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Agency

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September 1993

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Superfund Record of Decision:

Kalama Specialty, SC

50272-101

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SUPERFUND RECORD OF DECISION
Kalama Specialty, SC
First Remedial Action - Final

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09/28/93

6.

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401 M Street, S.W.
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13. **Type of Report & Period Covered**
800/800

14.

15. **Supplementary Notes**

PB94-964033

16. **Abstract (Limit: 200 words)**

The 50-acre Kalama Specialty site is comprised of a former 16-acre manufacturing plant and a 34-acre trailer park located in Beaufort, Beaufort County, South Carolina. Land use in the area is predominantly industrial, as well as a mix of residential, commercial, agricultural, and military. The site is predominantly flat and contains several drainage ditches, old buildings, and concrete slabs. An estimated 40 residences are located within a quarter mile of the site. In 1973, the Vega Chemical Company began onsite operations, which included chemical repackaging, custom hydrogenations, and manufacturing the herbicide, Krenite. Site operations generated wastewater, comprised of cooling water runoff, boiler blowdown, and pump seal leakage and spillage, which was disposed of onsite; and other non-aqueous and organic wastes, which were disposed of offsite. Between 1973 and 1975, the wastewater was discharged to a depression in the land, where it then percolated into the ground and contaminated onsite soil and ground water. Between 1976 and 1979, the wastewater was treated onsite by a land application system, pumped to a holding pond, stabilized in the pond, and discharged to a large tile field. During the 1970s, other releases to onsite soil may have occurred due to onsite incineration of non-chemical solid waste. Kalama Specialty purchased the 16-acre property in 1979 and the inactive trailer park in 1980. Later in

(See Attached Page)

17. **Document Analysis** a. **Descriptors**
Record of Decision - Kalama Specialty, SC
First Remedial Action - Final
Contaminated Media: soil, sediment, gw
Key Contaminants: VOCs (benzene, toluene, xylenes), 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 98
	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)

1979, an onsite explosion and fire damaged several reactors and vessels containing chemicals in various stages of manufacture. The estimated 200,000 gallons of water and fire control foam that were used to fight the fire, became contaminated with organics from the ruptured vessels, and migrated from the operations area, forming a pool onsite. This pooled fire water was recovered, and pending offsite disposal, was held in tanks, pools, and tankers. There was an effort to contain some of the material in the wastewater holding pond, but it accidentally seeped into the tile field. During the 1970s, State investigations resulted in the installation of a wastewater treatment system and the initiation of a ground water monitoring program in 1976, and also identified buried drums onsite. Further State investigations, in 1980, identified soil and ground water contamination by VOCs and metals. The State initially ordered Kalama Specialty to cleanup all of the identified contaminated areas. This was later modified and the company was only required to perform studies to determine the extent of the soil and ground water contamination and to design plans for conducting cleanup. In 1980, following abandonment of the original bentonite-lined pond and tile field, Kalama Specialty constructed a larger, plastic-lined lagoon to hold wastewater. Site operations ceased in 1983, and in 1986, Kalama Specialty leased the land to a local contractor for storing and staging of heavy equipment, materials, old oil tanks, construction debris, and concrete. In 1989, the site was abandoned, and the area was fenced. This ROD addresses a first and final action for the contaminated soil, sediment, and ground water. The primary contaminants of concern affecting the soil, sediment, and ground water are VOCs, including benzene, toluene, and xylenes; and metals, including chromium and lead.

The selected remedial action for this site includes sampling to ensure that all soil contaminated at levels exceeding performance standards is removed; excavating 604 yd^3 of contaminated soil and 80 yd^3 of sediment, and treating the soil onsite using volatilization and solidification; with replacement of the treated soil and sediment to the excavated areas; backfilling, grading, seeding, and establishing a vegetative cover for the excavated areas to control erosion and surface water runoff; providing a contingency for offsite disposal at a RCRA offsite landfill, if deemed more cost effective; treating the air emissions resulting from volatilization to meet ambient air quality standards, as necessary; pumping and treating contaminated ground water from the sand aquifer onsite using precipitation and filtration to remove metals, followed by air stripping to remove organic contaminants, and granular activated carbon as a polishing step; discharging the treated water onsite to an infiltration gallery, sprayfield, or surface water; collecting and temporarily storing dewatered solids from the filtration process onsite pending disposal; and monitoring ground water and air. The estimated present worth cost for this remedial action is $3,502,167, which includes an estimated present worth O&M cost of $1,896,527 for 30 years. The estimated present worth cost for the contingency remedy is $3,768,500.

PERFORMANCE STANDARDS OR GOALS:

Soil, sediment, and ground water cleanup goals are based on State and Federal standards or health-based risk factors. Chemical-specific soil and sediment cleanup goals include antimony 3 mg/kg; benzoic acid 25,000 mg/kg; chromium 40 mg/kg; 1,1-DCE 0.023 mg/kg; ethylbenzene 7 mg/kg; lead 500 mg/kg; mercury 2 mg/kg; nickel 140 mg/kg; toluene 4 mg/kg; and xylenes 60 mg/kg. Ground water cleanup goals are based on SDWA MCLs and include benzene 5 ug/l; 1,2-DCA 5 ug/l; 1,1-DCE 7 ug/l; ethylbenzene 700 ug/l; methylene chloride 5 ug/l; and xylenes 10,000 ug/l.

RECORD OF DECISION

KALAMA SPECIALTY CHEMICAL, INC.
SUPERFUND SITE

BEAUFORT, BEAUFORT COUNTY
SOUTH CAROLINA

PREPARED BY:

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

SEPTEMBER 28, 1993

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Kalama Specialty Chemical, Inc.
Beaufort, Beaufort County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Kalama Specialty Chemical, Inc., Superfund Site (the Site) in Beaufort, South Carolina, which was chosen 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. § 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. Part 300 et seq. This decision is based on the administrative record file for this Site.

The State of South Carolina concurs with 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 an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action addresses on-Site groundwater contamination, as well as on-Site soil and sediment contamination.

The major components of the selected remedy include:

* Treatment of soils and sediments (both on the surface and in the ditch) contaminated with volatile organic compounds (VOCs) and metals by excavation, volatilization, and solidification (or as a contingency, the removal of contaminated soils from the Site);

* Replacement of soils into the excavation;

* Extraction and treatment of groundwater to the MCLs for contaminants of concern; and

* Additional monitoring of groundwater with additional monitoring wells including new deep wells in the limestone aquifer.

DECLARATION

The selected soil and groundwater 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 technology to the maximum extent practicable for this Site. The selected remedy component satisfies the preference for treatment. The remedy is protective of human health and the environment and meets statutory findings.

In the event that the contingency remedy of off-Site soil disposal is chosen, the contingency soil remedy also 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. The off-Site soil remedy also meets statutory findings.

Because selection of this remedy will result in contaminated groundwater remaining on-Site above health-based levels until remedy implementation is complete, a five year review will be conducted after commencement of 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

9-28-93

Date

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1.0 KSCI SITE LOCATION AND DESCRIPTION

The Kalama Specialty Chemical, Inc. (the Site), Site is located in Beaufort, Beaufort County, South Carolina, on Highway 21 four miles from the City of Beaufort, across the highway from the Marine Corps Air Station (Figure 1-1). The Site consists of approximately fifty (50) acres, and includes the former Kalama manufacturing plant Site and the former Benton Trailer Park (Figure 1-2). The Kalama facility's operations included chemical repackaging, custom hydrogenations, and manufacturing Krenite, a herbicide. The facility was in operation from 1973 to 1983 under the names of Vega Chemical (Vega) and Kalama Specialty Chemical, Inc. (KSCI).

1.1 Site Description

The Site consists of two parcels, a 16-acre tract on which KSCI operated and an adjacent 34-acre former mobile home park, the Benton Trailer Park, that was purchased by Kalama Chemical, Inc. The Site is predominately flat with several drainage ditches within the Site, with several old buildings and concrete slabs remaining.

The Site is four miles north of Beaufort on US Highway 21. The Site is bordered on the East by Highway 21 and to the West by the Seaboard Coast Line Railroad. Across Highway 21 from the Site is the 5300 acre U.S. Marine Corps Air Station Beaufort (MCAS). The Site lies within the airport noise zone. The area near the Site developed without zoning and is a mix of residential, commercial, industrial, agricultural, and military land uses. The Site is zoned industrial. There are some forty (40) residences within a quarter mile of the Site, as well as a concrete plant, a drive-in theater, and a day care center. While salt marshes are a predominant feature of the Low Country, there are none located less than one mile from the Site.

