involves continued operation of the existing extraction and treatment system as well as a modification of the system. This modification will be designed to improve the capture of site-related contaminant plumes and optimize system effectiveness.

Modification is necessary to better define the contaminant plumes, ensure containment of these plumes, and enhance the efficiency of aquifer cleanup. Source characterization indicates the possible presence of metals and AEOs in the groundwater. The analyses to date do not adequately define this contamination. Therefore, modifications may be needed to more adequately monitor and, if necessary, treat this potential contamination in the groundwater.

EPA developed a list of proposed modifications for the purpose of estimating costs associated with Alternative 3. These modifications may include, but are not limited to: (1) installing approximately four additional extraction wells, (2) discontinuing the use of some existing wells, and (3) decommissioning monitoring wells that are no longer of use but are determined to be located in source areas. The exact number of wells affected and any altered pumping rates will be determined during the remedial design phase.

The remedial design will include a detailed design analysis of the existing system to determine the location of additional wells. It will also address, if necessary, the discontinued pumping of any existing wells. The design may include a schedule for temporarily shutting down the entire system to determine remedial action success. A shut-down would be initiated only after contaminant levels in the aquifer met the specified cleanup goals. This shut-down would allow the groundwater to recharge and reach an equilibrium condition. Additional sampling and analyses as well as careful monitoring of the aquifer could then determine whether or not the sources of contamination had been removed.

The existing groundwater monitoring program will be evaluated and modified as necessary to fully characterize the extent of contamination at the site. The modified monitoring program will be implemented for a period of three years or until the cleanup goals are met. After the onset of remedial action, EPA will conduct a review of the site within five years to verify that the aquifer is being restored to beneficial use. If the cleanup goals appear to be met after the first review, sampling would continue annually or semi-annually for a period of time necessary to verify that long-term restoration of the aquifer had occurred. However, if the review identifies a need for further remedial action, monitoring, or attainment of cleanup goals, the appropriate action will be initiated.

The present (1990) value cost for this alternative is estimated at $1,430,000. This estimated cost includes design modifications and construction of additional wells at a cost of $480,000. Also included is $950,000 for three years of system operation and maintenance as well as five years of groundwater monitoring.

4.4 Alternative 4 - Disposal via Spray Irrigation

This alternative would utilize the same groundwater extraction and treatment system described in Alternative 2. However, the method for disposal of treated groundwater involves spray irrigation with discharge to a drainage ditch.

Spray irrigation relies on two natural forces to dispose of water, evapotranspiration and percolation. Of the two, percolation is the predominant disposal method. Several design criteria are critical in evaluating a spray irrigation system: the amount of available acreage on which to apply the treated groundwater, hydraulic assimilation capacity of the site, and the application rate of the water.

The area has two major soil types, a satellite sand and Myakka sand. The estimated percolation rate of this area is approximately 0.6 inches/hr. Based on a hydrologic budget model prepared for the site, the average maximum hydraulic load the site could support is 3.9 inches per week. However, standing water has been observed throughout the dry season. This phenomenon is the result of improper drainage brought about by development on three sides of the site, creating a berming effect. In order to meet the requirements for spray irrigation, fill material would need to be brought in to raise the area approximately three feet.

In addition to its poor drainage, this site is further restricted by Section 17-6 of the Florida Administrative Code (FAC), which limits the hydraulic loading of slow rate (spray irrigation) systems to two inches per week (unless it can be sufficiently demonstrated that the land can handle higher hydraulic loading rates). Assuming that the maximum hydraulic loading allowed is two inches per week, the maximum amount of treated groundwater that could be applied to the site is 402,000 gallons per week (or approximately 57,000 gpd). The remaining portion of the treated water would have to be discharged to the drainage ditch. In order to handle 750,000 gpd at the two-inch-per-week maximum application rate, Harris estimates a need for approximately 100 acres of additional land.

One of the principal disadvantages of using a spray irrigation system is its dependence on weather conditions. Spray irrigation systems cannot be operated during or after periods of heavy or prolonged rainfall. During rainy periods, the treated groundwater would have to be stored or discharged to the drainage ditch. The spray irrigation system is also more labor intensive because the system must be switched on and off manually to meet the changing weather conditions and to avoid flooding of the area.

Environmentally, spray irrigation is attractive because it provides a secondary method of aerating the treated groundwater, and a portion of the water will be percolated back into the surficial aquifer for reuse. The principal environmental disadvantage is that almost half of the water will be discharged to the drainage ditch.

Harris does not currently have sufficient acreage for complete spray irrigation. In addition, the cost of bringing in fill to elevate the area is prohibitive. Environmentally, spray irrigation is preferable to reinjection. However, spray irrigation would be too land intensive, requiring approximately 100 acres of land to spray irrigate 750,000 gpd. Treated water would then have to be pumped approximately five miles. Site-specific features thus reduce the technical feasibility of Alternative 4. EPA did not estimate the costs associated with this alternative because it was eliminated early in the evaluation process and no current cost data exists.

4.5 Alternative 5 - Disposal via Percolation

This alternative utilizes the same groundwater extraction and treatment system described in Alternative 2. However, the method of disposal of treated groundwater would be to return the treated water to the surficial aquifer through a percolation pond with overflow to a drainage ditch.

For this alternative, several simplifying assumptions were made regarding the hydrogeology of the available eight acre tract. The first assumption was that the aquifer is an unconfined, homogeneous, isotropic, single-

layer system. (In reality, the site geology is known to be more complex and actually consists of three layers: an upper aquifer, an aquitard, and a lower aquifer.) Second, the assumed average permeability of the single-layer system was 150 gpd/ft^2. This value was determined by proportioning the measured permeability values and thickness of each of the three geologic layers. Third, the assumed average aquifer thickness was 93 feet, based on previous geological investigations. Other data used in this analysis include the following:

- average ground surface elevation at the site is +18' MSL
- average groundwater piezometric surface at the site is +10' MSL
- estimated distance to the Turkey Creek outfall is 2,500 feet
- percolation rate is 63 gal/day lineal foot of pond
- estimated water surface elevation at the Turkey Creek outfall is less than +2' MSL
- assumed maximum percolation pond water surface is +22" MSL
- assumed maximum usable pond area is 625' x 525' (7.45 acres), based on the berm configuration

These data and a modified version of Darcy's Law, led to the conclusion that the maximum seepage flow available at the 8 acre tract is about 40,000 gpd. However, the achieveable seepage rate at the site is probably much less than 40,000 gpd, because the actual subsurface conditions are less favorable for percolation than assumed in this analysis. Further, the actual hydraulic gradient may also prove to be lower than the gradient assumed for this analysis. One alternative would be to construct a percolation pond on the 8 acre tract and allow the overflow to discharge

to the drainage ditch. This would mean that during normal operating conditions, approximately 40,000 gpd would enter the soil and up to 710,000 gpd of treated groundwater would be discharged to surface waters.

There are several factors to be considered regarding the environmental impact of a percolation pond. On the positive side, the 8 acre pond would provide a 110 day retention time for treated water entering the pond, which would allow for further volatilization of any VOCs. The negative aspect to the percolation pond is that once the pond is filled, up to 710,000 gpd of treated water must be discharged to the surface waters and cannot be returned to the aquifer for use. In addition, volatilization will occur only at the surface interface unless an aerator is used to enhance volatilization of less accessible areas.

Harris does not currently own enough acreage adjacent to the Government Systems facility to construct a percolation pond to dispose of 750,000 gpd solely through percolation. Construction of a smaller percolation pond on the available land will allow percolation of an estimated 40,000 gpd. The remainder of the treated water will flow to the drainage ditch. The use of percolation ponds is not feasible, because there is insufficient acreage available to construct a percolation pond large enough to dispose of most of the treated groundwater. No current cost data exists for this alternative.

4.6 Alternative 6 - Disposal via Reinjection to the Surficial Aquifer

This alternative utilizes the same groundwater extraction and treatment system described in Alternative 2. However, the method of disposal of treated groundwater involves returning the treated water to the surficial aquifer via reinjection wells.

A review of the hydrogeological characteristics of the Harris site shows that reinjection into the surficial aquifer could take place in either of the two permeable zones present. The upper portion of the surficial aquifer is located from approximately +17' to -20' MSL and has an average permeability of 95 gpd/ft^2. The lower portion of the aquifer is located

from -30' to -80' MSL, with an average permeability of 200 gpd/ft^2.

Based on the transmissivity and permeability of the surrounding areas, 20 to 30 four-inch diameter shallow wells with five-foot screens capable of reinjecting 2 to 3.5 gpm would be required to inject 100,000 gpd treated water into the upper aquifer. The deeper zone of the surficial aquifer would require only three six-inch diameter wells with ten-foot screens reinjecting approximately 23 gpm to dispose of 100,000 gpd treated water.

In order to achieve maximum utilization of the available reinjection area, the wells must be located in lines running east and west, generally perpendicular to the north-south direction of groundwater flow. The required distance between wells is based on the cone of influence. This distance would be about 30 feet for the shallow wells and 200 feet for the deeper wells.

In selecting the system location, the first consideration is to position the reinjection wells outside the zone of influence associated with the groundwater withdrawal wells. This positioning is necessary to avoid a reduction in radius of influence of a given withdrawal system, and to avoid repumping treated groundwater. The only available reinjection area not in the zone of influence of the groundwater withdrawal wells is an eight acre tract located east of Perimeter Road on the Government Systems facility. Either two rows of 15 shallow wells each or three deep wells could be installed in this tract.

The presence of an aquitard at -20' to -28' MSL is another condition to consider. The aquitard limits the amount of water which can be injected into the shallow reinjection wells. Too great a reinjection rate will cause an upflow of the water, which could result in ponding. However, the aquitard has a positive effect on the deeper reinjection wells by acting as a barrier preventing water from rising to the surface.

The increased pressure applied to the aquifer should check any further dispersion of the contaminants to the east by establishing wells east of the suspected area of contamination. In addition, the reinjected water can be returned to the aquifer instead of being lost to surface water

discharge. However, there is a potential for introducing trace amounts of VOCs into groundwater currently considered free of these contaminants.

The existing groundwater treatment system has been designed to remove VOCs to the prescribed levels in the Harris/FDER Consent Order. This system also has operating safeguards such as an automatic shutdown in the event of a malfunction in the air stripping tower fan.

Despite these precautions, the possibility exists for inadvertently contaminating the aquifer due to the lag time between sampling the treated effluent and receiving the analytical laboratory results. Use of a 1.2 million gallon treated water holding tank would eliminate the possibility of discharging contaminated water into the aquifer. However, prior to initiating reinjection, an acceptable air to water ratio for achieving the concentration limits established in the Consent Order would be set during start-up activities. Once the normal operation begins, this ratio is expected to be fairly consistent. Therefore, failure of the tower fan is the only likely means of introducing contaminated groundwater into the clean zone of the aquifer. The motor control system design addresses this contingency. In the event of tower fan failure the influent pumps automatically shut down. As a result, the system would not require large holding tanks.

The preferred zone of reinjection would be outside the area of contamination in the lower surficial aquifer, which is more permeable, requires fewer wells and prevents ponding. Environmentally, reinjection offers two positive aspects. Pressurizing the aquifer will prevent the spread of VOC contamination to the east and allow the treated water to be reused by placing the water back into the surficial aquifer. The potential for reinjecting contaminated water back into a clean area may be reduced by incorporating the proper instrumentation and motor control switches to avoid discharge of contaminated water if the fan motor fails.