1.2 Site Topography and Drainage

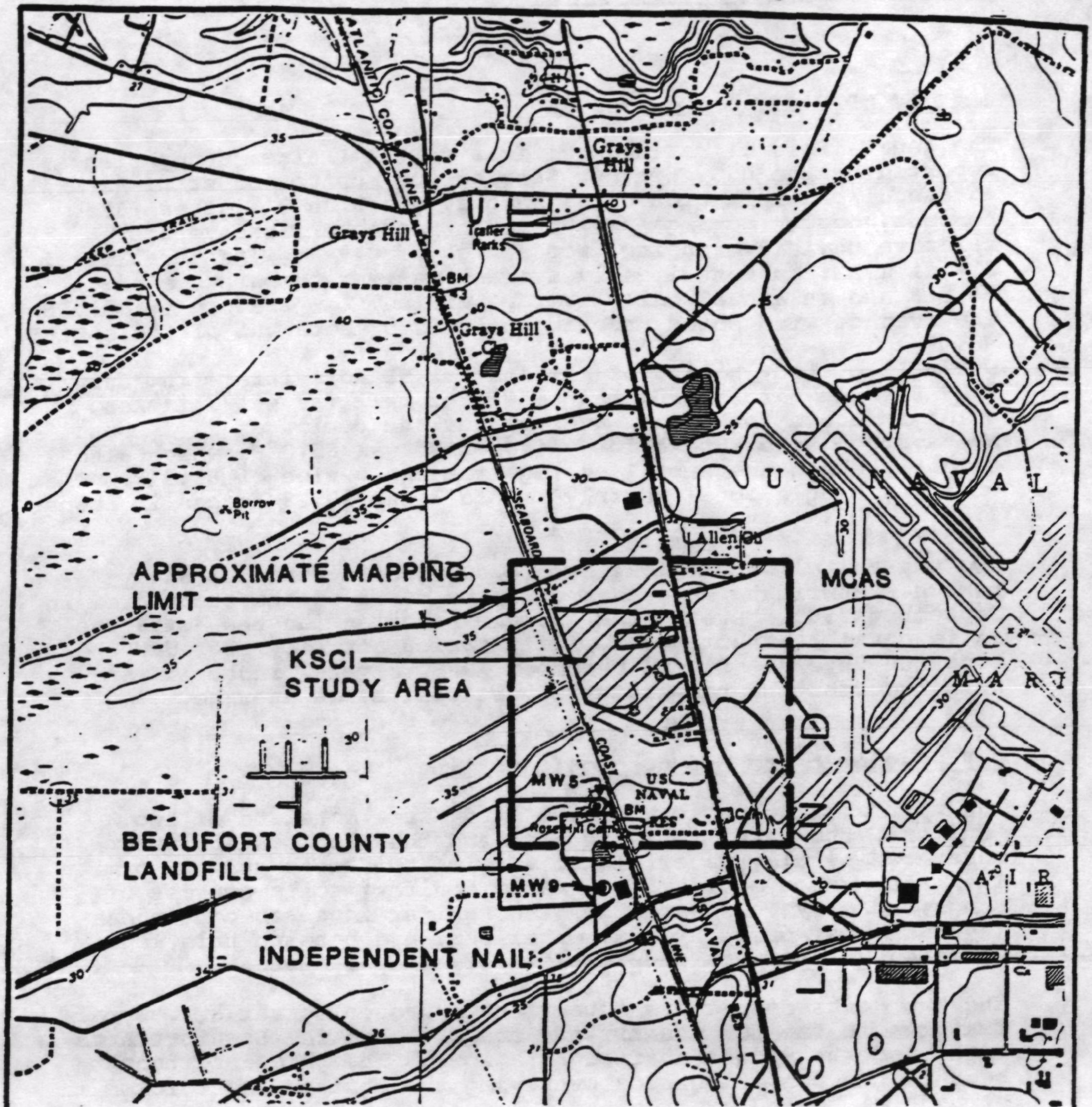
The Site is predominately flat with less than fourteen feet of relief, not including man-made berms that previously formed the lined lagoon. The study area topography was taken from aerial surveys. A closed depression lies directly west (225 feet) and other low-lying depressions lie to the northwest (some 100 feet) of the operations area. Surface topography suggests that these areas may be hydraulically connected during times of heavy rain. Surface drainage from the process reactor pad area flows west toward the closed depression. Portions of drainage ditches remain on both the Kalama and Benton Trailer Park parcels.

The study area has no known history of flooding, with the exception of periodic standing water in the shallow closed depressions. The state flood maps indicate no flood hazard zones within the property boundaries. The Site property is very close to the peak elevation of Port Royal Island.

GENERAL LOCATION MAP

POST, BUCKLEY, SCHUH & JERNIGAN, INC.
KALAMA SPECIALTY CHEMICALS, INC.
STUDY AREA

FIGURE 1-1



FROM: BEAUFORT, S.C. AND LAUREL BAY, S.C. 7.5 MINUTE QUADRANGLE MAPS

2000' 0 2000' 4000'

GRAPHIC SCALE IN FEET

STUDY AREA LOCATION MAP

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

KALAMA SPECIALTY CHEMICALS, INC.
STUDY AREA

FIGURE 1-2

1.3 Meteorology

The generalized climatic conditions for the Kalama study area as reported by the U.S. Weather Service for monitoring stations are: an annual precipitation of 51 inches, of which 32 inches (62 percent) occurs during April through September; an average relative humidity ranging from a high of 84% at 4 AM to a low of 50% at 1 PM; an annual daily average maximum temperature of 74.5°F and an annual daily average minimum temperature of 58.7°F. The average wind speed and direction is 5 knots out of the south.

During the study period of the initial RI activities from July 1989 through March 1990, the total rainfall was 46.77 inches, which is above the annual average for the period of 37 inches. The average temperature for this period was 65.3°F, which also is slightly above the annual average for the period of 63.5°F. The greatest single total monthly rainfall was 10.29 inches in August 1989.

Two unusual climatological events occurred during the study period. Hurricane Hugo passed to the north of the study area in September 1989. Due to the extreme winds during the hurricane, it is possible that actual precipitation actually exceeded the reported levels. During December 1989, several inches of snow were recorded and temperatures were well below average.

1.4 Geologic and Hydrogeologic Setting

The near surface geology of the study area consists of two aquifers, the water table aquifer and the Floridan Aquifer, separated by clay materials of varying thickness and uniformity. The water table aquifer (or "sand" aquifer) soils consist of sands and clays. Beneath the sand aquifer is a non-continuous layer of clay or silty clay materials, and beneath this is a confined to semi-confined aquifer of sandy limestone.

The two most conspicuous subsurface hydrogeological structural features in the Low Country and the Site are the Beaufort Arch (a high) and the Ridgeland Trough (a low). They are important because the confining beds overlying the aquifer are thicker in structural basins or troughs, but are thinner over structural highs. The shallow depth to the limestone aquifer over the Beaufort Arch, the low yields of water available from the sand aquifer, and the objectionable water quality found in the sand aquifer have caused the local well drillers and owners to target the limestone aquifer for water supplies, rather than the sand aquifer. This limestone aquifer is the major regional water supply aquifer for the area and is part of the Floridan Aquifer.

The subsurface investigation at the Site found these Site-specific lithologies:

* Fine to medium sand from land surface to 15-25 feet;

* Very fine sand occurs beneath to a depth of 60-65 feet, clay content and lenses increase to the bottom of layer;

* Clay and sandy clay, although discontinuous, from 75-85 feet deep; and

* Sandy limestone at 85 feet, the top of Floridan Aquifer.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

Operations began at the Site in 1973 by a chemical company known as Vega Chemicals (Vega), who leased the sixteen (16) acre tract from the Beaufort County Development Corporation. Vega spent approximately two years constructing its operating facilities at the Site, and began full scale operations in 1975.

In 1976, KSCI purchased a financial interest in Vega, and later purchased the balance of the company in 1978. KSCI purchased the sixteen (16) acre tract in 1979 from the Beaufort County Development Corporation. A second parcel of property, a vacant thirty-four (34) acre tract of land, adjacent to the 16 acre tract, previously operated as a mobile home park known as the Benton Trailer Park, was purchased by KSCI in 1980. KSCI continued to operate at the Site until 1983 when it closed its operations. The Site remained inactive until 1986, when KSCI leased the sixteen (16) acre tract to a local contractor, Floyd Sears Construction, who used the Site for storage and staging of heavy equipment, as well as a variety of materials, such as preserved timbers (telephone poles), old oil tanks, construction debris, and concrete from the MCAS Beaufort. Floyd Sears Construction leased the property until 1989, at which point the Site was abandoned.

The former operations area of the Site has been fenced with "No Trespassing" signs posted identifying the property as a Superfund Site. The fencing is currently inspected regularly by a local security company.

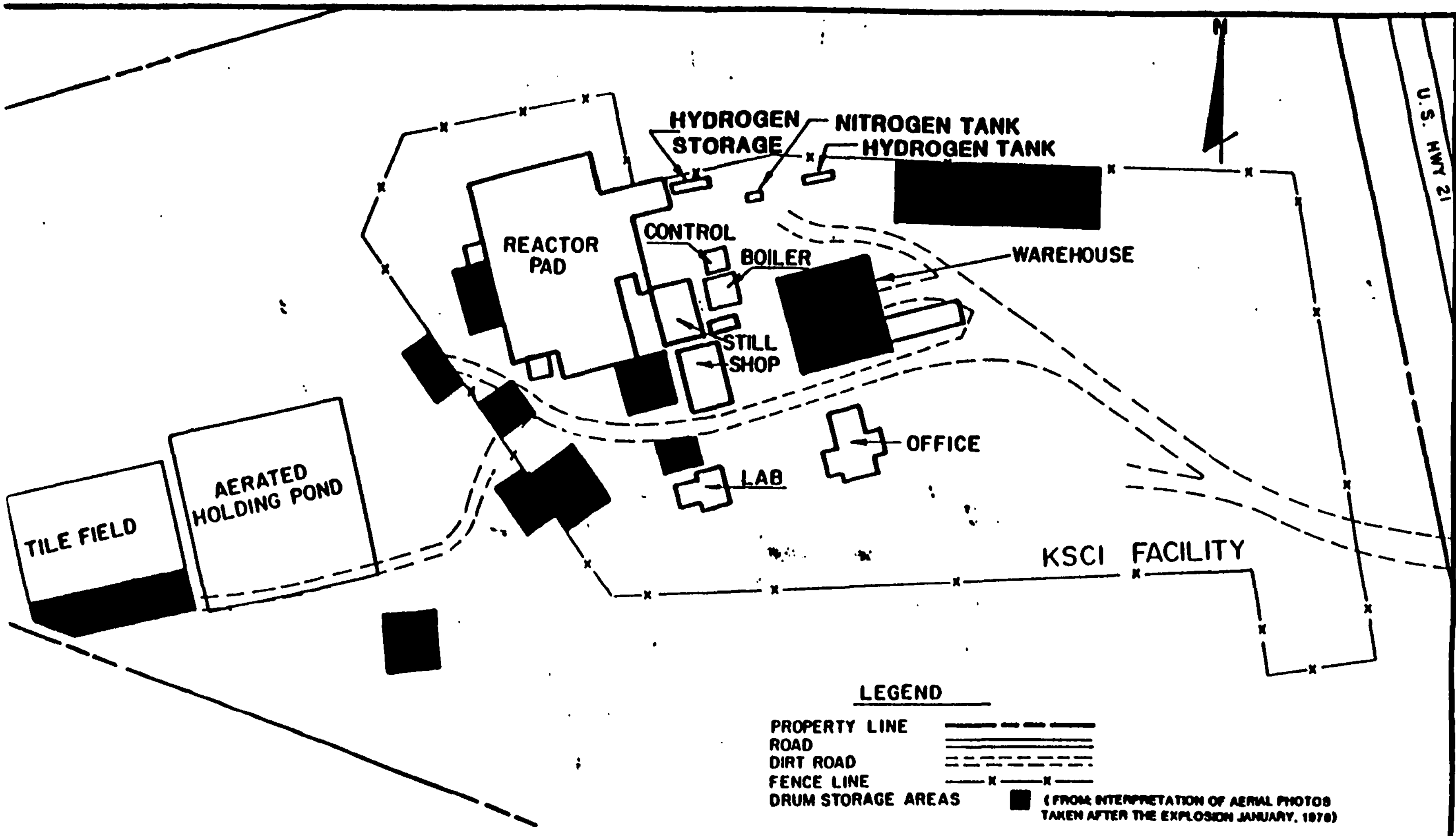
The Site was operated by both Vega, and later KSCI, primarily in the production of specialty chemicals. A wide range of chemicals were produced in small, special-order batches. The principal product manufactured at the Site was known as Krenite, an herbicide made under contract with the DuPont Company. Wastes from the Site included wastewater, comprised of cooling water, runoff, boiler blowdown, and pump seal leakage and spillage, which was disposed of on-Site, and other non-aqueous and organic wastes, which were disposed of at approved off-Site incineration or disposal facilities.

During the period of 1973 through 1975, wastewater from the facility was discharged from the production area of the facility to a small depression in the land, where the wastewater then percolated into the ground. Between 1976 and 1979, the wastewater was treated on-Site by a land application system consisting of an aerated, bentonite-lined holding pond and tile field. A lift station pumped this wastewater from the operations area to the holding pond via an underground six (6) inch diameter PVC pipe. The wastewater was stabilized in the pond and discharged to a large tile field, in an attempt to percolate stabilized wastewater to the water table aquifer to prevent its migration to surface waters off-Site.

In addition to the release of wastewater at the Site, other releases may have occurred because of on-Site incineration which took place at the Site during the 1970s. Non-chemical solid waste materials (cardboard, pallets, and fiber containers) were periodically burned in a depressed location beyond the fence line, west of the operations area. Additionally, a methanol/ethanol waste stream, possibly containing trace amounts of ethyl chloride from the Krenite manufacturing process, was burned in a bentonite-lined pit on-Site. The pit also was used by Kalama for fire-fighting training. The location of the pit, which was reportedly filled in January 1979, has not been precisely determined.

In January 1979, there was an explosion and fire at the Site which resulted from a laboratory experiment. The explosion and fire damaged a number of reactors and vessels containing chemicals in various stages of manufacture. Chemicals ran off the reactor pad principally to the west and northwest. It was estimated that over 200,000 gallons of water and fire control foam were used to fight the fire on the pad, and this fire water, contaminated with organics from the ruptured vessels, also ran off the operations area and pooled in low areas west and northwest of the reactor pad. The majority of the pooled fire water (contained by an earthen dam) was recovered, and pending off-Site disposal, was held in tanks, pools, and tankers. An effort was made to hold some of the material in the wastewater holding pond, but due to a plug failure, this material seeped into the tile field. Figure 1-3 shows the Site's features as they existed in 1979.

Following the 1979 explosion and fire, use of the wastewater treatment system was curtailed during plant rebuilding and start-up. Any washdown or wastewater sent to the pond was held and



STUDY AREA SHOWING OPERATIONAL FEATURES, 1979

SCALE: 1" = 100'

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.
KALAMA SPECIALTY CHEMICALS, INC.
STUDY AREA
BEAUFORT, SOUTH CAROLINA

FIGURE 1-3

JOB No: 18-017.66

PRO PRODUCTS, INC 78 314359

pumped into tankers for off-Site disposal. In 1980, following abandonment of the original bentonite-lined pond and tile field, KSCI constructed a larger, plastic-lined holding lagoon. This pond had no discharge; wastewater was held for off-Site disposal. This pond was utilized until 1983, when KSCI closed its operations.

2.2 Enforcement Activities

During the 1970s, contamination problems at the Site came to the attention of the State of South Carolina (the State), and were investigated by the South Carolina Department of Health and Environmental Controls (SCDHEC). SCDHEC ordered KSCI to install a wastewater treatment system. Early inspections at the Site led to the initiation of a groundwater monitoring program in 1976, and the discovery of buried drums at the Site in 1979. Further inspections led to the decommission of the inadequate pond and tile field system in 1980 (all sludge and contaminant structures from these areas were sampled and disposed of in an approved landfill, and are no longer evident), and the decommission of the larger wastewater lagoon in 1983.

Soils at the Site were analyzed by the State, and were found to be contaminated with benzene, toluene, ethylbenzene and xylenes, 1,2-dichloroethane, acetone, methylene chloride, lead, nickel, and mercury, with especially high concentrations detected in areas which received substantial runoff from the fire and explosion in January 1979. State groundwater sampling at the Site also detected ethylbenzene, xylenes, 1,2-dichloroethane, acetone, and methylene chloride, all with the potential to affect the Floridan aquifer.

In 1980, a Consent Order issued by SCDHEC to KSCI as a result of frequent releases of wastewater into the soils, required the characterization of soil and groundwater quality at the Site, and called for a cleanup of all identified contaminated areas. This Consent Order was later amended to require KSCI to perform studies on the extent to which soil and groundwater contamination had occurred and to design plans to clean up the contamination.

Due to the presence of contaminants in soils and shallow groundwater, and the potential impact of these contaminants on the Floridan Aquifer, EPA formally proposed the Site for listing on the National Priorities List (NPL) (40 C.F.R. Part 300, Appendix B), on September 8, 1983. The Site was finalized on the NPL by publication in the Federal Register on September 21, 1984, 49 Fed. Reg. 37083, with a Hazard Ranking System (HRS) score of 59.9.

EPA and the State agreed that SCDHEC would have lead responsibility for the disposition of the Site. From 1983 to

1986, SCDHEC pursued the necessary studies and remedial activities with KSCI under the SCDHEC Consent Order. Overall, however, KSCI experienced difficulty in meeting schedules and completing work assignments. In an attempt to resolve these difficulties, the State turned the lead for the Site over to EPA's Superfund Enforcement Branch in late 1986.

After reviewing the work done previously by KSCI under the SCDHEC Consent Order, EPA determined that further study was needed to determine the nature and volume of the waste, pathways by which contaminants would move or present the risk of exposure to human health and the environment, and the hydrologic relationship between the upper shallow layer of groundwater and the deeper aquifer. As a result of this determination, EPA on January 13, 1988, entered into an Administrative Order on Consent (AOC) with KSCI to perform a Remedial Investigation/Feasibility Study (RI/FS) at the Site under EPA's oversight. KSCI provided EPA with its final RI report in January 1993.

During the entire RI/FS process (a span of approximately five (5) years), EPA experienced major difficulties in receiving approvable documents from KSCI's contractor Post, Buckley, Schuh and Jernigan, Inc. (PBS&J). PBS&J claimed the existence of a continuous clay confining layer between the soils and deeper aquifer, the existence of which was disputed by both the State and EPA. As a result, each revision submitted during this long period, though somewhat more improved than the previous, remained inadequate due to the characterization of the supposed clay layer.

On December 14, 1992, EPA sent KSCI a letter informing it that EPA would be taking back the Site, pursuant to the AOC, to complete the RI/FS process due to the failure of KSCI to address comments and concerns of both EPA and the State. Concurrently with the letter, KSCI was informed that, as part of the "Dispute Resolutions" section of the AOC, KSCI would be given the opportunity to submit one final revised set of RI/FS documents for EPA review within the twenty-eight (28) day period set forth in the AOC. If this final set of documents was not approvable, EPA would immediately begin work at the Site.

KSCI retained an additional consultant and new counsel in order to address State and EPA concerns. KSCI was able to submit its final revision of the documents on schedule, and has removed or reworded the language regarding a confining clay layer to EPA's and the State's satisfaction.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Initial RI/FS community relations activities at the Kalama Specialty Chemical Site began with community interviews in

Beaufort and the finalization of a Community Relations Plan in August 1987. Concerns expressed at that time included what effects the Site would have on drinking water, agriculture, aquatic life, and future development in the area. In addition, an information repository was established in August 1987, at the Beaufort County Library on Craven Street in Beaufort.

A "kickoff" fact sheet announcing the start of the RI/FS was issued in early February 1988. Community interest during the RI/FS preparation was very low. EPA received few letters or telephone calls regarding the Site or the RI/FS study. EPA has updated the Site information at the Information Repository and posted signs on the Site perimeter listing contacts at EPA and SCDHEC. Several calls that were received informed EPA of trespassers on the Site. The Site now is patrolled by a local security service to control trespassing.

Following completion of the RI and the FS, the Site mailing list was updated and the Proposed Plan was mailed out in mid-June 1993. An advertisement was published in area newspapers on June 22, 1993. Both the advertisement and the Proposed Plan stated that the Public Comment period would be held from June 22, 1993, to July 22, 1993.

The Proposed Plan public meeting was held on July 1, 1993, to present the Agency's selection of Preferred Alternatives for addressing soil and groundwater contamination at the Site. The local newspaper, several citizens, and a number of local governmental representatives were present, as well as representatives from local environmental groups. In early July 1993, a request was received to extend the public comment period to provide additional time for review of the Proposed Plan and RI/FS documents. EPA approved the request and extended the comment period until August 23, 1993.

Comments received by EPA through August 23, 1993, and EPA's responses to the comments are contained in the Responsiveness Summary, Appendix A to this document. This decision document presents the selected remedial action for the Site, in Beaufort, South Carolina, 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.

4.0 SCOPE AND ROLE OF THIS ACTION WITHIN SITE STRATEGY

The Site principally poses a threat to human health and the environment through contaminated soils and contaminated groundwater in the surficial aquifer. These contaminated areas could cause deleterious health effects directly through direct or long-term exposure to the soils or indirectly by contaminants leaching into the shallow groundwater aquifer that could be used as a potable water source. EPA's plan for remediation of the KSCI Site will address all threats posed by the Site: contaminated soil on-Site and groundwater contamination both on and off-Site. 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. The first series of Site investigation field activities completed under the Work Plan commenced on July 10, 1989, and was completed March 22, 1990. A second series of field work was conducted under a Supplemental Plan and commenced on September 16, 1991, and concluded on October 11, 1991. The field investigation at the study area consisted of the following activities:

- Monitoring well integrity testing
- Permeability (slug) testing
- Drilling soil borings and collecting soil samples for characterization
- Installing and developing ten new monitoring wells
- Upgrading and/or abandoning of selected existing monitoring wells
- Metal detection survey
- Soil, surface water, sediment, and groundwater sampling

Groundwater was sampled on four occasions (October 1989, December 1989, February 1990 and October 1991).