The information presented thus far for Alternative 6 relates to the reinjection of 100,000 gpd. In order to accommodate the reinjection of a maximum of 750,000 gpd, 20 additional deep reinjection wells would be required across the Government Systems property. However, according to

Harris, placement of the reinjection wells around the site would be difficult due to the extensive network of underground utilities. As with Alternatives 4 and 5, no current cost data for this alternative exists.

5.0 Summary of Comparative Analysis of Alternatives

EPA uses nine criteria for evaluating remedial alternatives at NPL sites. The first two are known as threshold criteria and are the minimum requirements that all alternatives must meet: overall protection of human health and the environment and compliance with site-specific cleanup standards. There are five balancing criteria used for comparison of the alternatives: long-term effectiveness; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; and cost. The last two, state acceptance and community acceptance, are known as modifying criteria and can serve to influence the EPA preferred remedy.

5.1 Overall Protection of Health and the Environment

Alternative 1, No Action, would allow for the continued migration of contaminants to the GDU wellfield downgradient of the site. This alternative is not considered effective because it does not mitigate potential health risks associated with exposure to groundwater by ingestion and dermal absorption. Alternative 1 exceeds the 1×10^{-4} to 1×10^{-6} target risk range and, therefore, is not protective of human health and the environment. The No Action Alternative will not be considered further as a remedial option for this site.

Alternatives 2 through 6 are protective of human health and the environment based on the use of air stripping treatment for VOCs. By providing a barrier for contaminant migration as well as treatment of the contaminant plume, these alternatives mitigate the risk of migration to the GDU well field and other potential users of the aquifer. The capture zone of the extraction system prevents migration as well as discharge of contaminated groundwater to surface water, thus avoiding a potential environmental threat.

5.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Remedial actions performed under CERCLA must comply with all site-specific Applicable or Relevant and Appropriate Requirements (ARARs). The ARARs for this site can be grouped into six categories. The Harris remediation system must comply with cleanup standards from: the Safe Drinking Water Act (SDWA), the Underground Injection Control (UIC) program, the National Pollutant Discharge Elimination System (NPDES), the Resource Conservation and Recovery Act (RCRA), the State of Florida Administrative Code (FAC), and the Clean Air Act (CAA).

All alternatives except for the No Action Alternative would comply with ARARs. "No Action" would allow contaminants to remain in the groundwater at concentrations above drinking water standards. This level of contamination would violate the SDWA and FAC. Alternatives 2-6 assist in restoring the levels of contaminants in the aquifer to drinking water standards and, therefore, lead to compliance with the SDWA and FAC. Water injected into the Floridan Aquifer in Alternatives 2 and 3 would meet the UIC permit requirements. Water discharged to the drainage ditch in Alternatives 2 and 3 would meet NPDES permit limits. In Alternatives 2-6, the extracted groundwater would be treated to meet health-based standards prior to disposal and would, therefore, meet the current RCRA Regional guidance regarding contaminated groundwater. Finally, emissions from the air stripper used in Alternatives 2-6 would meet National Ambient Air Quality Standards.

Safe Drinking Water Act

The SDWA mandates EPA to protect human health from contaminants in drinking water. Since the groundwater in the area of the Harris site is an existing drinking water source, the aquifer is classified as Class II groundwater. Therefore, the SDWA standards set by EPA are relevant and appropriate.

EPA has developed two types of drinking water standards, primary and secondary standards. Primary standards are based upon protection of human

health. These Maximum Contaminant Levels (MCLs) are enforceable at the federal level. MCLs are contaminant-specific standards and are potential ARARs for affected potable water at NPL sites. Section 121(d)(2)(b)(i) of CERCLA prescribes that these standards, as determined by the Safe Drinking Water Act (SDWA) (40 CFR Part 141 and 142) and Section 304 of the Clean Water Act, should be used in setting cleanup goals for response actions at NPL sites. Secondary standards (SMCLs) are often concerned with the aesthetic quality of water as well as economic considerations and are not enforceable at the federal level. However, SMCLs are in the category of standards "to-be-considered" (TBC) as ARARs in order to protect the groundwater for future use.

For some constituents, there are no primary or secondary standards established pursuant to the SDWA. In this event, concentrations of contaminants in groundwater remaining at the completion of the remedial action must still be protective of human health and the environment. For carcinogens, the one in one million (1E-6) cancer risk level is considered adequately protective of human health. For non-carcinogens, a threshold value may be determined from the currently available EPA toxicological data base. If a proposed MCL (pMCL) is available for a constituent, it may also be used. Proposed MCLs are not enforceable standards, but are considered TBCs.

In summary, Alternatives 2 through 6 meet the ARARs for VOCs based on use of the aeration treatment system. The primary ARARs that apply to aquifer remediation are the MCLs promulgated under the SWDA. These are applicable where water will be provided directly to 25 or more people or to 15 or more service connections. MCLs are relevant and appropriate when the surface or groundwater is used or may be used for drinking water. "To be considered" remediation goals, including proposed MCLs and risk based calculations, apply when a population is exposed to contaminants.

Underground Injection Control

The Safe Drinking Water Act also provides for a permit program which is designed to prevent contamination of underground sources of drinking

water. This program is known as the Underground Injection Control (UIC) program. The UIC program regulates underground injection into five classes of wells. There are two Class I permitted injection wells present on the Harris Corporation Government Systems facility for the disposal of industrial waste water. These wells are not currently permitted for the injection of hazardous waste. Therefore, the groundwater must be treated to health-based standards as described in the Table III on page 26 before injection.

Alternatives 2 and 3 involve additional ARARs for the deep well injection of treated groundwater into the Floridan Aquifer. The Floridan Aquifer is not a potential source for drinking water because it is saline and nonpotable. The UIC permit administered by FDER lists the injectate limits as shown in Appendix B.

National Pollutant Discharge Elimination System (NPDES)

In addition, the extraction and treatment system described in Alternatives 2 and 3 must comply with the National Pollutant Discharge Elimination System (NPDES) standards under the Clean Water Act (CWA). Currently, discharges from the treatment system to the drainage ditch east of Perimeter Road may occur during equipment failure or emergencies. As an alternative to deep well injection, the treated groundwater can be discharged to the surface through this permitted NPDES outfall. Any surface water discharge flowing into this ditch eventually runs into a tributary of Turkey Creek. The current NPDES discharge limits are listed in Appendix C.

Resource Conservation and Recovery Act

The volatile organic compounds present in the groundwater associated with Government Systems are characterized as spent solvents. Spent solvents are RCRA "listed" hazardous wastes as defined in 40 CFR 261.31. Since it contains a listed hazardous waste, the contaminated groundwater must be

managed as a hazardous waste. As a result, groundwater containing hazardous waste cannot be injected into the Class I injection wells at the site. To do so would be in violation of RCRA and UIC requirements, including the Land Disposal Restrictions. After treatment to health-based levels, which the Harris system accomplishes, EPA considers that the groundwater no longer contains hazardous waste. Once these health-based levels are reached, the groundwater is no longer subject to regulation under Subtitle C of RCRA.

In addition, EPA has determined that Resource Conservation and Recovery Act (RCRA) technical standards regarding corrective action and closure are relevant and appropriate for the groundwater plumes and contaminant source areas at Government Systems. Corrective action on any portion of the site determined to be releasing contaminants to the groundwater will comply with RCRA technical standards.

Florida Administrative Code

EPA considers all appropriate state standards as potential ARARs. The State of Florida has requested that EPA include the Florida Administrative Code (FAC) requirement that the aquifer be cleaned up to a level such that the groundwater is "free from nuisance". EPA has determined that the "free from" requirement, a secondary standard pursuant to the SDWA, is relevant and appropriate for this site. The existing Consent Order between FDER and Harris lists protective standards for aquifer cleanup. These standards are considered to meet the "free from" criteria for the site.

Clean Air Act

Emissions from the air stripper used in Alternatives 2-6 must meet ambient air standards from the National Ambient Air Quality Standards (Section 109 of the Clean Air Act as set forth in 40 CFR Part 50).

Cleanup Goals for Operable Unit One

Table V is a list of the site-specific contaminants and the appropriate cleanup levels based on the ARARs discussed above. These cleanup levels are based on MCLs, the FAC "free from" requirements, pMCLs, 1E-6 health-based risk values, and SMCLs as appropriate for each contaminant listed.

The State of Florida MCLs that are more stringent than federal standards will be used as ARARs. In addition, the cleanup criteria identified in the FDER/Harris Consent Order will be used to meet the FDER "free from" requirements. This approach provides for consistent application of the FDER Consent Order with respect to EPA response goals.

5.3 Long-Term Effectiveness and Permanence

Alternatives 2-6 mitigate the risk to the population of exposure to contaminated groundwater. The extraction and treatment system used in all of these alternatives adequately reduces the exposure to VOCs in the groundwater. Alternative 3 allows for enhanced control of contaminant migration by making the system more efficient in treating for VOCs as well as addressing the potential for AEO and inorganic contaminants. Alternative 3 would also remediate the groundwater to a long-term acceptable risk range. Alternative 6 involves some risk due to the reinjection of treated groundwater to the surficial aquifer. In Alternative 6, this risk is associated with the potential exposure to contaminants in the drinking water from downward migration to the lower aquifer.

5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 2-6 reduce the toxicity and volume of the contaminants in groundwater through treatment. In addition, these alternatives limit the mobility of contaminants by decreasing the size of the contaminant plume and/or eliminating part of the source through the use of extraction

TABLE V

Government Systems Groundwater Remediation Goals

Contaminants	Concentration (ppb)	Basis
Vinyl chloride	1	MCL (1)
Trichloroethylene	3	MCL (1)
1,1-Dichloroethylene	5	CO
c-1,2-Dichlorethylene	5	CO
Methylene chloride	5	1E-6, pMCL, TBC
1,1-Dichloroethane	5	CO
Chlorobenzene	25	CO
t-1,2-Dichloroethylene	5	CO
1,2-Dichlorobenzene	25	CO
Ethyl benzene	25	CO
Toluene	25	CO
1,1,1-Trichloroethane	5	CO
Trichlorobenzene	25	CO
Lead	15	MCL (2), TBC
Mercury	2	MCL
Chromium	50	MCL
Copper	1000	SMCL
Fluoride	2000	SMCL

MCL Maximum Contaminant Level

(1) The State of Florida has promulgated MCLs for TCE and VC which are more stringent than EPA's MCLs, therefore, the State MCLs are ARARs for the Harris Site.

(2) The present MCL for lead is 50 ppb. A level of 15 ppb has been proposed as a health-based standard and is, therefore, a to-be-considered (TBC) site cleanup goal.

CO These standards are listed in the 1983 FDER/Harris Consent Order and are considered to be the "free from" criteria identified in the Florida Administrative Code.

TBC To-be-considered cleanup goal

1E-6 One in one million excess cancer risk level

pMCL Proposed Maximum Contaminant Limit (40 CFR/ Vol. 54, No. 97/ May 22, 1989)

SMCL Secondary Maximum Contaminant Level

Note: This list does not include cleanup goals for acid extractable organics (AEOs) because current sampling data do not identify specific AEOs.

wells. Alternative 3 not only allows for more efficient reduction of the contaminant plume, it allows for treatment of the potential groundwater contamination from metals, fluoride, and AEOs.

5.5 Short-Term Effectiveness

Alternatives 2-6 eliminate the immediate risk to the general population of exposure to contaminated groundwater. Any short-term risk to workers involved in construction of the selected remedy would be reduced through implementation of a health and safety plan.

The environmental impact of alternatives 2 and 3 is minimal since groundwater is reinjected into the deep Floridan Aquifer which is not a potable water source in the area. Alternatives 4 and 5 pose some environmental impact to aquatic organisms exposed to the surface water and any volatile organics. Alternative 6 poses an environmental threat to the surficial aquifer by potentially introducing trace amounts of VOCs to an area currently considered free of contamination.

Alternatives 2 and 3 would each require an estimated three years to implement. Implementation time frames for Alternatives 4 through 6 are not applicable because these alternatives were considered and eliminated at an early stage of the project.

FDER estimates that Alternative 2 will substantively meet the cleanup criteria stated in the FDER Consent Order within three years. Implementation of Alternative 3 will take approximately three years and will produce information necessary to estimate the time required for restoration of the aquifer to EPA standards.

5.6 Implementability

The implementability of an alternative is based on technical and administrative feasibility, constructibility, and the availability of materials and services needed to implement a specific remedy.

Alternatives 2 and 3 are technically and administratively feasible. These two alternatives involve technologies which have been used in the past and have a demonstrated performance record. The groundwater recovery, treatment, and disposal system specified in Alternative 2 is already operational. Alternative 3 also utilizes this system, but with modifications. Alternatives 4 and 5 are not currently implementable due to a lack of available land. Alternative 6 is not administratively feasible because of the potential for contamination of a drinking water aquifer in the event of equipment failure. The technical feasibility is questionable because of the uncertainties in our ability to predict its effect on the physical characteristics of the aquifer. For example, reinjection into the surficial aquifer may introduce indeterminate influences on the existing groundwater flow patterns.

EPA policy allows for interim remedies at sites involving groundwater contamination. An interim remedy can be location-specific or medium-specific and should be used when there is enough existing information to effect the remedy. A limited evaluation of alternatives can be used to compare the advantage of taking an early action to the possible ramifications of waiting until a comprehensive site investigation has been completed. An interim groundwater extraction and treatment system at Harris has served to protect the drinking water supplied by GDU. As a result, the phased implementation of the existing treatment system produced data that can be used in optimizing the system during the modifications to be determined in Alternative 3.

5.7 Cost

The present worth value represents the total cost of remediation expressed in today's dollars. The present worth cost associated with Alternative 1 is approximately $355,000. Alternative 2 has an estimated present worth cost of $792,000, including Operations and Maintenance (O&M) costs. The estimated present worth cost of Alternative 3 is $1,430,000, including O&M costs. The costs associated with Alternatives 4 through 6 have not been estimated because these alternatives were eliminated early in the evaluation process and no current cost data is available.

5.8 State Agency Acceptance

The State of Florida, as represented by the FDER, concurs with the use of Alternative 3 for Operable Unit One. This alternative is acceptable to FDER with provisions that the FDER is a part of the review process for the design analysis. In an early action designed to capture the contaminant plume and protect the GDU wellfield, FDER approved the use of Alternative 2 after also considering Alternatives 4-6.

5.9 Community Acceptance

EPA received comments from local citizens at the public meeting held on March 27, 1990 and during the public comment period. Responses to specific comments are available in the Responsiveness Summary for this Record of Decision. Based on these comments, the community supports the EPA decision to modify the existing groundwater extraction and treatment system at the Harris site.

6.0 Selected Remedy

Operable Unit One addresses the groundwater contamination associated with the Government Systems facility of Harris Corporation. The selected remedy for this operable unit is Alternative 3, which requires modification to the existing groundwater extraction and treatment system.

This remedy consists of: (1) continued operation of the existing extraction, treatment, and disposal system, (2) a design analysis for plume containment and treatment, (3) modification of the system based on results of the design analysis, (4) continued sampling and monitoring of the cleanup, and (5) a review of the system by EPA and FDER within five years after the onset of remedial action. This remedy includes the current deep well injection of groundwater treated to EPA health-based levels. As an alternative, the treated groundwater will be discharged to the surface through a NPDES permitted outfall.

Implementation of Alternative 3 will improve the treatment and containment of the existing groundwater extraction and treatment system. It will involve a review of existing sampling data as well as the resampling of wells outside the plume as defined by Harris. This alternative will determine the effects of the present remediation system in accordance with existing EPA policy. The effects to be determined include the current and future effects of the air emissions from the air stripping towers at Harris and GDU. In addition, EPA will determine the effectiveness of plume containment with respect to VOCs, AEOs, and inorganics as well as the effects of the various groundwater pumping regimes in the immediate area. Furthermore, Alternative 3 does not involve significant additional capital costs to attain these measures.

As part of the design analysis, "point of compliance wells" will be designated in order to detect the presence of contamination above cleanup standards. Sampling information obtained from these wells will be used to determine exact locations of the plumes and design groundwater extraction modifications for compliance with the RCRA technical standards.

The cleanup goals for this alternative are listed in Table V on page 46. These cleanup levels may be modified in accordance with later guidance and/or regulations. In addition, the goals may be modified due to potential uncertainties about the ability of the treatment system to achieve established cleanup goals within the existing physical groundwater system.

The Interagency Section 7 Consultation Process, 50 CFR Part 402, requires that EPA consult with the Department of Interior, the Fish and Wildlife Service, and the National Marine Fisheries Service as appropriate during remedial design. This consultation will assure that endangered or threatened species are not adversely impacted by implementation of this remedy. EPA has already consulted with the National Oceanic and Atmospheric Administration on the potential environmental risks posed by the site.

7.0 Statutory Determinations

The EPA and FDER have determined that this remedy will satisfy the CERCLA statutory requirements for providing protection of human health and the environment, attaining ARARs related to other federal and state environmental statutes, is cost-effective, and utilizes either permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

At the date of this decision, the selected remedial action meets all Federal and State requirements. However, EPA is currently reviewing Harris compliance with the FDER UIC program as well as the Safe Drinking Water Act. As a result of this review, Harris may be required to make modifications as necessary.

7.1 Protection of Human Health and the Environment

The selected remedy of groundwater extraction, treatment, and deep well injection to the Floridan Aquifer is protective of human health and the environment. By containing the contaminant plume, treating the contaminated groundwater, and removing the sources of contamination, this remedy will eliminate the contaminant plume. This remedy will eliminate the risk of migration to the GDU well field and the entire potable aquifer. By reducing the level of contamination in the groundwater, this remedy will reduce the carcinogenic and noncarcinogenic risks associated with exposure to the untreated groundwater.

The existing treatment system was designed for treating groundwater in order to meet cleanup levels established in the FDER/Harris Consent Order. In this system, treated groundwater is discharged to the Floridan Aquifer rather than to surface water and, as a result, presents no environmental risk. This water is presently recycled for manufacturing use as exhaust scrubber water before disposal via deep-well injection.

7.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

This remedy assures that the contaminated aquifer will be cleaned up to meet appropriate MCLs under the SDWA. For those chemicals that do not have an assigned MCL, the ARARs based on to-be-considered health-based values, FAC "free from" requirements, or SMCLs will be attained. Discharge from the groundwater treatment system will meet either the UIC permit injection standards or NPDES permit discharge limits under the CWA. The treated groundwater will meet RCRA Land Disposal Restrictions prior to disposal. The contaminant plumes will be monitored and remediated according to the technical standards for RCRA corrective action and closure. In addition, emissions from the air stripper will comply with the National Ambient Air Quality Standards.

7.3 Cost-Effectiveness

The EPA selected remedy, Alternative 3, allows for a higher degree of overall protectiveness. Modification of the existing extraction and treatment system in accordance with the EPA groundwater remediation policy will enhance cleanup of the aquifer. Alternative 3 requires continuation of the existing process for discharging the treated groundwater by injection into the Floridan Aquifer which is a nonpotable water source in the area. However, this remedy allows for full characterization of contamination at Government Systems and enhances the elimination of the contaminant plume. Therefore, the selected remedy yields an overall effectiveness that is proportional to its increased costs.

7.4 Utilization of Permanent Solutions and Alternative Treatment Technology or Resource Recovery Technologies to the Maximum Extent Practicable

EPA and FDER have determined that this remedy is the most appropriate remedy for Operable Unit One and provides the best balance among the evaluation criteria for the remedial alternatives evaluated. Alternative

3 provides both short- and long-term protection to potential human and environmental receptors. This remedy allows for containing, treating and eliminating the groundwater contamination in order to reduce risk from potential exposure to the groundwater. In addition, this remedy utilizes a proven technology for treating VOC contamination and can be implemented year round.

7.5 Preference for Treatment as a Principal Element

Groundwater contamination with volatile organic compounds is the principal threat at the site. Air stripping is an effective remediation method for treating groundwater contaminated by VOCs.

APPENDIX A

REPORTS ON PREVIOUS INVESTIGATIONS CONDUCTED AT THE GOVERNMENT SYSTEMS FACILITY

Reports on Previous Investigations
Conducted at the Government Systems Facility

CH2M Hill. Phase I Report - Aquifer Contamination Studies at Port Malabar Well Field. Document GN10067.JO. August, 1983

CH2M Hill. First Interim Report on Groundwater Contamination Studies at Port Malabar Well Field - Phase II. Document GN16067.NO. February, 1984.

CH2M Hill. Second Interim Report on Groundwater Contamination Studies at Port Malabar Well Field - Phase II. Document GN16067.NO. March, 1984

Geraghty & Miller, Inc. Building 6 Ground-water Assessment - Government Systems - Harris Corporation, Palm Bay, Florida. July, 1987.

Geraghty & Miller, Inc. Addendum to Building 6 Ground-water Assessment in Palm Bay, Florida. July, 1988.

Geraghty & Miller, Inc. Harris Corporation National Priority List Review of Remedial Investigations, Feasibility Studies and Remedial Actions, Government Systems Facility. May, 1989.

Geraghty & Miller, Inc. Summary of Soils Investigations and Metals in Ground Water, Harris Corporation, Palm Bay, Florida. April 1990.

Post, Buckley, Schuh & Jernigan, Inc. Harris Corporation - Groundwater Studies - Vicinity of General Development Utilities and Palm Bay, Florida - Investigations: March - October 1982. October 21, 1982.

Post, Buckley, Schuh & Jernigan, Inc. Analysis of Potential Groundwater Withdrawal and Treatment Systems. March 8, 1983.

Post, Buckley, Schuh & Jernigan, Inc. Harris Corporation Task B-4 - Final Report of Hydrogeological Study. Document 780-002.34. December 2, 1983.

Post, Buckley, Schuh & Jernigan, Inc. Harris Corporation Task B-1 - Soil and Sediment Investigation. Document 780-002.31. March, 1984.

Post, Buckley, Schuh & Jernigan, Inc. Harris Corporation Task B-2 - Surficial Groundwater and Analysis Summary Report. Document HC#7/780-002.32. January 25, 1984.

Post, Buckley, Schuh & Jernigan, Inc. Bench-Scale Treatability Study or Air Stripping of Selected Volatile Organics. Document 775-003.72. April, 1984.

Post, Buckley, Schuh & Jernigan, Inc. Harris Corporation Task B-8 - Old Storm Sewer Investigation Interim Report. Document 780-002.38. May, 1984.