Principal groundwater contaminants detected during the sampling events include BTEX compounds, 1,2 DCA, acetone, and methylene chloride. The highest groundwater contamination occurred in wells MW-46A and MW-46B, and Hydrocone location HC-6. Total BTEX levels up to 24,000 ug/l have been detected; 1,2-DCA at 12,000 ug/l is present in the MW-46 location. Acetone and methylene chloride (2,500 ug/l and 130 ug/l, respectively) also are present.

5.1 Site-Specific Geology and Hydrogeology

The lithology beneath the KSCI study area is comprised of the Floridan Aquifer and overlying units extending to the surface. The lithologies are described from oldest to youngest - starting with Eocene limestones and continuing with Miocene sands and clays, and Pliocene-Holocene sands and clays. The Floridan Aquifer corresponds with the Eocene limestones and the water table aquifer with the Pliocene-Holocene sands. Many previous investigations have been conducted in this area, including Hayes

(1979), and Glowacz, et al. (1980).

5.1.1 Geology

The Floridan Aquifer occupies a large geographical area in the South Carolina Coastal Plain and supplies groundwater to hundreds of wells. It is the principal aquifer in the region and was estimated to supply over 99 percent of the groundwater and more than 70 percent of all water used in Beaufort County in 1976 (Hayes, 1979). In the Central Coastal Plain, this aquifer occurs at or near land surface and is tapped by many small-diameter wells less than 100 feet deep. In the Low Country (including the Beaufort area), the aquifer system occurs near the land surface, and confining beds vary in thickness from being absent to being more than 150 feet thick. Groundwater occurs mainly under artesian conditions, but in some areas, confining beds are thin or absent and partial confining conditions occur.

There are five water-bearing or permeable zones (separated by less permeable rock in the Floridan Aquifer. Only two of these zones are present under the Site, the Upper and Lower Hydrologic Units. These two units supply most of the groundwater pumped from the Floridan Aquifer in the immediate Savannah area. The upper unit of the Floridan Aquifer serves as a groundwater reservoir and is used as a water supply in this region. In some areas of the coastal Low Country, water-bearing zones in the lower Floridan Aquifer contain mineralized water and the upper Floridan Aquifer is the only source of potable water. The depths of wells that tap the upper unit range from less than 50 feet in the vicinity of the Beaufort Arch to more than 200 feet in Jasper County. In many areas, the upper portion of the upper unit is the most permeable (Spigner and Ransom, 1979).

5.1.2 Hydrogeology

Historically, there have been three primary groundwater users in the Port Royal Island vicinity: the Marine Corps Recruit Depot (MCRD) on Parris Island; the former Beaufort Naval Air Station (BNAS), now a U.S. Marine Corps Air Station (MCAS); and the local municipalities of Beaufort and Port Royal. A fourth water use was for agricultural irrigation, but no records exist documenting the well locations, volumes pumped, or problems encountered.

Several reports document historical water quality and water level problems encountered on Port Royal Island as water users sought to obtain a dependable supply of fresh drinking water. The major reports are:

- Mundorff (1944) wrote the first groundwater assessment of the area for the U.S. Marine Corps and generated the first local potentiometric map.

- Burnett (1952) chronicled the installation of wells for water supply as the Marines moved their well fields farther and farther north of the Parris Island depot, as they tried to develop a dependable water supply.
- Hazen and Sawyer (1956 and 1957) compared engineering costs for several water supply alternatives for the Beaufort area, including a groundwater supply from across the Broad River and a surface water supply from the Combahee River.
- Siple (1960) documented the groundwater resources of the Low Country area, emphasizing the Floridan Aquifer System.
- South Carolina Resources Commission (1972) investigated the Port Royal Sound area to assess the impact of the proposed deepening of the shipping channel in Port Royal Sound on the local groundwater resources.
- Hayes (1979) provided an updated evaluation of the Floridan Aquifer for the Capacity Use Investigation for the Low Country Area, including aquifer hydraulics, water levels, and water use.
- Spigner and Ransom (1979) addressed the requirements of the Capacity Use Regulations, and drew heavily from Hayes (1979) for technical data.

In 1944, all known wells in Beaufort county obtained water from the Floridan Aquifer. However the history shows since 1899, wells drilled into the limestone aquifer were prone to salt water intrusion. Attempts to drill deeper wells beneath the aquifer resulted in low salt content, but were objectionable because of the temperature (90-100 °F), and because the water contained excessive amounts of other minerals (fluoride and bicarbonate). This history indicates that the Marine Corps kept moving their well fields further north to seek fresh water after successive wells and well fields became salty. In January 1965, the Beaufort-Jasper Water Authority, with assistance from the local military installations, constructed a surface-water supply plant that pulled water from the Savannah River to provide water that was independent of the groundwater supply to the area. The plant was designed for a capacity of 8 million gallons per day (MGD), was upgraded to a 16 MGD capacity in the 1980s, and currently supplies an average of 8 to 9 MGD with a 12 MGD peak flow during the summer peak.

According to the South Carolina Water Resources Commission, there are currently no permitted Class A groundwater users on Port Royal Island. All wells on the island that formerly supplied public drinking water currently are abandoned or have been placed on stand-by status. The only water users that continue to use groundwater supplies are rural homeowners, where city water is not available, and certain small-scale commercial enterprises.

5.2 NATURE AND EXTENT OF CONTAMINATION

5.2.1 Types of Contamination

Soils at the operations area west and northwest of the reactor pad have been impacted by VOCs (BTEX compounds), chlorinated hydrocarbons (methylene chloride, 1,2-dichloroethane), semi-volatile organic compounds (benzoic acid, benzyl alcohol), and inorganic metals (lead, nickel, and mercury). Attached Figure 5-1 shows the area of soil contamination at the Site.

Groundwater in the water table aquifer has been impacted by VOCs (BTEX compounds), methylene chloride, and 1,2-dichloroethane. These compounds occur in two plumes that partially overlap with separate source areas. The eastern plume contains benzene, ethylbenzene, xylenes, 1,2-dichloroethane, and methylene chloride above their maximum contaminant levels (MCLs); the western plume contains benzene, toluene, ethylbenzene, and xylenes, but only benzene is above its MCL.

Greater detail on specific contaminants found at the Site is provided in Chapter 6 of this document. Chapter 6, "Summary of Site Risks," discusses contaminants by media (soil, sediments, groundwater, etc.), and discusses the associated risks. To avoid a lengthy duplication of information, the reader is referred to Chapter 6 for a more detailed discussion of Site contaminants (see Sections 6.2.1 to 6.2.5).

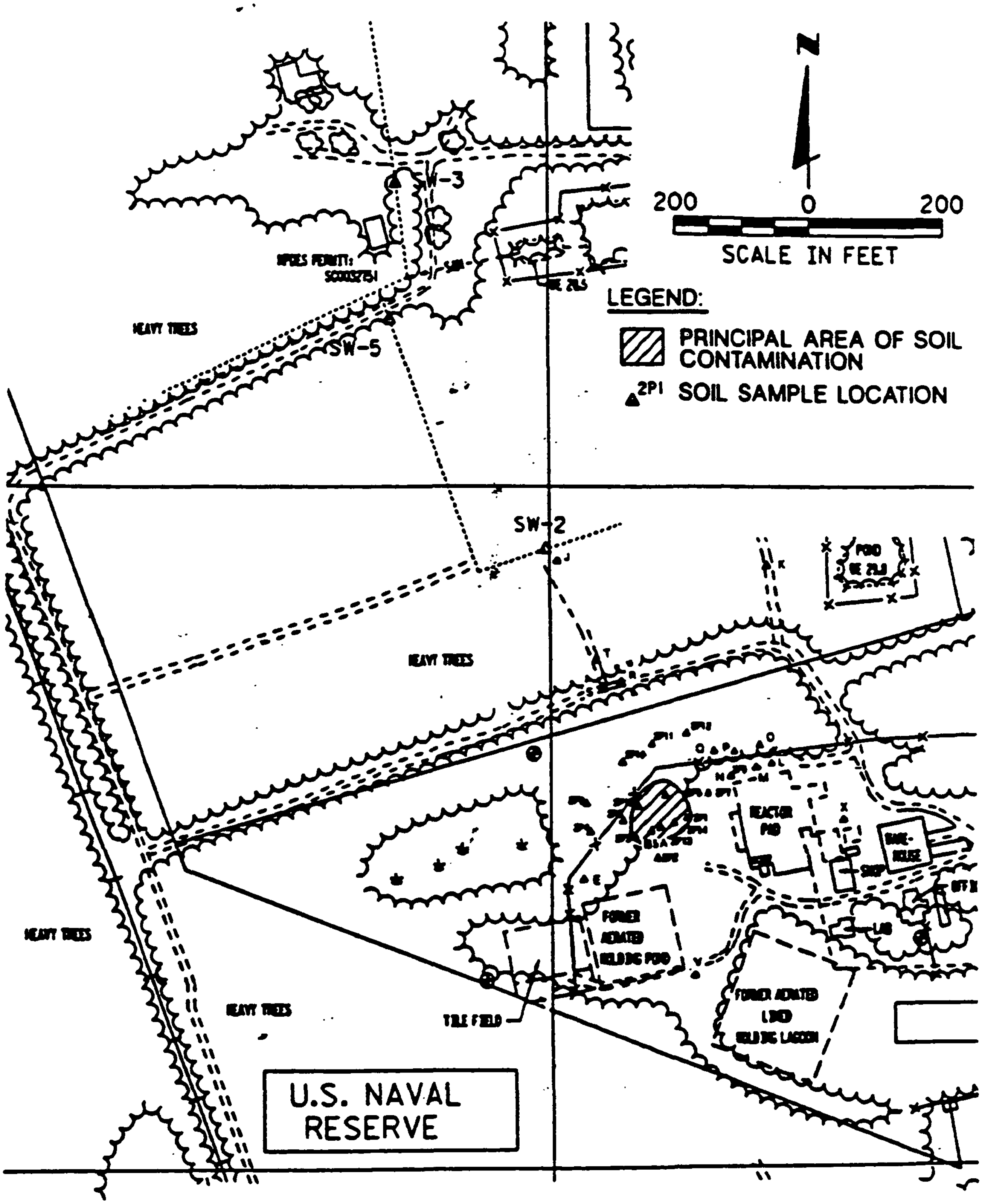
5.2.1 Sources of Contamination

The portion of the operations area of the KSCI facility from the reactor pad west to the B-5A soil sampling location, and northwest in the direction of contaminant flow and ponding from the January 1979 explosion and fire, is a source of groundwater contaminants and the source for the eastern plume.