APPENDIX B

UNDERGROUND INJECTION CONTROL
CLASS I PERMIT INJECTION LIMITS

Underground Injection Control
Class I Permit Injection Limits

PERMITTEE:
Harris Corporation

I. D. Number:
Permit/Certification Number:
UC05-126519
Date of Issue:
Expiration Date: 7/1/92

SPECIFIC CONDITIONS:

8. Monitoring - Deep Injection Wells

The deep injection well shall be monitored in accordance with the requirements of Rule 17-28.26(2), F.A.C. The permittee shall submit monthly a report which shall at a minimum include the following data for each injection well:

Daily specific conductance
Daily pH
Daily temperature
Daily average injection pressure (psi)
Daily maximum injection pressure (psi)
Daily minimum injection pressure (psi)
Daily minimum flow rate (gpm)
Daily average flow rate (gpm)
Daily maximum flow rate (gpm)
Total volume discharged → Daily (gallons)
Total volume discharged → Monthly (gallons)
Monthly average of total volume discharge per day

9. Monitoring - Treatment Plant

The effluent stream shall be monitored monthly for the following parameters. A copy of these data shall be submitted monthly to the Technical Advisory Committee (TAC).

Organic	Deep Well Effluent Limits/Month Average
Trichloroethane, ug/l	5
1,1,1,-Trichloroethane, ug/l	5
Methylene Chloride, ug/l	25
O-Dichlorobenzene, ug/l	5
Tetrachloroethene, ug/l	5

PERMITTEE:
Harris Corporation

I. D. Number:
Permit/Certification Number:
UC05-126519
Date of Issue:
~~Expiration~~ Date: 7/1/92

SPECIFIC CONDITIONS:

Inorganic

BOD 5 Day	*
Chemical Oxygen Demand (C.O.D.), mg/l	*
Dissolved Oxygen (D.O.), mg/l	*
Total Kjeldahl Nitrogen (T.K.N), mg/l as N	*
Ammonia, mg/l as N	*
Un-ionized Ammonia (NH_3), mg/l as N	*
Total Phosphorus (TP), mg/l as P	*
Total Suspended Solids, mg/l	*
Arsenic, mg/l	5
Cadmium, ug/l	10
Chromium, mg/l	0.05
Copper, mg/l	1
Cyanide, ug/l	10
Fluoride, mg/l	200.0
Lead, mg/l	0.05
Mercury, ug/l	0.2
Nickel, mg/l	0.1
Selenium, mg/l	1
Silver, ug/l	50
Zinc, mg/l	5

*General Limitation: Must be compatible with the injection system, injection zone, and confining zone and not hazardous pursuant to Section 17-30.03(1), Florida Administrative Code.

The treatment plant shall be operated in such a manner as to maintain specific parameters within the above listed effluent limitations.

10. Monitoring - Monitor Wells

A representative ground water sample shall be obtained from the monitor well(s) monthly. These samples shall be analyzed for the following parameters. The results of these analyses shall be reported in the monthly operating report submitted to the department.

Fluoride	TDS
Total Kjeldahl Nitrogen	Specific Conductance (field)
pH	Total Phosphorus
Chloride	Sulfate

APPENDIX C

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT DISCHARGE LIMITS

National Pollutant Discharge Elimination System
Permit Discharge Limits

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning October 1, 1984 (or upon start-up of discharge) and lasting through the term of this permit, the permittee is authorized to discharge from outfall serial number 002, treated groundwater only.

Such discharges shall be limited and monitored by the permittee as specified below:

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS kg/day (lbs/day) Daily Average	Daily Maximum	Other Units (Specify) Daily Average	MONITORING REQUIREMENTS Measurement Frequency	Sample Type
Flow, M^3/Day (MGD)	-	-	-	Continuous	Recorder
Trichloroethene	-	-	< 5 µg/l	1/Week	Grab
1,1-dichloroethene	-	-	< 5 µg/l	1/Week	Grab
1,2-cis-dichloroethene	-	-	< 5 µg/l	1/Week	Grab
1,2-trans-dichloroethene	-	-	< 5 µg/l	1/Week	Grab
Vinyl chloride	-	-	< 5 µg/l	1/Week	Grab
1,1,1-trichloroethane	-	-	< 5 µg/l	1/Week	Grab
1,1-dichloroethane	-	-	< 5 µg/l	1/Week	Grab
Methylene chloride	-	-	< 25 µg/l	1/Week	Grab
1,2 dichlorobenzene	-	-	< 25 µg/l	1/Week	Grab
Chlorobenzene	-	-	< 25 µg/l	1/Week	Grab
Ethyl benzene	-	-	< 25 µg/l	1/Week	Grab
Toluene	-	-	< 25 µg/l	1/Week	Grab

The pH shall not be less than 6.0 standard units nor greater than 8.5 standard units and shall be monitored once per week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): nearest accessible point after final treatment but prior to actual discharge or mixing with the receiving waters.

RESPONSIVENESS SUMMARY

HARRIS CORPORATION / PALM BAY FACILITY SUPERFUND SITE PALM BAY, BREVARD COUNTY, FLORIDA

JUNE 28, 1990

VOLUME I

PREPARED FOR:

U.S. ENVIRONMENTAL PROTECTION AGENCY REGION IV

ATLANTA, GEORGIA

EPA WORK ASSIGNMENT NO. 06-4XL8
UNDER
ARCS IV CONTRACT NO. 68-W9-0048

PREPARED BY:

EBASCO SERVICES INCORPORATED
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RESPONSIVENESS SUMMARY

HARRIS CORPORATION/PALM BAY FACILITY SUPERFUND SITE

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G	Written Public Response
H	Harris Corporation Response
I	General Development Utilities Responses

1.0 INTRODUCTION

A public meeting addressing the Harris Corporation/Palm Bay Facility Superfund Site was held by the U.S. Environmental Protection Agency (EPA), Region IV, at the Palm Bay Community Center in Brevard County, Florida on March 27, 1990. The meeting was chaired by Ms. Camilla Warren, Chief of the South Florida Superfund Section. Other attendees from the EPA Region IV office in Atlanta, Georgia were Ms. Gail Scogin, Superfund Remedial Project Manager for the site; Ms. Suzanne Durham, the Superfund Community Relations Coordinator; Ms. Becky Fox, Regional Toxicologist and Mr. Robert James from the Office of Regional Counsel. Mr. Joe Applegate, State Project Manager with the Florida Department of Environmental Regulation (FDER) and Mr. Larry Sims from Geraghty & Miller, Incorporated, a consultant for Harris Corporation, presented information on the site history and actions taken to date.

The purpose of the meeting was to inform the public of the groundwater remediation alternatives considered at the Government Systems facility on the Harris site and to discuss the alternative preferred by EPA. EPA first presented the evaluation of alternatives and the preferred alternative in the Superfund Proposed Plan Fact Sheet mailed to members of the community on March 16, 1990 (Attachment A). This Fact Sheet was also made available to the public along with the Administrative Record at the Palm Bay Public Library. EPA announced the public meeting and document availability in a legal advertisement in the Florida Today Sunday newspaper on March 18, 1990 (Attachment B). The fact sheet and legal notice announced the public comment period which began on March 18, 1990 and ended on April 17, 1990. Local newspapers published articles on site issues on December 13, 1989 and March 25 and 27, 1990 as shown in Attachment C.

This Responsiveness Summary documents the comments received by EPA Region IV during the public comment period regarding the proposed cleanup alternatives described in the Proposed Plan Fact Sheet and as presented at the public meeting held March 27, 1990. This Responsiveness Summary provides the EPA with information about the views of the community and potentially responsible parties regarding the proposed remedial action and alternatives. The Responsiveness Summary documents how public comments have been considered during the decision-making process and provides answers and information to questions and issues raised. The Responsiveness Summary becomes available to the public as part of the Record of Decision (ROD) upon signature by the Agency.

The record of attendance, provided as Attachment D, lists 49 attendees including representatives from Harris Corporation, General Development Utilities, Incorporated (GDU), Florida Audobon Society, Turkey Creek Sanctuary Advisory Board, Florida Institute of Technology, the Orlando Sentinel newspaper, South Brevard Water Authority as well as city, county and state officials.

Attachment E contains the transcript of the public meeting. EPA and Harris Corporation utilized overhead transparencies in the meeting presentations to describe the site history, groundwater contamination, and the existing Harris remediation program as well as five additional remedial action alternatives. EPA provided copies of the overheads and other information to meeting attendees. Attachment F contains the meeting handouts.

2.0 OVERVIEW OF THE PROPOSED PLAN

Of the six alternatives evaluated, EPA has determined that the preferred alternative is Alternative 3, modification of the existing groundwater extraction and treatment system. Alternative 3 compares favorably with the alternatives based on an evaluation using the nine criteria mandated by the Superfund Amendments and Reauthorization Act of 1986 (SARA). EPA defines Operable Unit One as the groundwater contamination associated with the Government Systems facility at Harris. EPA has further identified at least one additional operable unit for management of response activities at other portions of the site. Any additional operable units will involve subsequent RODs.

This ROD presents Alternative 3 as the appropriate course of remedial action for Operable Unit One at the Palm Bay site. This remedy consists of (1) continued operation of the existing extraction and treatment system, (2) a design analysis for plume containment and treatment, (3) modification of the system based on results of the design analysis, (4) continued monitoring of the cleanup, and (5) a review of the system and cleanup progress by EPA and FDER after a period of five years.

Based on comments received during the public comment period, the residents and local officials are amenable to EPA-directed modifications to the existing treatment system. However, one resident stated specifically that he is against the use of deep well reinjection. Citizens submitted ten response cards to EPA, six at the conclusion of the public meeting and four during the public comment period. In addition, EPA received five letters: one letter presented at the public meeting by counsel for GDU and four mailed in during the public comment period. Attachment G contains all written comments from the public received during the

public comment period. Attachment H contains the response submitted by Harris Corporation, the potentially responsible party (PRP). Attachment I provides GDU comments and responses received by EPA.

ACKGROUND ON COMMUNITY INVOLVEMENT

nity interest in the Harris Corporation/Palm Bay Facility
to the spring of 1982 when news media sources announced that
ndwater contamination was discovered at GDU wells. FDER
equently reached an agreement with Harris in 1983 to determine
extent of contamination and implement a groundwater restoration
gram. In 1984, FDER held two public meetings at Palm Bay's City
ncil Chambers to discuss contamination found on Harris and GDU
operties. At the second meeting on April 26, 1984, FDER
nounced that GDU's treatment system was successfully removing
ontamination from the drinking water supply.

The population of Palm Bay has doubled since 1982, and many newer community members have no knowledge of the history of groundwater concerns at the Harris and GDU properties. City officials reported that no public concern has surfaced since the 1984 public meetings regarding the site and there has been limited news media attention. The Florida Today newspaper announced that the Harris site was being proposed as a Superfund site in 1985. EPA announced final inclusion of the Harris/Palm Bay site on the National Priorities List (NPL) in July 1987.

Currently, FDER and Harris Corporation officials provide local government agencies with regular updates and monitoring reports. Officials from these local agencies also expressed an interest in being informed of EPA involvement.

The principle public concerns expressed during FDER remediation activities at the Harris site were groundwater contamination and resulting public health concerns. FDER addressed these concerns through newspaper coverage by announcing that contaminated wells at GDU had been removed from production service, thereby minimizing

any potential threat to human health. FDER also identified successful groundwater treatment methods being used by both Harris and GDU. Other public concerns included surface water contamination, especially if it should reach Turkey Creek, as well as potential increases in water utility rates.

4.0 SUMMARY OF COMMENTS RECEIVED AND AGENCY RESPONSE

Comments raised during the Harris Corporation/Palm Bay Facility public comment period on the proposed plan are summarized briefly below. The comment period was held from March 18, 1990 to April 17, 1990. All written public comments received by EPA are provided as Attachment G. The comments are categorized by relevant topics.