The tile field, which received wastewater from the original holding pond, also is a source of groundwater contaminants and is the source for the western plume.

Drainage areas, drum storage areas, and areas of both documented and alleged historical activities have been investigated as potential contaminant sources, but no discrete source areas distinguishable from the two plume sources stated above have been identified.

FIGURE 5-1



EXTENT OF PRINCIPAL SOIL CONTAMINATION

5.2.2 Fate and Transport

A contaminant plume extends approximately 700 feet northwest of the tile field; a second plume, which partially overlaps the first plume, extends approximately 550 feet northwest of the operations area. The groundwater beneath the study area is calculated to be moving at flow rates of 20 ft/year in the middle unit of the water table aquifer and 28 ft/year in the deep unit. However, as indicated by the transport model, the leading edge of the plume is estimated to be traveling at rates up to 1.5 to 2 times the groundwater flow rates. The groundwater contaminant plumes in the upper aquifer are shown in attached Figure 5-2.

There have been no contaminants detected above their MCLs in the water table aquifer off-Site, although xylene and ethylbenzene have been detected at below MCLs at one location immediately west of the property boundary. The estimated travel time for benzene, in the western plume, to reach the nearest downgradient property boundary at the MCL level is two to six years.

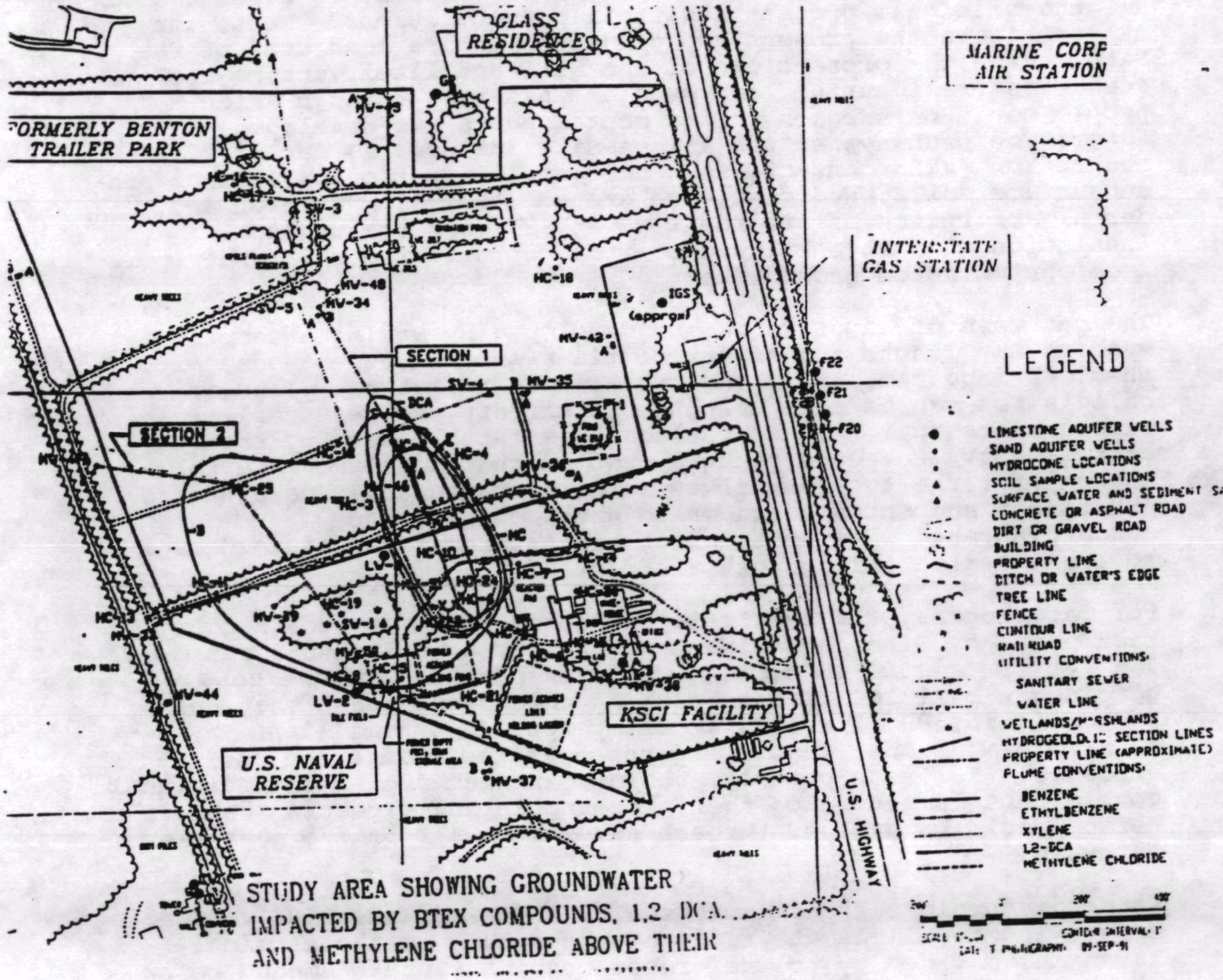
Vertical migration of contaminants from the water table aquifer to the Floridan Aquifer is partially inhibited, though not entirely prevented, by the presence of clay materials in a confining layer throughout much of the study area. Low levels of water table aquifer contaminants (1,2-dichloroethene at 21 ug/l, 1,2-dichloroethane at 0.3 ug/l (J), and 0.6 ug/l (J)) have been detected in the Floridan Aquifer beneath the Site in three samples. "J" qualifiers listed after detection values indicate that the number should be considered an estimated value, typically because the value while above zero is below the quantification limit of the sample or the test equipment. 1,2-dichloroethane also has been detected at low levels in limestone wells to the southwest of the Site, but it has not been conclusively determined whether this is related to an on-Site source area.

The intermittent, standing water in the "L-shaped" ditch and the sediments in a limited area of the ditch have been determined to contain some of the chemicals of concern (COCs including BTEX, 1,2-DCA, and lead).

6.0 SUMMARY OF SITE RISKS

The preceding subsection discussed the contaminant source areas and how the contaminants have been transported through and beneath the Site. The important use of this information is the effect the contaminants have upon human and animal life, and the environment on and around the Site.

FIGURE 5-2



STUDY AREA SHOWING GROUNDWATER IMPACTED BY BTEX COMPOUNDS, 1,2 DCA, AND METHYLENE CHLORIDE ABOVE THEIR

6.1 Baseline Risk Assessment-Purpose and Methodology

The Baseline Risk Assessment (BRA) describes the risks to human health and the environment which would result if the contamination present at the Kalama Site is not cleaned up. The BRA proceeds in a series of steps. First, a list is generated of all the chemicals present and their concentrations. Next, the BRA considers the present and projected future land uses of the Site. From the present use of the Site and likely future use scenarios (residential land uses), "pathways" through which people could be exposed to the contaminants are developed. Future use pathways at the Kalama Site include: 1) dermal absorption (skin contact) and incidental ingestion of surface and subsurface soils, sediment, and groundwater, 2) ingestion and dermal absorption of groundwater, and 3) exposure through inhalation of dust/particulates from contaminated soil and vapors from contaminated groundwater.

The pathways of exposure can be developed by making assumptions such as the length and number of times exposed, the amount of chemical ingested, and using certain other factors. Thus, a calculation can be made using known effects and reasonable exposure assumptions, and the health effects caused by the contaminant. For each pathway, two calculations are made to account for the two general types of contaminants: carcinogens, substances suspected or known to cause cancer, and noncarcinogens, substances which are hazardous and cause damage to human health through other effects.

For carcinogens, the result is expressed as the excess cancer risk posed by Site contaminants. EPA has established a range of 1×10^{-4} to 1×10^{-6} as acceptable limits for lifetime excess carcinogenic risks. Excess risk in this range means that one person in 10,000 (1×10^{-4}) to one person in one million (1×10^{-6}) will risk developing cancer after a lifetime of exposure. For each pathway, the cancer risk from each individual contaminant is added together, because in any exposure scenario a person could be exposed through several or all of the possible pathways.

Noncarcinogenic risk is expressed as a Hazard Index (HI). The Hazard Index (HI) is the ratio of the amount of the chemical taken in, divided by the reference dose, an intake amount below which no adverse effects are known to occur. As for cancer risk, for each pathway, the HIs for the individual contaminants are added together.

Carcinogenic risk and noncarcinogenic HIs were calculated for both the current land use scenario, with no residents at the Site, but including trespassers (both adult and children) accessing the Site, and for the anticipated future use scenario of the Kalama Site becoming a residential area.

In addition to the risks to human health, the environmental risks from the study area also are evaluated in the BRA. The environmental risk assessment is qualitative rather than quantitative. The BRA finds that the primary exposure routes affecting flora and fauna in the KSCI study area include dermal contact with or ingestion of soils in the operations area and dermal contact with or ingestion of surface waters, sediments, and organic matter in the ditch. Secondary exposure routes for predators include consumption of prey that have been affected by the primary exposure routes and consumption of aquatic organisms.

More detailed information concerning Site risks is presented in the Kalama Site's Baseline Risk Assessment, which is available at the public information repositories for the Kalama Site located at both the Beaufort County Library and EPA Region 4 offices in Atlanta, Georgia.

6.2 Contaminants of Concern

Based on RI data, contaminant concentrations to be included and evaluated in the BRA were selected. Table 6-1 presents a summary of these contaminants in all media sampled. The data analyzed in the preparation of the RI consisted of Contract Laboratory Program (CLP) data from soil, sediment, surface water and groundwater samples collected at the KSCI study area. Tables 2-3 through 2-6 in the RI indicate the monitoring wells, sediment, soil, and surface water locations sampled and the analyses for each round of sampling. Sample collection methods used and rationale, as well as the number and location of samples, are discussed in detail in Volume 1, Sections 3 and 4 of the RI report. Only CLP target compound list (TCL) and target analyte list (TAL) data were incorporated into the BRA. No historical data (i.e., non-RI) nor data from the Hydrocone sampling and field laboratory were used in this evaluation because of uncertainties in data validity.

A general review of the analytical results in Table 6-1 provides evidence of chemical impact in the soils, sediments, surface water and water table aquifer by aromatic hydrocarbons, inorganics and chlorinated hydrocarbons. The chemically impacted media are found primarily on an approximate 10-acre portion of the study area, relative to the 50-acre study area. Based on this data review, it appears the primary areas of concern at the KSCI study area correspond to the KSCI operations area (i.e., reactor pad runoff from the 1979 explosion and fire and the old lagoon and tile field) and the "ditch" in the vicinity of sample location SW-2. The primary media of concern in these areas are soils and groundwater.