4.1 Health Issues

1. Has a health risk analysis been performed at the site, and if so, is it available to the public?

EPA Response: In October, 1988 the Florida Department of Health and Rehabilitative Services (FDHRS) published a preliminary Health Assessment prepared for the Agency for Toxic Substances and Disease Registry (ATSDR). This report states that "based on the existing condition of the Harris Corporation site, the potential environmental pathways of concern are migration of contaminated groundwater and windblown volatile organic compounds from the air stripper. Potential human exposure pathways of primary concern are ingestion and dermal absorption of contaminated groundwater, and inhalation of off-gassing volatiles from the air stripping system."

During pilot testing of the air stripping tower at Harris, FDER analyzed projected air emissions. This analysis indicated that the projected volume of emissions was not high enough to present an unacceptable health risk. EPA performed a similar analysis in February, 1990 using the FDER air emissions criteria used for the pilot test on the 1988 and 1989 air stripper data from Harris. This analysis showed that the air stripper emissions in 1988 and 1989 were within the limits used by FDER for the projected emissions.

Since the original FDER analysis, the exposure limits for many of the volatile organic compounds have been reduced and newer clean air regulations have been enacted by Florida and EPA. EPA is currently analyzing the air stripper emissions using the most recent Florida and EPA criteria and comparing the results with health risks and the recently revised Clean Air Act and FDER equivalents. EPA will require that the air stripper emissions comply with the new requirements.

In order to address the remaining exposure pathway of groundwater ingestion, EPA prepared a risk (or endangerment) assessment based on the available groundwater sampling data. This risk assessment, in the form of a memo, shows the results of calculations for the risks associated with the consumption of groundwater. These calculations indicate that drinking untreated groundwater at Government Systems would constitute an unacceptable human health risk. This memo as well as the other EPA and ATSDR documents are available in the Administrative Record for public review.

2. Do VOCs in groundwater percolate up through the soil - or concrete, if there are cracks in the concrete?

EPA Response: According to ATSDR, it is possible for VOCs to volatilize from the water table and migrate through the soil and cracks in the concrete to reach the air above ground. The VOCs migrating through the soil typically enter the air via the soil/air interface or via cracks in the concrete in areas where the soil is covered.

Some workers at the site have expressed concern about VOCs entering the buildings. A National Institute of Occupational Safety and Health (NIOSH) representative states that the migration of VOCs through cracks in concrete and into the buildings is unlikely to cause a health hazard at this site. While it is possible for VOCs to enter the buildings, the

health hazard would be minimized by the air exchange rate in the buildings and the dilution of the VOCs by the existing air in the buildings. Please see the response to Question 3 for more information.

3. Are there any risks at this site from breathing either indoor or outdoor airborne contaminants?

EPA Response: FDER analyzed outdoor emission projections for the air stripper which do not indicate that inhalation presents a health-based risk at this site. Further, EPA received the results from indoor air quality studies performed in November, 1989 by NIOSH and concurrently by the Harris Corporation Health and Safety Department. The detection limits that NIOSH used are well below the levels established by the Occupational Safety and Health Administration (OSHA) as permissible for an eight hour occupational exposure. These studies indicate that the indoor air in Building 8 on the Harris facility is not contaminated with airborne volatile organic compounds. In addition, the health symptoms reported to NIOSH in a self-administered employee questionnaire "were mostly respiratory and sinus complaints which could have been the result of allergies, colds, or episodic respiratory infections commonly experienced by any worker population."

4. Is it acceptable for people to be working at this site? What are the risks, health effects, or possibility of one dying as a result of working 10 or 20 years at this site in a location directly above the area of highest concentration in the groundwater plume?

EPA Response: Various studies and investigations have been conducted at the site by FDER, USEPA, ATSDR, and NIOSH. Neither the information available from these studies nor the

scientific literature indicate that undue or significant adverse health effects can be expected or have been observed from exposure to the VOCs in the groundwater.

In addition, there is no information in the scientific or medical literature that addresses the possibility of dying from long term above-ground exposure to VOCs in groundwater. Further comments on this issue would be conjecture.

5. Has any health monitoring for chemical toxicity symptoms in workers been done at this site? If so, are these reports available to the public? Will medical profiles be established for workers at the site?

EPA Response: These are issues that are appropriately directed to the Harris Corporation Health and Safety Department. EPA contacted Harris and determined that certain Harris employees undergo routine medical monitoring based on the potentially hazardous nature of their jobs. However, monitoring of other workers at the site would be initiated at the request of an individual employee or Program Director, in the case of a non-Harris employee. Harris reported that to date there have been no individual requests for medical surveillance.

6. Have local cancer rates been studied to see if there is a correlation between chemical exposure at Harris and the incidence of cancer?

EPA Response: EPA is not aware of any such studies. However, the FDHRS maintains a cancer surveillance program on each county in Florida. One can obtain further information from:

Dr. Roger Inman, Chief
Toxicology and Hazard Assessment Section
Florida Department of Health and Rehabilitative Services
1317 Winewood Boulevard
Tallahassee, FL 32301

The telephone number is (904) 488-3931.

7. Have local health officials/professionals been given detailed information about the location, type, and toxicity levels of the chemical pollutants related to this site?

EPA Response: Information on chemical pollutants at this site is publicly available in two ways. First, EPA established an information repository on March 6, 1990 containing information about the groundwater contamination associated with the Government Systems facility. Second, the Emergency Planning and Community Right-to-Know Act of 1986 (also known as Title III) establishes requirements for federal, state, and local governments and industry regarding emergency planning and "community right-to-know" reporting on hazardous and toxic chemicals.

OSHA requires companies to compile information on the identity of hazardous chemicals used or produced including the health and physical hazards as well as exposure limits for these chemicals. This information is reported on Material Safety Data Sheets (MSDSs).

Section 311 of the Emergency Planning and Community Right-to Know Act (Act) requires facilities that must prepare MSDSs under OSHA regulations to submit either copies of their MSDSs or a list of MSDS chemicals to the local emergency planning committee (LEPC), the state emergency response commission

(SERC), and the local fire department. If a list is submitted, the facility must submit a copy of the MSDS for any chemical on the list at the request of the LEPC or SERC.

The LEPC for Brevard County, Florida is based in Winter Park and the contact person is Leslie Banks who can be reached at (407) 645-3339. The SERC is located in Tallahassee and is comprised of members who are appointed by the governor to oversee and implement Title III provisions. The contact person for the SERC is Jim Loomis of the Department of Community Affairs. He can be reached at (904) 488-1472.

If the facility submits a list of MSDS chemicals, the list must include the chemical or common name of each substance and must identify the applicable hazard categories. These categories include among others, the immediate (acute) health hazard and delayed (chronic) health hazard.

Section 313 of the Act requires EPA to establish an inventory of routine toxic chemical emissions from certain manufacturing facilities. These facilities must have more than ten full-time employees and manufacture, process or otherwise use a listed toxic chemical (from a list containing over 300 compounds) in excess of specified threshold quantities. For example, facilities manufacturing or processing any of these listed chemicals in excess of 50,000 pounds in 1988 were required to report to EPA by July 1, 1989 their routine releases to the environment. This information is maintained in the Toxic Release Inventory System (TRIS) database as well as TOXNET, a similar database that is accessible to the public. EPA has confirmed that Harris reported routine toxic chemical emissions under Section 313 for 1987 and 1988. This information is available on request under the Freedom of Information Act by contacting:

Ms. Phyllis Strong
Office of Public Affairs
U.S. Environmental Protection Agency
345 Courtland Street N.E.
Atlanta, GA 30365

8. At what level is vinyl chloride or the other volatile organics at the site toxic in air and water? At what concentrations can these compounds be smelled?

EPA Response: The OSHA Permissible Exposure Limit for airborne vinyl chloride (VC) in the workplace is 1 part per million (ppm) over an eight hour period. In drinking water, the health-based risk for VC is 0.02 parts per billion (ppb). The odor threshold for VC in air is 260 ppm.

Exhibit 1 and the following discussion give more detailed information about the toxic levels for VC and other VOCs in air and water. For water, health-based risk levels can be expressed as concentrations representing the lifetime consumption level that would result in an additional increased lifetime cancer risk of one in one million. For air, three primary health-based risk levels are used to determine acceptable exposures in the workplace. These levels are the Threshold Limit Values (TLV) as determined by the American Conference of Governmental Industrial Hygienists (ACGIH), Permissible Exposure Limits (PEL) enforced by the Occupational Safety and Health Administration (OSHA), and Recommended Exposure Limits (REL) determined by NIOSH.

The TLVs as defined by the ACGIH refer to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects. There are three categories of TLVs which are specified as follows:

Exhibit 1

EXPOSURE AND ODOR PARAMETERS FOR
VARIOUS VOLATILE ORGANIC COMPOUNDS

Volatile Organic Compound	Acceptable Water Conc. (ppb)	Air Exposure Limits (ppm)	Odor Threshold (ppm)
Vinyl Chloride*	0.02[a]	1[b]	260 [f]
1,1-Dichloroethane	0.4[a]	100[b]	120 [f]
Methylene Chloride*	4.8[a]	500[c]	212 [f]
Trichloroethylene*	3.2[a]	100[d]	21 [f]
Chlorobenzene	140	75[b,c]	0.2[f]
1,2-Dichlorobenzene	630	50[b,e]	0.3[g]
1,2-Dichloroethylene	140	200[b,c]	1.0[f]
Ethyl Benzene	700	100[b,c]	2.3[g]
1,1-Dichloroethylene*	0.06[a]	1[b]	---
Toluene	---	100[b,c,d]	4.7[g]

Notes:

* Human or suspected human carcinogen

a This concentration represents the lifetime groundwater consumption level that would result in an additional increased lifetime cancer risk of one in one million.

b PEL

c TLV

d REL

e TLV-C

f Source: American Society for Testing and Materials; Publication DS-48A; Compilation of Odor and Taste Threshold Values Data.

g Source: Amoore J.E. and Hautala E., 1983. Odor as an aid to chemical safety: Odor thresholds compared with threshold limit values and volatilities for 214 industrial chemicals in air and water dilution; Journal of Applied Toxicology; 3:272-290.

a) Threshold Limit Value - Time-weighted Average (TLV-TWA) - The time-weighted average concentration for a normal 8-hour workday and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

b) Threshold Limit Value - Short Term Exposure Limit (TLV-STEL) - A 15 minute time-weighted average exposure which should not be exceeded at any time during a work day even if the 8-hour time-weighted average is within the TLV. Exposures at the STEL should not be longer than 15 minutes and should not be repeated more than four times per day. There should be at least 60 minutes between successive exposures at the STEL.

c) Threshold Limit Value - Ceiling (TLV-C) - The concentration that should not be exceeded during any part of the working exposure.

9. Several people working on the site have expressed concern that a very serious and unaddressed problem exists that is threatening worker health. For example, a government employee working in Building 8 on the Harris Government Systems facility is concerned about an undiagnosed persistent cough she has experienced since beginning work at the site in 1985. She explained that none of the 35 people in her office were informed that they work ten feet over groundwater containing toxic wastes. Although she has not noticed any VOC odors, she is concerned about VOCs percolating into the building due to a groundwater to air media transfer and the resulting potential adverse health effects.

EPA Response: Air sampling conducted at Building 8 by NIOSH and the Harris Health and Safety Department identified no airborne contamination in the breathing zone. At this time EPA has not performed a risk analysis for an air exposure pathway.

Although he sees no cause for alarm, an ATSDR representative has advised this employee to contact her management about relocating to a different office space if necessary to alleviate these concerns.