TABLE 6-1

SUMMARY OF CHEMICALS OF POTENTIAL CONCERN IN ALL MEDIA SAMPLED
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

Chemical	Soils		Groundwater	Surface Water		Sediments		Air
	Surficial Soil (mg/kg)	Subsoil (mg/kg)	(ug/L)	On-Site (ug/L)	Off-Site (ug/L)	On-Site (mg/kg)	Off-Site (mg/kg)	(ug/m3)
Acetone	0.004-2.90	0.005-33.0	2.0-7300	3.0-160.0	9.0 (K)	0.0185-4.30	0.021-0.067	N/A
Antimony	L	L	51.0-58.0	108.0 (K)	L	24.36 (K)	N/A	N/A
Arsenic	0.92-4.20	1.23-7.18	6.40-28.08	5.50-19.85	L	2.89-12.68	L	N/A
Barium	5.45-49.26	3.87-34.33	23.0-239	27.0-82.0	10.0 (K)	7.57-65.14	N/A	N/A
Benzene	L	0.00007-19.0	6.0-1000	1.0-78.0	L	0.004-1.50	L	N/A
Benzoic Acid	L	0.056-0.093	15.0 (K)	L	L	0.94-3.30	0.054-8.30	N/A
Beryllium	L	L	1.0-3.0	1.0 (K)	L	0.76 (K)	N/A	N/A
Bis(2-Ethylhexyl)Phthalate	0.019-0.30	0.010-0.39	2.0-29.0	3.0-17.0	43.0 (K)	0.13-5.0	0.087-2.90	N/A
Butanone, 2-	0.004 (K)	0.003-25.0	42.0 (K)	77.0 (K)	L	L	L	N/A
Cadmium	1.15 (K)	L	5.0-28.5	5.0-6.4	L	2.58-8.00	L	N/A
Carbon Disulfide	L	L	0.20-70.0	8.0-160.0	L	0.95 (K)	L	N/A
Carbon Tetrachloride	L	L	0.10 (K)	L	L	0.64 (K)	L	N/A
Chlorobenzene	0.009-0.086	0.0006-0.012	6.0-55.0	3.0 (K)	L	L	L	N/A
Chloroethane	L	L	1.0-130	L	L	L	L	N/A
Chloroform	0.11 (K)	0.0002-1.7	0.08-19.0	L	L	0.27 (K)	L	N/A
Chloromethane	0.001 (K)	L	2 (K)	L	L	0.93 (K)	L	N/A
Chromium	1.90-4.10	2.15-11.94	10-1290	10.4-38.0	18.6 (K)	3.59-15.03	3.40-25.30	N/A
Copper	L	4.62-12.88	5.0-8.0	4.0-25.0	L	3.14-43.67	N/A	N/A
Dichloroethane, 1,2-	L	0.017-1.65	0.30-12,500	7.0-640.0	L	0.006-3.10	L	N/A
Dichloroethene, 1,1-	L	0.0056 (K)	230-420	L	L	0.96 (K)	L	N/A
Dichloroethene, 1,2-	L	L	0.50-21.0	L	L	L	L	N/A
Di-N-Butylphthalate	L	0.009 (K)	2.0 (K)	L	L	L	0.011-0.029	N/A
Dinitrophenol	L	110 (K)	L	L	L	L	L	N/A
Ethylbenzene	0.011 (K)	0.002-1,800	5.0-1300	0.70-61.0	L	0.006-5.30	0.010 (K)	N/A
Fluoranthene	L	0.010-0.081	L	L	L	L	0.008 (K)	N/A
Lead	1.75-119	0.88-494.85	3.6-16.8	5.20-89.90	3.0-29.9	8.39-5964.6	3.70-76.70	N/A
Manganese	1.40-12.20	1.09-15.30	8.0-688	6.0-195	11.5-74.5	5.66-10.20	3.40-17.20	N/A
Mercury	0.010-49.89	0.010-1.52	0.22-4.70	0.24-1.03	L	0.065-0.365	0.02-0.13	N/A
Methylene Chloride	0.005-4.0	0.0057-41.0	1.0-570	1.0-170.0	L	0.004-1.10	0.002 (K)	N/A
Nickel	14.90-268.57	12.07-229.61	35.0-92.0	39.0-82.0	L	24.93 (K)	L	N/A
Phenanthrene	L	0.068 (K)	L	L	L	L	L	N/A
Pyrene	L	0.015-0.073	L	L	L	L	0.033-0.081	N/A
Selenium	L	L	3.89-5.90	L	L	3.38 (K)	N/A	N/A
Silver	L	L	35.0 (K)	16.0-28.0	L	L	L	N/A
Tetrachloroethene	L	L	L	L	2.0 (K)	0.53 (K)	L	N/A
Toluene	0.002-0.47	0.001-59.0	0.30-290	0.60-89.0	L	0.0205-1.30	0.003-0.008	N/A
Trichloroethane, 1,1,1-	0.001 (K)	L	9.0 (K)	L	L	0.56 (K)	0.001-0.003	N/A
Trichloroethene	L	L	0.10-98	1.0 (K)	L	0.33 (K)	L	N/A
Vanadium	3.16-5.73	4.50-8.55	15.0-93.0	L	L	4.29-17.90	N/A	N/A
Vinyl Chloride	L	L	L	L	L	2.00 (K)	L	N/A
Xylenes	0.0005-1.10	0.0001-4,700	0.20-4500	0.90-210.0	L	0.011-25.0	L	N/A

KEY:
N/A = Not Analyzed.
– = Value Not Available.
K = No Range Available, Only One Detected Value.
L = No Range Available, No Sample Values were Detected Positive.

After the KSCI study area sampling investigation was completed, a large quantity of analytical data was available. Each sample, from the various media, was analyzed for the presence of TCL and TAL constituents, and many of these chemicals were detected. EPA guidance (1989) states that chemicals of concern may be identified at a site under evaluation to streamline the exposure assessment process and subsequent risk characterization. In order to identify potential chemicals of concern (COCs), standardized data evaluation procedures must be employed. These procedures are:

- Evaluation of analytical methods
- Evaluation of quantitation limits
- Evaluation of qualified and coded data
- Evaluation of chemicals in blanks
- Evaluation of tentatively identified compounds
- Comparison of samples with background

The outcome of this evaluation for COCs was (1) the identification of a set of chemicals that are likely to be KSCI Site-related and (2) reported concentrations that are of acceptable quality for use in the quantitative risk assessment. Chemicals remaining after this evaluation may be carried through the quantitative risk assessment and are referred to as chemicals of potential concern.

As a result of the RI, specific locations of chemicals in the groundwater, surface water, sediment and soil have been identified. Chemicals detected at least once in each medium are shown in Table 6-1 and are discussed in the following subsections. A total of two hundred fifty-one samples were collected from the various media at the KSCI study area. These samples were analyzed for TCL and TAL parameters (over 100 compounds). Thirty-nine organic chemicals and twenty inorganic chemicals were detected in these samples. A description of the methodology and results of the environmental monitoring investigation is presented in the RI, Volume 1 of the RI/FS Report, which can be found in the Information Repository.

Because of the potential for contact with these chemicals given potential current and future land use exposure pathways, all chemicals detected in their respective media were initially considered in the selection of COCs. Chemicals of concern are those chemicals detected which are most toxic, mobile, persistent, and are present in significant concentrations. Chemicals selected as COCs are the focus of the toxicity assessment, exposure assessment, and risk characterization. Other factors considered in selection of COCs were frequency of detection, physical properties of the chemicals, potential carcinogenicity, and qualitative assessment of relative chemical concentration and toxicity.

6.2.1 Potential Contaminants of Concern in Soils

Twenty-five organic and seventeen inorganic chemicals were detected at least once in soils at the KSCI study area. The frequency of detection, range of concentrations, and background values for each chemical detected also are presented in Table 2-3 of the RI. Twenty of the organic chemicals identified in soil samples have been included as COCs to be carried through the quantitative risk assessment process. The remaining five organic compounds (benzyl alcohol, 4-methyl-2-pentanone, di-n-octylphthalate, styrene, 1,1,2-trichloroethane) were excluded from the risk characterization because they either were detected infrequently (i.e., once in eighty-three samples), and/or were present at low concentrations (i.e., qualified as an estimated value), and/or their relative toxicities were low. Ten inorganic chemicals (arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel and vanadium) were carried through the quantitative risk assessment.

The remaining seven inorganic compounds were excluded from the risk characterization because they reflect naturally occurring compounds, were detected below background levels, were detected infrequently, and their toxicities were low.

6.2.2 Potential Contaminants of Concern in Sediments

Table 2-6 of the RI lists each chemical detected at least once, along with the frequency of detection, and range of concentrations for each chemical detected in sediments at the KSCI study area and the designated off-Site sampling points. Twenty-five organic chemicals and nineteen inorganic chemicals were detected in the sediment samples collected. Of the twenty-five organic chemicals detected, twenty-one were carried through the quantitative risk assessment. Butylbenzyl phthalate, hexanone-2, 4-methyl-2-pentanone, and vinyl acetate were not evaluated quantitatively in this risk assessment. These chemicals were eliminated from the quantitative risk assessment based primarily on frequency of detection (all four were detected only once), qualitative assessment of concentration (only estimated values were reported), and low toxicity. As with the soils, arsenic, barium, cadmium, chromium, copper, lead, manganese, mercury, nickel, vanadium, antimony, and beryllium were included for evaluation during the risk assessment. The remaining inorganic chemicals were eliminated from the quantitative risk assessment based on evaluation of natural occurrence, concentration, and toxicity.

6.2.3 Potential Contaminants of Concern in Groundwater

Twenty-eight organic chemicals and twenty-one inorganic chemicals were detected in groundwater samples collected at the KSCI study area and designated off-Site wells. Table 2-5 of the RI lists the chemicals detected, the frequency of detection, range of concentrations detected, and drinking water criteria. Of the twenty-eight organic chemicals detected, six (bromomethane, 2-hexanone, vinyl acetate, trans 1,3-dichloropropene, isophorone, and 2,4-dimethylphenol) were excluded from the quantitative risk characterization. These compounds were excluded from the quantitative risk characterization based either on frequency of detection (detected once or twice out of eighty-four samples) and/or qualitative assessment of concentration (present at only low, estimated value concentrations) and toxicity. Arsenic, cadmium, chromium, lead, mercury, nickel, barium, beryllium, copper, selenium, silver, and vanadium detected in groundwater were included in this quantitative risk assessment. The remaining inorganic constituents detected in the groundwater were eliminated from the risk assessment based on evaluation of natural occurrence, frequency of detection, concentration, and toxicity.