10. The same government employee filed a NIOSH complaint which resulted in a NIOSH air quality study conducted by Mr. Stanley Salisbury in November, 1989. The employee identified three concerns about how the study was conducted:

A. Mr. Salisbury reportedly normally deals with air quality issues relating to dust, spores, and bacteria rather than with toxic waste.

B. NIOSH conducted the study during the cooler month of November and, in addition, the air conditioning system which had not been operating formerly was running during the test. She believes that these factors may invalidate the test.

C. The results reported values in the parts per million range and she is concerned about parts per billion exposure.

In addition, has any other air quality sampling been done in Building 8 or elsewhere at the site?

EPA Response: The detection limits used by NIOSH were several orders of magnitude below the OSHA Permissible Exposure Limits for workers. Also, the existing occupational air exposure standards for vinyl chloride, for example, is in the parts per million range. Levels of vinyl chloride in the

groundwater are reported in the parts per billion range and therefore, would not likely result in any significant human exposure.

EPA contacted Mr. Salisbury to address the above-mentioned concerns about the study. He stated that he has had significant experience with indoor air quality and measured for "the six VOCs present in groundwater at concentrations in excess of the current groundwater standards" according to the established NIOSH protocol. He confirmed that the Harris Health and Safety Department conducted concurrent air monitoring during his visit. The Harris Health and Safety Department's results were consistent with the NIOSH results which indicated no measurable VOC airborne contamination.

EPA contacted Harris to determine whether or not any additional indoor air monitoring has taken place. Harris reported previous sampling for VOCs and carbon dioxide in response to worker concerns about contamination from past manufacturing operations in Building 6. This sampling is consistent with the Harris policy in which the Health and Safety Department conducts air monitoring on request for the numerous buildings at the site.

11. Is the contaminated groundwater getting to GDU? If so, how much contamination is the public receiving from the drinking water?

EPA Response: The contamination has reached some of the GDU wells. At least one of the wells has been shut down and the water from several other wells is being pre-treated for VOCs using an air stripper. The water undergoing pre-treatment is tested before and after air stripping. The VOC test results after air stripping do not show VOCs to be present above the detection limits (measured in parts per billion). In addition, the finished water distributed to Palm Bay residents is tested before distribution. The VOC test results for the finished water do not show VOCs to be present above the

detection limits (measured in parts per billion). Sampling analyses indicate that the residents receive water from GDU that meets drinking water standards.

In April, 1989 GDU had Target Compound List (TCL) analyses performed on water samples from eight production wells before pre-treatment and on one finished water sample. Pesticides, PCBs, and semi-volatile organics were not present above the detection limits (measured in parts per billion) in the samples from the production wells. Several VOCs were detected in the samples from the production wells, but were not present above the detection limits in the finished water. Lead, chromium, and zinc were present at low concentrations in several of the production wells, but the levels were within the primary and secondary drinking water standards.

The finished water sample analyses showed no contaminants above the detection limits, except for several trihalomethanes, chromium, and zinc. The trihalomethanes, which are common VOCs in finished water, were detected at low concentrations but were within the total trihalomethane MCL (100 ppb) for finished water. The chromium and zinc values were below the primary maximum contaminant level (MCL) for chromium (MCL is 50 ppb) and the secondary maximum contaminant level (SMCL) for zinc (SMCL is 5000 ppb).

12. A resident asked why the air stripping tower contained no air pollution control devices, and if anyone performing maintenance of this air stripper would be in any danger from the emissions.

EPA Response: Before construction of this tower, FDER analyzed the projected emissions based on the volume of groundwater to be treated. FDER determined that based on an eight-hour occupational exposure and 24-hour residential exposure over a long period of time, the treatment system design would present no significant short or long term risk.

4.2 Technical Issues

1. Why does EPA want to modify the current treatment facilities? Couldn't modification cause leakage between the aquifers from further drilling or maintenance?

EPA Response: The current EPA cleanup goals are significantly different from those identified in the FDER Consent Order. Therefore, a treatment system that meets the criteria specified in the order would not necessarily meet the EPA criteria for cleanup of the aquifer. For example, vinyl chloride and trichloroethylene now have more stringent cleanup goals. These and the other EPA cleanup goals are specified in the Record of Decision.

EPA and FDER will oversee a monitoring program to determine when the aquifer has been remediated to an acceptable level so that the treatment system is no longer required. A design analysis will help determine system effectiveness and efficiency as well as predicting the remediation time frame.

It is unlikely that modifications to the existing remediation system would result in leakage between the aquifers. The additional monitoring wells which are being considered would be drilled using established methods that minimize the chance of creating remedy-related leakage between the aquifers. These drilling methods offer the ability to place casing in the borehole at selected depths to effectively seal off one aquifer from another.

EPA and FDER would review any proposed drilling, well installation, or well completion procedures for compliance with EPA-accepted procedures prior to drilling. EPA and FDER would also check that procedures would not create leakage between the aquifers in situations where several aquifers would be drilled through or result in potentially contaminated fluids inside the casing from one aquifer being introduced to another aquifer. Deviations from accepted procedures would be corrected prior to actual drilling. EPA and/or FDER representatives would be present during drilling, well installation, and well completion activities to confirm that proper procedures had been followed.

In addition to the above precautions, unused monitor wells or suspect monitor wells would be decommissioned to prevent them from being or becoming potential conduits for downward or upward migration of contaminants. Decommissioning would be in accordance with recognized methods which prevent the creation of vertical conduits between the aquifers by removing the materials used to construct the decommissioned well and sealing the decommissioned well borehole with an impermeable grout.

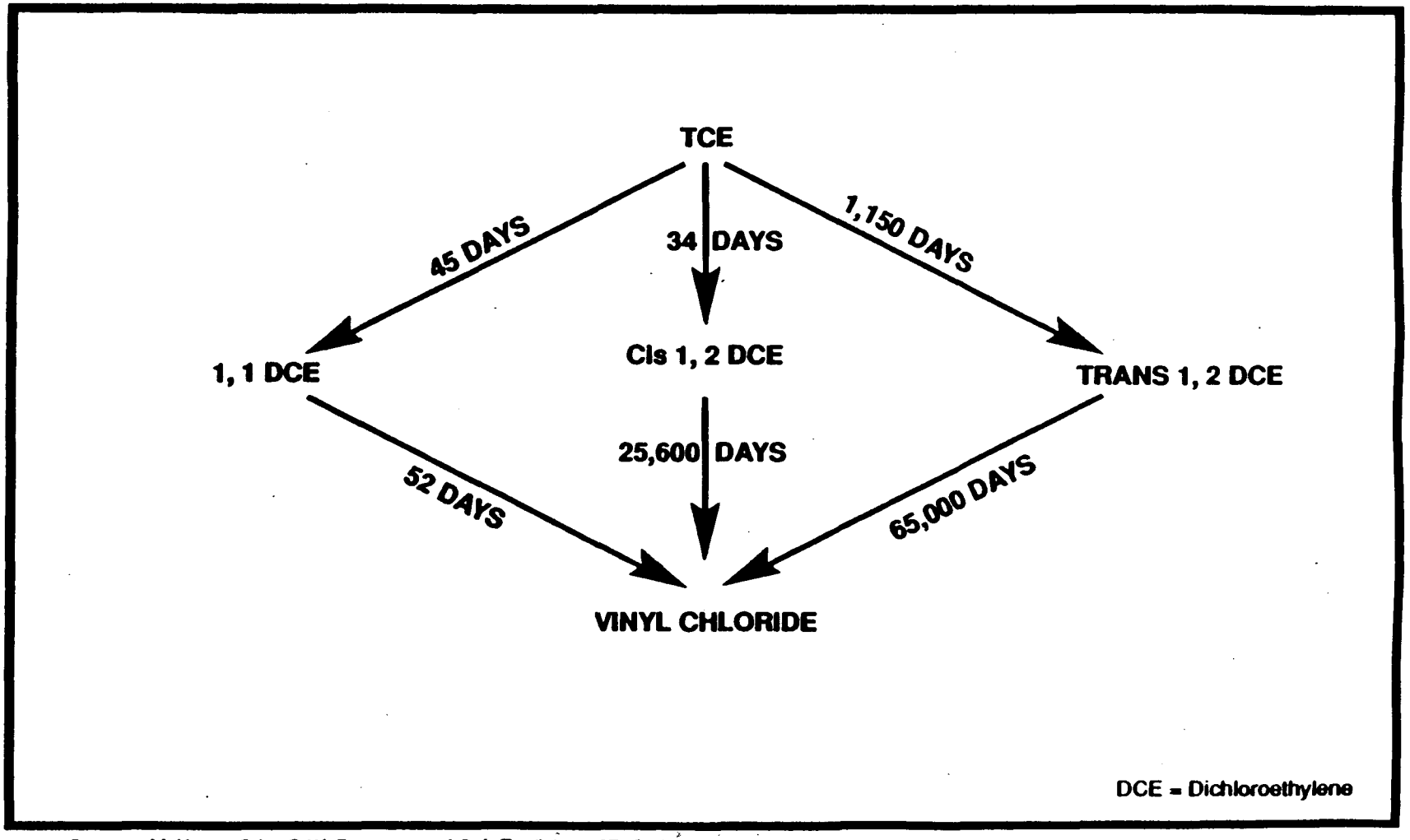
The groundwater treatment system would continue to operate during any decommissioning or additional drilling procedures.

2. Do volatile organics decompose on their own naturally? Do they decompose to safer or more harmful components?

EPA Response: Some decompose to safer materials and eventually to carbon dioxide (CO_2). Others decompose through intermediary stages that become more toxic. The decomposition of trichloroethylene (TCE) to vinyl chloride (VC), shown in Exhibit 2, is an example of the organic degradation product being more toxic than the original contaminant.

Exhibit 2

Degradation Reaction of Trichloroethylene



Source: McKown, G.L., G.W. Dawson, and C.J. English, 1987. Critical Elements in Site Characterization. In: Ground-Water Monitoring Seminar Series; Technical Papers, U.S. EPA (CERI-87-7)

3. What was the Hazard Ranking System rating for Harris and how does this compare with other sites?

EPA Response: The Hazard Ranking System (HRS) involves a mathematical model which scores sites from 0 to 100, indicating the probability and magnitude of risk to public health and the environment. Any site with a score of 28.50 or higher is eligible for inclusion on the National Priorities List (NPL), which would make available federal Superfund monies for cleaning up the site as necessary. The highest score received by a site is 75.60. The Harris site received an HRS ranking of 35.52.

4. What is done with the contaminated waste that is eliminated from the water at Harris?

EPA Response: VOCs in the groundwater are removed from the water in an air stripping tower. The design of the tower allows the volatiles to disperse into the air at a rate that yielded an acceptable risk range for protection of human health based upon the FDER projected emissions calculations. The treated groundwater is used as process water in parts of the Harris manufacturing process. This process water is subsequently discharged into a deep saline aquifer under a permit from FDER.

5. Is Harris introducing new waste products into the aquifer or has that been stopped?

EPA Response: EPA is not aware of any new contamination as a result of the current operations at the site. However, a comprehensive analysis of potential source areas may identify any ongoing, previously unidentified contamination areas.

6. Can the water at the 40 foot zone migrate in directions other than the southerly direction indicated by the water level contour map?

EPA Response: In general, the groundwater flow direction may be determined from water level contour maps by drawing lines that intersect the water level elevation contours at right angles. This indicates that the overall groundwater flow direction at Harris is southerly in the 40 foot zone. Localized deviations with more southeasterly or southwesterly directions can occur in areas where the water level elevation is irregular or where the distance between the water level elevation contours is large relative to the difference in water level elevation thereby creating a nearly flat gradient. However, these localized deviations resume a southerly flow direction within short distances.

7. How close are these contaminants to the surface and what is the highest concentration found there?

EPA Response: Volatile organic contaminants are present in the groundwater within 15 feet below the ground surface in some areas of the Government Systems facility. The contaminant concentrations measured in groundwater from SP-2 (located near Building 6 in the 15-foot zone) in December, 1986, are:

42 ppb 1,1-dichloroethane (DCA)
19 ppb chloroethane
1.7 ppb trans-1,2-dichloroethylene
1.5 ppb vinyl chloride
1.2 ppb trichloroethylene

4.3 Air Quality Issues

1. What is the possible interaction of volatile compounds with other waste gases or airborne products from nearby sources and what kind of effects does it have on the atmosphere?

EPA Response: EPA has not looked at local waste gas issues since the primary risk being addressed by the Agency at this time is groundwater. However, the State is involved in air analyses at and around the site. EPA will continue to coordinate any further analysis with the State. However, during pilot testing of the air stripping tower at Harris, FDER analyzed projected air emissions. This analysis indicated that the projected emission volume would not be high enough to present an unacceptable health risk.

2. What are the other waste gases that are being discharged from Harris Corporation or any other industries in the area?

FDER Response: The FDER Air Section has collected some air samples; specific information is available from Chuck Collins at the FDER district office in Orlando. His telephone number is (407) 894-7555.

3. Numerous residents have complained to City officials and agencies about odors coming from or around the area of Harris Corporation. Neither FDER nor the local fire department have been able to identify the source. One resident mentioned that the smell is heavy and sweetish. Others describe chlorine or aspirin-like smells. The sweet, heavy odor occurs frequently after sundown, sometimes until the early morning hours. This smell can be so repulsive in the area where one resident lives west of Harris Semiconductor that she does not go outside. She and others are now concerned that the odor could be from the air stripper and would like to know how to recognize the smell of volatile organic compounds.

EPA Response: EPA has been informed by the City of the concerns of the odors and will continue to work with FDER who is the agency addressing this concern. City officials have informed EPA that this odor problem is recent. Since the air stripper operation has been ongoing for several years, FDER will also be investigating any new sources. Exhibit 1 (see page 14) indicates the odor thresholds for various VOCs.

4.4 Water Treatment Issues

1. What is done with the sludge residue which remains after water treatment processes at GDU?

GDU Response: Sludges from wastewater is treated with lime and is trucked as mil-organite to farms for disposal on pasture land. It has some fertilizer value to it and no heavy metals. It is tested quarterly and meets the regulatory requirements for that type of disposal.

2. What happens to water that is deep well injected?

EPA Response: Treated water is injected into a deep well in a saline aquifer which is not potable or acceptable for irrigation. This disposal method is currently operating under an FDER underground injection permit. A consultant for Harris Corporation indicated that the case depth of the well is 2000 feet and the aquifer is an open hole to 2500 feet. Monitoring wells overlaying this zone have not detected any leakage from the wells into other aquifers.

3. Members of the audience were aware that GDU had shut down a well recently because of VOC contamination. One member of the audience wanted to know how EPA can say that Harris wells are successfully capturing contaminants from their site when a GDU well has to be closed due to increased contaminants.

EPA Response: The GDU well that was shut down about 4 months ago was not part of the treatment system. However, none of the GDU wells undergoing treatment contains volatile organics which exceed the allowed maximum contaminant level (MCL), even before treatment.

The GDU well that was shut down is near the Harris Building 100, recently identified as an area of contamination. It is not uncommon to find new areas of contamination or trace contaminants during an investigation. EPA is addressing these findings in a subsequent operable unit or as a part of the system modification in this Record of Decision. GDU has a program in place to assure that the public water supply is tested and meets drinking water standards before it leaves the plant.

4.5 Local Well Water Supply Issues

1. A resident living just west of the Harris site was concerned about the circumstances under which groundwater would migrate from Harris in a westerly direction and thereby be drawn into the residential sprinkler system.

EPA Response: It is unlikely that groundwater would migrate westward from the Harris site. Private wells used for sprinkler systems will not significantly impact the southward directional draw of groundwater which is created by the extraordinarily large pumping rate required at the GDU wellfield.

2. A residential subdivision east of Turkey Creek is not serviced by GDU. A resident of this subdivision wanted to know the possibility of contamination in their local wells, perhaps from isolated contaminated groundwater pockets from years ago.

EPA Response: If there is concern about the water quality or another potential source of contamination nearby, EPA suggests

that the resident contact the local health department or FDER. Without additional information regarding the local wells in question, further discussion would be speculative.

3. Another resident is concerned about whether well surveys have been done for residential wells near the Harris property. No one knows how long contaminated groundwater may have been consumed by residents, since the contamination was not found until 1981. The plume location was first identified in 1984. The resident was concerned that contaminated water supplies may have been consumed unknowingly over a long period of time.

EPA Response: A well survey was done recently as part of an investigation at the Semiconductor Complex on the Harris site.

Without historical analytical and water well location data, it is speculative to determine where and how much contamination existed before 1981. However, historical contamination may have originated at Radiation Corporation, which began operations in 1960. Harris has placed monitor wells east of the known plume area near residences to determine whether groundwater contamination may be present. Sampling data from these monitor wells have not shown evidence of contamination.

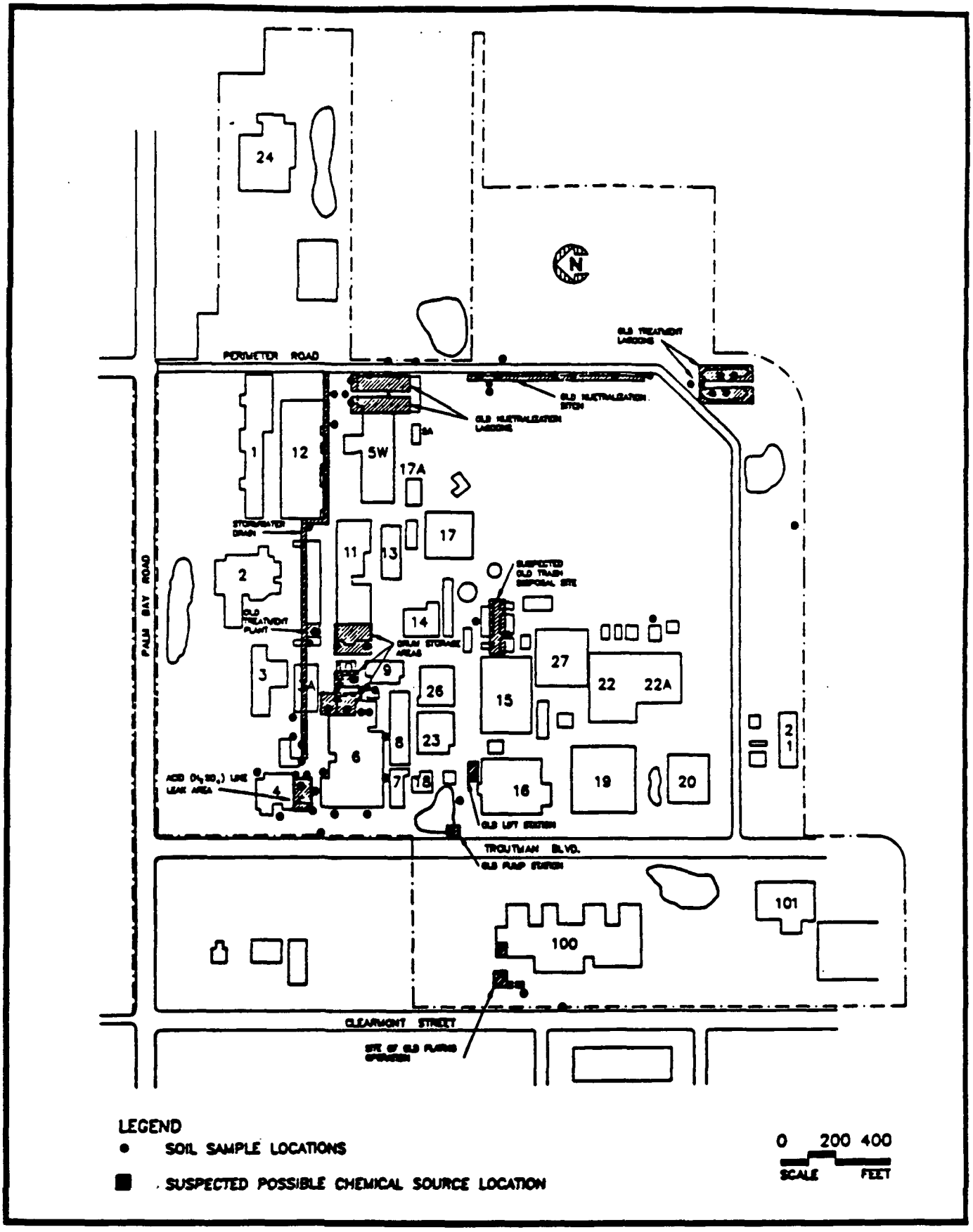
4.6 Soil Testing Issues

1. How has soil contamination been addressed?

EPA Response: Harris has conducted investigations to determine the impact of VOCs, metals, and acid extractable organics at Government Systems as well as other areas of the site. Soil samples at Government Systems were taken based on the location of possible source areas identified by past operating and handling practices. These sampling locations are shown in Exhibit 3.

Exhibit 3

Harris Corporation / Palm Bay Facility
Government Systems Soil Sample Locations



Source: Geraghty & Miller, Inc. April 1989. File No. MF0769EP01.

Soils found to contain VOCs were remediated by a process of removal, spreading, and discing the soil in order to allow the chemicals to volatilize. This remediation took place for soils in the area of the old neutralization ditch and treatment lagoons near the east side of Government Systems and from an area along the location of the old stormwater drain north of Building 6.

2. Were soil samples taken beneath the buildings? At what levels were these contaminants found from the surface?

EPA Response: Numerous soil samples have been taken around buildings at Government Systems and on one occasion samples were taken by drilling holes into the floor of Building 6. No VOCs were detected in soil samples taken in 1985 in and around Building 6. However, some phenolic compounds (acid extractable organics) were detected at low levels (1 ppm or less) in eight samples collected from four locations at the 3-foot and 6-foot levels. In addition, several metals were found with copper and lead being of greatest concern. Fluoride was also reported in these soil samples. The maximum levels of metals in these samples were 407 mg/kg copper, 38 mg/kg lead, and 94 mg/kg fluoride, all at the 6-foot level. Subsequent soils analyses done in 1987 from three borings around Building 6 showed phenolic compounds to be below the detection limits. These samples were taken in intervals from 3 to 39 feet. Copper was found at a maximum of 37 mg/kg at the 39-foot depth, and fluoride was found at maximum of 6 mg/kg at a depth of 5 feet.

4.7 Water Utility Costs and Services Issues

1. One citizen expressed concern that he is paying for the cost of water treatment in his monthly utility bill.

EPA Response: Harris Corporation has been responsible for the costs associated with the groundwater treatment system on the

Harris property as well as the costs for constructing, maintaining, and monitoring of the air stripping tower at GDU.

4.8 Harris Corporation Comment

Harris Corporation submitted a letter during the public comment period identifying questions and concerns about the EPA preferred alternative. The letter and attached report are provided as Attachment H.