6.2.4 Potential Contaminants of Concern in Surface Water

Table 2-6 of the FS lists each chemical detected in surface water at the KSCI study area, or in the designated off-Site sample point. It also includes the frequency of detection, range of concentration for each chemical, and the respective water quality criteria value. Seventeen organic chemicals and nineteen inorganic chemicals were detected in surface water samples. Of the seventeen organic chemicals detected, four (2-hexanone, vinyl acetate, methyl phenol, and 4-methyl-2-pentanone) were excluded from the qualitative risk assessment. These compounds were excluded based on frequency of detection (detected only once) and concentration. As has been the case with the previous media discussed, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, and silver were evaluated during the quantitative risk assessment. The remaining inorganics detected in surface water were eliminated from the risk assessment based on evaluation of natural occurrence, frequency of detection, concentration, and toxicity.

6.2.5 Identification of Contaminants of Concern Summary

A number of steps were employed in order to develop confidence that key Site-related COCs were identified in the RI. A summary is presented below:

- Sample numbers, types, and locations were specified in an EPA-approved Work Plan dated November 1988, a Project Operation Plan dated February 1989, and a supplemental Work Plan dated October 1991.

- Each medium was sampled for TCL/TAL constituents.

- CLP protocol was used for sample analysis.
- Data quality was evaluated according to EPA guidance (1989).

Selection of COCs is summarized here and detailed in Section 6.2.4. For soils, toxicologically significant inorganic analytes were included in the evaluation if one of two concentration guidelines was met. The analyte was included if the concentration detected at a sampling Site exceeded that of a designated background location, or, if the sample concentration exceeded the expected inorganic background levels described in United States Geological Survey Paper #1270 (Shacklette and Boerngen, 1984). Exposure point concentrations were calculated using the 95% upper confidence limit on the arithmetic average assuming a log normal distributed contamination pattern.

For groundwater data, all inorganic target analytes were addressed if their detected level at any sampling site exceeded the applicable Maximum Contaminant Level (MCL) or Secondary Maximum Contaminant Level (SMCL) standard. An exception was made in the case of iron which exceeded the SMCL, but was not included in the summary table. This compound was excluded from further consideration because of its low potential toxicity and because its presence appears to be the result of high natural concentrations of iron (i.e., found in background wells) rather than from anthropogenic sources. Inorganic target analytes detected that are carcinogens also were addressed regardless of the level detected at any sampling location. Similar criteria were used for the inclusion of target organic compounds in the selection of groundwater COCs. All organic compounds detected that exceeded an applicable MCL or MCLG (maximum contaminant level goal) standard were included. All organic target compounds detected that are carcinogens were addressed, regardless of the level detected.

Additional evaluation criteria for inorganic and organic compounds included frequency of detection, physical properties of the chemicals, potential carcinogenicity, and qualitative assessment of relative chemical concentration and toxicity.

This evaluation produced groups of chemicals which are known or suspect carcinogens and/or known or suspect causative agents of chronic human health hazards. These groups of chemicals were evaluated quantitatively to estimate potential risks to human health associated with current and possible future use of the KSCI study area.

6.3 Exposure Assessment

An important step in determining potential risks to human health and the environment is the identification of actual and potential exposure pathways. Only complete exposure pathways are considered for the purpose of determining risks and for developing target concentrations. To be complete, an exposure pathway must have four components:

- A source of chemical release;
- An environmental transport medium;
- An exposure point for human or non-human receptors; and,
- A likely exposure route.

If any one of these components is not present, the exposure pathway is incomplete and would not contribute to the total exposure from the Site.

Because complete exposure pathways are present at the KSCI study area, an exposure assessment was conducted. Exposure pathways are shown in Table 6-2. The objectives of the exposure assessment included:

- Identify actual or potential routes of exposures to contaminants;
- Characterize exposed human and environmental populations; and,
- Determine the extent of actual or potential exposure.

6.4 Toxicity Assessment of Contaminants

In Section 4 of the BRA, the toxic effects of contaminants were investigated and evaluated. The critical variables needed to calculate estimates of risk were obtained from the EPA toxicological database (IRIS and HEAST). Critical toxicity values for the Kalama Site contaminants are presented in Tables 4-2, 4-3, 4-4, and 4-5 within the BRA.

Cancer potency factors (CPFs) have been developed by EPA's 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 underestimation of 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. RfDs and slope values are listed in Table 7-4.

The reference dose (RfD) used in estimating non-carcinogenic risk

Table 6-2

EXPOSURE PATHWAYS
BASELINE RISK ASSESSMENT
KSCI STUDY AREA

EXPOSURE MEDIUM/ EXPOSURE ROUTE	RESIDENTIAL POPULATION	INDUSTRIAL POPULATION	RECREATIONAL POPULATION
CURRENT USE			
ONSITE SURFACE WATER/			
INCIDENTAL INGESTION	--	--	C
DERMAL CONTACT	--	--	C
OFFSITE SURFACE WATER/			
INCIDENTAL INGESTION	--	--	C
DERMAL CONTACT	--	--	C
ONSITE SEDIMENT/			
INCIDENTAL INGESTION	--	--	C
DERMAL CONTACT	--	--	C
OFFSITE SEDIMENT/			
INCIDENTAL INGESTION	--	--	C
DERMAL CONTACT	--	--	C
SURFICIAL SOIL/			
INCIDENTAL INGESTION	--	--	C
DERMAL CONTACT	--	--	C
SUBSURFACE SOIL/			
INCIDENTAL INGESTION	--	A	C
PARTICULATE INHALATION	--	A	--
DERMAL CONTACT	--	--	C
FUTURE USE			
ONSITE SURFACE WATER/			
INCIDENTAL INGESTION	C	--	--
DERMAL CONTACT	C	--	--
OFFSITE SURFACE WATER/			
INCIDENTAL INGESTION	C	--	--
DERMAL CONTACT	C	--	--
ONSITE SEDIMENT/			
INCIDENTAL INGESTION	C	--	--
DERMAL CONTACT	C	--	--
OFFSITE SEDIMENT/			
INCIDENTAL INGESTION	C	--	--
DERMAL CONTACT	C	--	--
SURFICIAL SOIL/			
INCIDENTAL INGESTION	A,C	--	--
DERMAL CONTACT	A,C	--	--
PARTICULATE INHALATION	A,C	--	--
SUBSURFACE SOIL/			
DERMAL CONTACT	A,C	--	--
INCIDENTAL INGESTION	C	--	--
GROUNDWATER/			
INCIDENTAL INGESTION	A,C	--	--
DERMAL CONTACT	A,C	--	--
VAPOR INHALATION	A,C	--	--

C= EXPOSURE IN CHILDREN MAY BE SIGNIFICANTLY GREATER THAN ADULTS
A= EXPOSURE IN ADULTS
--= EXPOSURE OF THIS POPULATION VIA THIS ROUTE IS NOT LIKELY TO OCCUR

is an estimate of the daily dose of a substance to which individuals may be exposed without appreciable risk of health effects. It is expressed as mg/kg-day. RfDs are based on human epidemiological studies or animal studies, and have built-in uncertainty factors that prevent underestimation of potential adverse effects.

In estimating carcinogenic risk, a slope factor (SF) is used to estimate the maximum excess cancer risk posed by a lifetime of exposure to carcinogens. The SF is an estimate of the dose-response curve at very low doses, and is extrapolated from dose-response data at high doses.

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

Group A: Known human carcinogen.

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.

6.5 Risk Characterization

The final step of the generation of numerical estimates of risk, was accomplished by integrating the exposure and toxicity information. Tables 5-1, 5-2, 5-3, and 5-4 of the Baseline Risk Assessment present the total hazard quotient (non-carcinogenic risk) and total cancer risk associated with the Site.

To estimate non-carcinogenic risk, hazard quotients (HQs) are calculated for each contaminant in each exposure pathway. The HQ is the ratio of the daily intake divided by the RfD. An HQ value equal or close to unity, (1), indicates the potential for adverse effects. For each pathway, the individual contaminant HQs are added together to give a total hazard index (HI). Under a reasonable worst-case scenario, a person could be exposed to more than one pathway (for example, while gardening, dermal and incidental ingestion of shallow soil). Therefore, the total HI for each population is a summation of all the exposure pathways for each constituent. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Carcinogenic risk estimates are generated in similar fashion for exposure pathways and populations. EPA has established an excess risk range of 1 x 10^{-4} to 1 x 10^{-6} as acceptable and sufficiently protective of human health and the environment. An excess lifetime cancer risk of 1 x 10^{-6} indicates that, as a plausible upperbound, 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.

To characterize potential risks to human health associated with the KSCI study area, results of the toxicity and exposure assessments have been integrated. Possible human intake, by substance and pathway, is estimated in order to predict the potential human health hazards posed by existing and potential levels of chemicals of concern. The resultant quantitative information, qualified with assumptions and uncertainties, is intended to assist in the development of remedial alternatives for the KSCI study area.

6.5.1 Cancer Risk Estimates

Known or suspect carcinogens identified at the KSCI study area are:

- Arsenic
- Benzene
- Beryllium
- Bis (2-Ethylhexyl) phthalate
- Cadmium
- Carbon Tetrachloride
- Tetrachloroethene
- Chloroform
- Chloromethane
- Chromium VI
- 1,2-Dichloroethane
- 1,1-Dichloroethene
- Lead
- Nickel
- Methylene Chloride
- Trichloroethene
- Vinyl Chloride

Cancer risk estimates were developed using the exposure pathways, estimated CDI (chronic daily intake), and the toxicity values. The cancer risk estimate for current land use is presented in Table 5-1 of the BRA, and that for future land use is presented in Table 5-2. Adult and child exposure pathways were summed to obtain total cancer risks. All raw calculations of risk were carried out to two or more decimal places. However, in accordance with the Risk Assessment Guidance, all estimates of risk are expressed as one significant figure only. Values were rounded as follows: decimal values equal to or greater than .5 were rounded up to the next higher whole number, and decimal values less than .5 were rounded down to the next lowest whole number.