1. This letter stated the Harris position that "the issues of chemical source areas and metals in the soils and groundwater have been adequately addressed" and that "no additional work on soils removal or metal characterization is necessary."

EPA Response: EPA has reviewed the Harris comment letter and report entitled "Summary of Soils Investigation and Metals in Groundwater". Despite Harris' assertion that "This report indicates metals are not an issue of concern at the site, there are no existing sources of chemicals remaining in the soils and sediments, and no additional work on soils removal or metal characterization is necessary.", metals in the soil and groundwater are a concern. The report is not sufficient to address this issue. Soil remedial levels based upon analytical methods with which we are unfamiliar may not be sufficiently protective of groundwater quality and therefore may not support the remedial action taken by Harris. As a result, additional soil/source characterization may be necessary at the Harris site.

Hydroxide sludges were reportedly observed in the Neutralization Lagoon, but metal analyses were not performed. EPA has not located a discussion of what became of the hydroxide sludges, which are sources for metals. In addition, the groundwater monitoring program for metals has been inconsistent; not all wells have been analyzed for metals. The wells which have undergone metals analyses show an

irregular sampling frequency. Many wells listed in the tables were only sampled once, typically in the fourth quarter of 1986. The irregular sampling frequency makes it difficult to determine the nature of the contamination and the behavior of contaminants over time. Thus, it is not possible to conclude that metals are not an issue of concern. Also, the existing treatment system (air stripping) does not remove metals from groundwater.

There are instances where EPA contaminant-specific cleanup goals were exceeded, but subsequent sampling was not performed. For example, there was no subsequent sampling in well SC-17S where lead was found at 140 parts per billion in February, 1988. The EPA health-based cleanup level for lead is 5 parts per billion. In addition, there are many cases where the detection limit exceeded the EPA cleanup standard for the contaminant, but subsequent sampling was not performed to attain a detection limit below the cleanup standard.

2. The Harris comment letter states that "the existing recovery system is not only reducing the concentration of chemicals in the groundwater, but also effectively capturing the plume and effectively remediating the aquifer." Therefore, no modification to the existing system is necessary.

EPA Response: EPA has not yet reviewed the groundwater modeling program conducted by Geraghty & Miller on the existing Harris recovery system. However, this recovery system was designed to meet the requirements specified in an administrative order on consent with FDER. The current EPA cleanup criteria for the aquifer are more stringent, in some cases, than those identified in the order. Also, the plumes have been defined by an aggregate value for VOCs rather than by values for individual contaminants. Therefore, it is uncertain whether or not the existing recovery system is effectively capturing the plumes and thus preventing contaminants from escaping the recovery system. As a result,

EPA must first verify through a comprehensive site groundwater evaluation what modifications are necessary and then determine the specific modifications required to optimize the system for treatment of the aquifer.

Until this comprehensive evaluation occurs, it is uncertain what modifications will be required. The modifications may involve a different groundwater recovery system, i.e. installation of additional recovery wells or discontinued use of existing wells. In addition, the sampling regime may be modified to verify that the system is meeting EPA cleanup criteria. Monitoring wells in potential source areas may be sealed (or decommissioned), if necessary, to prevent the downward migration of contamination from the surface. Similarly, EPA will make an independent determination of whether or not the wells "were constructed in a fashion that seals the zones of the aquifer from interconnecting."

3. Harris "questions the premise that air emissions from the air stripping tower may require additional testing."

EPA Response: Testing of the air emissions from the air stripper will be required to demonstrate compliance with applicable air cleanup standards. The EPA Air, Pesticides and Toxics Management Division states that the air stripper technology will comply with the cleanup standards, but this does not relieve Harris of its responsibility to demonstrate that the air emissions and effluents are in compliance with federal and Florida air quality standards.

4. Harris states that "additional analysis of wells outside the identified plume areas is unnecessary" because of the extensive sampling conducted to date.

EPA Response: EPA confirms that an extensive amount of sampling data has been collected at the site. However, the sampling regime was not systematic in some cases. As a

result, it is difficult to get a comprehensive view of the contamination at the site. In addition, containment of plumes will ultimately be determined by the regular sampling of monitor wells outside the plume areas.

5. The Harris comment letter states the Government Systems groundwater remediation system is not an interim measure, but was designed as the "final remedial alternative for the identified plumes of chemicals" under the Government Systems facility.

EPA Response: EPA policy on the extraction and treatment of contaminated groundwater considers recent evidence suggesting that it may be more difficult than is often estimated to achieve cleanup concentration goals in groundwater. The policy recommends an approach involving the initiation of early action while gathering more detailed data prior to committing to full-scale restoration. This recommendation encourages the collection of data to allow for the design of an efficient cleanup approach that more accurately estimates the time frames required for achieving the groundwater cleanup goals. Early action proves valuable in preventing the contaminant plume from spreading while the investigation to optimize the remediation system progresses.

6. The Harris letter states that "should GDU choose unilaterally to significantly modify its groundwater withdrawal scheme, this will directly impact the ability of the Harris remedial system to control the plume in the lower surficial aquifer."

EPA Response: Due to the long-term nature of the cleanup process, the Harris remediation system must be able to function independently of GDU groundwater withdrawals. The remedial system should be designed such that it can take advantage of GDU's withdrawals and the predictable impacts on the groundwater flow, as well as contaminant transport. The

remedial system should also be demonstrated to be adaptable and responsive to modifications in GDU's groundwater withdrawal scheme.

7. The letter states that "it is not necessary or appropriate for water from the treatment system to meet potable water standards" because the treated water is used strictly for industrial purposes.

EPA Response: The treatment standards for disposing treated groundwater depend upon the intended disposal method. If treated groundwater is to be used for human consumption or returned to the aquifer via percolation ponds or reinjection wells, the drinking water quality standards are the treatment criteria.

This Record of Decision selects a disposal option involving the use of permitted underground injection wells or, as an alternate, surface water discharge. In either case, the treated water must meet permit requirements; the Underground Injection Control (UIC) permit for deep well injection and the National Pollutant Discharge Elimination System (NPDES) permit for surface water discharge. These permits specify the levels to which the groundwater must be treated before disposal. For example, before disposal into the UIC permitted wells, the treated groundwater must not contain hazardous waste. Regional guidance states that EPA considers that the groundwater no longer contains hazardous waste once it has been treated to health-based levels.

8. EPA has reviewed the report that accompanied the comment letter. This report recaps data collected between 1986 through March 1989 which has been presented in previous reports.

EPA Response: The statement that "Sufficient data are available to assess the level of metals in groundwater at different depths across the site." is inaccurate. Most of the monitoring wells on the site have not been analyzed recently for metals. Given this, it is not possible to conclude that "metal levels in the groundwater do not currently exceed MCLs..."

The data included in the report shows that groundwater cleanup goals for metals are exceeded (or are potentially exceeded) in several instances. In twelve wells sampled in 1987, a detection limit of 50 parts per billion (ppb) was reported for cadmium. The Maximum Contaminant Level (MCL) is 10 ppb. Therefore, we do not know if these wells are contaminated to a level that exceeds the MCL. These wells have not been resampled. Two wells had positive results for cadmium, one above and one below the MCL.

Chromium concentrations have been recorded at levels well above the MCL of 50 parts per billion in numerous wells. Although the more recent sampling results do not show elevated levels of chromium in these wells, the likely explanation for this phenomenon is that the contaminant plume has moved away from these wells over the intervening three year period. This situation illustrates the need to more completely characterize the nature and extent of groundwater contamination at the site.

At least five wells have shown levels of lead above the MCL of 50 ppb, and numerous others have been shown to be contaminated above the health-based cleanup level of 5 ppb. The frequency of positive detections has decreased over time. However, it is uncertain to what locations these metals have migrated in the groundwater. In addition, the assumption that the lead concentration in SC-17S is anomalous is inappropriate. An appropriate procedure would be to perform

subsequent sampling to confirm either that the value is anomalous or that lead is present in the groundwater.

The hydroxide sludges in the old Neutralization Lagoon (now under Building 5) were not chemically characterized for metals. EPA has not received documentation for what became of these sludges. Whether or not the hydroxide sludges and underlying soils would have required remediation is not known. As a result, the area around Building 5 remains a potential source area.

Based upon the data presented in the report, it is not possible to conclude that "metals are not present in groundwater... at levels that warrant remediation." The above-mentioned examples indicate that the metals contamination at the site is not well-defined and potentially significant. If Harris has additional data which has been used to reach their conclusion, the data or studies should be made available to EPA for analysis.

4.9 General Development Utilities Comment

GDU submitted two letters during the public comment period identifying concerns about EPA actions and the preferred remedial alternative at the Harris Corporation site. These letters are presented in Attachment I.

1. The GDU letter poses the question of whether the cleanup standards will be the current EPA standards and not those standards identified in the Consent Order between FDER and Harris.

EPA Response: The cleanup standards identified in the EPA Record of Decision for Operable Unit One of the Harris site are based on the contaminant levels necessary to restore beneficial use of the aquifer. Three of these cleanup levels (trichloroethylene, vinyl chloride, and methylene chloride) are more stringent than those identified in the 1983

FDER/Harris Consent Order. These aquifer cleanup levels are obtained from a number of sources as appropriate for each contaminant. These sources are: the current State of Florida Maximum Contaminant Levels (MCLs), health-based criteria for a one in one million excess cancer risk level, the cleanup criteria identified in the 1983 FDER/Harris Consent Order, and Secondary MCLs.

2. The GDU letter expresses concern that a temporary shut-down of the Harris remediation system will accelerate migration of the contaminant plume and affect GDU wells.

EPA Response: Such a shut-down would be initiated only after contaminant levels in the aquifer had reached or was below the cleanup goals specified in the ROD and had reached an asymptotic level below which no decrease occurred over a significant period of time. In this case, a temporary shut-down of the extraction system concurrent with careful monitoring of the groundwater would allow us to determine whether or not the sources of contamination had been removed.

3. It is unclear how the monitoring program identified in the ROD will be implemented.

EPA Response: The existing monitoring program will be modified as necessary to fully characterize the extent of contamination at the site. A monitoring program will continue for an estimated three years or until the cleanup goals are met. Following the onset of the EPA specified remedial action (Alternative 3), EPA will conduct a review of the site to verify that the aquifer has been restored to beneficial use.

4. GDU is concerned that the Harris remediation system is dependent upon the GDU water supply wells.

EPA Response: As described earlier, due to the long-term nature of the cleanup process, the Harris remediation system must be able to function independently of GDU groundwater withdrawals. The remedial system may be able to take advantage of GDU's withdrawals and any predictable impacts on the groundwater flow. The remedial system should also be adaptable and responsive to modifications in GDU's groundwater withdrawal scheme.

5.0 REMAINING PUBLIC CONCERNS

Issues and concerns which EPA was unable to address during remedial planning activities for Operable Unit One, groundwater remediation at the Government Systems Complex, included the following:

- Specifying the modifications to be made to the existing groundwater extraction and treatment system.

- Request for EPA to thoroughly review the issues raised at the public meeting and to advise the public of anticipated actions in a follow-up meeting.

Specific modifications to the treatment system will not be available until a design analysis is conducted for the treatment system. EPA will release this information as soon as it is available.

Additional operable units may be designed for groundwater cleanup at other portions of the Harris facility, e.g., the Semiconductor Complex and Building 100. Another potential operable unit is source control or soil cleanup of discrete sources at the facility. The public will be notified of ongoing investigations and findings as well as opportunities for public participation.