For the current land use scenarios, the total exposure risk is 7×10^{-5} of which 6×10^{-5} represents the pathway risks for dermal contact with and ingestion of sediment. This total exposure risk is within the Superfund remediation goal range of 10^{-4} to 10^{-6} set forth in the National Contingency Plan (NCP). In the future risk scenarios, the total exposure risk is 6×10^{-3}. That also is the total pathway risk for ingestion of groundwater; excluding that route, the sum of other future pathway risks is 9×10^{-5}. The potential cancer risk of 6×10^{-3} for future use is elevated in comparison to NCP goals, resulting in a total exposure risk which is out of the NCP range, unacceptable without remediation.

In addition to on-Site current and future land use scenarios, cancer risk estimates were developed for off-Site surface water and sediment in the "L-shaped" ditch. For the current use off-Site scenarios, the total exposure risk is 3×10^{-7}. Dermal contact with off-Site sediments (2×10^{-7}) represents the primary pathway risk. In the future risk off-Site scenarios, the total exposure risk is 1×10^{-7}. Dermal contact with off-Site sediments (1×10^{-7}) represents the primary pathway risk. Both of these total exposure risks are less than the Superfund remediation goal range of 10^{-4} to 10^{-6}.

The cancer risk associated with the KSCI study area is strongly driven by the route of exposure, with its attendant assumptions and uncertainties. In either current or future use evaluation, the total exposure risk is representative of one or two pathways, not the additive total of all pathways. In other words, one or two pathways (dermal contact and ingestion of sediment for present use; groundwater consumption for future use) constitute a larger potential risk than the sum of other possible pathways.

6.5.2 Chronic Hazard Index Estimates

In addition to known and suspect carcinogens, additional contaminants of concern were identified based upon possible non-carcinogenic health effects. Using the exposure pathways and estimated CDI discussed in Section 3.4.2 of this ROD and the toxicity values presented in Tables 4-2 and 4-3 of the BRA, chronic hazard index estimates were developed. The estimated chronic hazard index for current land use is presented in Table 5-3 of the BRA, that for future land use is presented in Table 5-4 of the BRA. Adult and child exposure pathways were summed to obtain the total HI. All raw calculations of risk were carried out to two or more decimal places. However, in accordance with the Risk Assessment Guidance, all estimates of risk are expressed as one significant figure only. Values were rounded as follows: decimal values equal to or greater than 0.5 were rounded up to the next higher whole number, and decimal values less than 0.5

were rounded down to the next lowest whole number.

For current land use scenarios, the estimated total non-cancer hazard index is 2×10^0, which exceeds the NCP goal of 1. The major contributing pathway is ingestion of on-Site sediments (hazard index = 0.7); secondary pathways include ingestion of surficial soil (hazard index = 0.2) and ingestion of on-Site surface water (hazard index = 0.2). The influence of two primary compounds, arsenic (hazard index = 0.4) and antimony (hazard index = 0.5) was greatest. In the future use scenarios, the estimated total non-cancer hazard index is 7×10^1. This total risk is representative of a single exposure pathway, ingestion of groundwater (hazard index = 7×10^1). For current and future use chronic health hazards, risk appears to be directly related to the route of exposure.

As with cancer risk estimates, chronic hazard index estimates were developed for surface water and sediment in the "L-shaped" ditch. For the current use off-Site scenarios, the total exposure risk is 5×10^{-2}, which primarily is representative of a single exposure pathway, ingestion of off-Site sediment (hazard index 3×10^{-2}). In the future risk off-Site scenarios, the total exposure risk is 1×10^{-2}. Both the off-Site current and future use total exposure risks are less than the NCP goal of 1.

6.6 Environmental (Ecological) Risks

This section provides a qualitative appraisal of the actual or potential effects of chemicals present at the KSCI study area on the environment. The purpose of this section is to provide information on threats to the natural environment associated with the chemicals of concern under baseline conditions (no-action). The objectives of the environmental assessment were to:

- Conduct an environmental exposure analysis;
- Review ecotoxicity data; and
- Qualitatively characterize risk.

This exposure analysis focuses on three ecosystems identified for the KSCI study, which are:

- The KSCI operations area, including the abandoned lagoon system and tile field;
- The aquatic environment, comprising the abandoned sanitary oxidation pond, Benton's smaller pond, and ephemeral waters of the ditch and low areas of the Site; and,
- The forested area, including all terrestrial/wetland habitats in the study area other than the KSCI operations area.

There are no listed endangered species in the study area, and there is no designated critical habitat for endangered species near the Beaufort area.

6.6.1 Summary of Potential Environmental Exposures

Based on evaluation of the environments on the KSCI study area, the most important exposure routes affecting flora and fauna are:

- Dermal contact with or ingestion of soil and organic matter at the operations area; and
- Dermal contact with or ingestion of surface waters, sediments, and organic matter in the ditch.

Secondary exposures which will primarily affect predators from all environments include:

- Consumption of prey that has had extended contact with or ingested chemical-containing soil and organic matter; and
- Consumption of aquatic organisms.

Low-level or low-probability exposure includes:

- Predation of contaminated organisms by migrating animals, or animals with extended range.

Also of concern may be the chronic effects to the flora and fauna of the KSCI study area as a result of bioaccumulation and biomagnification of organic and inorganic compounds.

Comparison of these values with the calculated exposure point concentrations used during the human health evaluation indicates that - at least for these chemicals of concern - it is not likely that exposure to concentrations found at the KSCI study area will produce a significant adverse effect. In reviewing toxicity and monitoring data for human health effects, risk estimates were made for potential mammalian and/or human health effects due to soil (Section 6.2.1), sediment (Section 6.2.2) and groundwater (Section 6.2.3). These risk estimates, while primarily focused on human health, provide a qualitative risk estimate for most wildlife species found at or near the KSCI study area. It can be concluded that aquatic organisms in surface water are not at risk from exposure to these compounds.

6.7 KSCI Baseline Risk Assessment Results Summary

For the current land use of the study area, the total carcinogenic exposure risk is 7×10^{-5} of which 6×10^{-5} represents the pathway risk for dermal contact and ingestion of sediment. Because there is no current groundwater use, there is no current pathway risk for ingestion of groundwater. In the future risk scenarios (assuming a future residential use), the total carcinogenic exposure risk is 6×10^{-3}, which also is the total pathway risk for ingestion of groundwater (assuming residents drinking groundwater from the water table aquifer); excluding that route, the sum of other future pathway risks is 9×10^{-5}. The greatest contributor to the carcinogenic risk is 1,2-DCA with a value of 5×10^{-3}. The potential cancer risk of 6×10^{-3} for future use is above the goals of EPA's National Contingency Plan (NCP), Federal Regulations which guide cleanups at Superfund Sites.

In addition to on-Site current and future land use scenarios, the Baseline Risk Assessment develops cancer risk estimates for off-Site surface water and sediment in the "L-shaped" ditch. For the current use off-Site scenarios, the total exposure risk is 3×10^{-7}. Dermal contact with off-Site sediment represents the primary pathway risk (2×10^{-7}). In the future risk off-Site scenarios, the total exposure risk is 1×10^{-7}, which also is the pathway risk for dermal contact with off-Site sediments.

The cancer risk associated with the KSCI Site is predicted based on the route of exposure, with several assumptions and uncertainties. In both the current or future use evaluations, the total exposure risk is representative of a single pathway, not the additive total of all pathways. In other words, one pathway (dermal contact for present use; groundwater consumption for future use) constitutes a larger potential risk than the sum of other possible pathways.

For current land use scenarios, the estimated total non-cancer hazard index is 2, which exceeds the NCP goal of 1. This total represents the additive sum of three primary exposure pathways: ingestion of surficial soil (hazard index = 0.2); ingestion of on-Site sediments (hazard index = 0.7); ingestion of on-Site surface water (hazard index = 0.2); and the influence of two primary compounds: arsenic (hazard index = 0.4) and antimony (hazard index = 0.5). In the future use scenarios, the estimated total non-cancer hazard index is 70. This total risk is representative of a single exposure pathway, ingestion of groundwater (hazard = 70). Thus current and future use chronic health hazards are directly related to route of exposure. Chemicals of concern that produced the greatest non-cancer risks include ethylbenzene, mercury, antimony, 1,1-DCE, cadmium, arsenic, and nickel.

Similarly to the calculation of cancer risk estimates, the BRA also develops chronic hazard index estimates for surface water and sediment in the "L-shaped" ditch. For the current use off-Site scenarios, the total exposure risk is 5×10^{-2}, which is representative of the pathway risk for ingestion of off-Site sediment (HI = 3 x 10^{-2}). In the future risk off-Site scenarios, the total exposure risk is 1 x 10^{-2}. In the current and future use off-Site scenarios, the non-cancer risks associated with these media fall within the NCP Superfund goal range of less than 1. Comparison of textbook values with predicted concentrations indicates that it is unlikely that either plant or wildlife at the Site will be negatively affected.

Actual or threatened releases of hazardous substances from this 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.

7.0 REMEDIAL ALTERNATIVES

7.1 Remedial Objectives and Goals

Based on the RI and the Risk Assessment, the following two sets of remedial action objectives for the Kalama Site were developed:

For Source Control

* Prevent or mitigate the release of contaminants that would result in groundwater concentrations at levels above the Maximum Contaminant Levels (MCLs).

* Reduce risks to human health associated with dermal contact or ingestion of the contaminated soils and inhalation of soil particulates to less than one for chronic hazard (HI) and to between 10^{-4} and 10^{-6} for carcinogens.

* Reduce contaminant concentration in the soil to levels that are safe for environmental receptors that may come in contact with soil contaminants.

For Groundwater Control

* Prevent off-Site migration of groundwater containing contaminants above MCLs.

* Prevent ingestion of groundwater from the water table aquifer containing chemicals of concern where the chronic hazard risk is more than one and the MCL is exceeded.

EPA has established specific remediation goals (RGs, or cleanup standards) for certain soil, groundwater, and surface water contaminants. Such standards are established under several federal environmental laws, including the Safe Drinking Water Act (for water systems and potable water sources such as groundwater) and the Clean Water Act (surface waters). South Carolina has similar statutes. Some of the contaminants regulated under these standards are present at this Site. In cases where there is no state or federal standard, such as soil and sediments, remediation goals were developed in the FS based on human health risks (risk assessment calculations) for direct contact with the contaminant or the contaminants' leachability potential. This second method produces a cleanup goal for the level of the chemical in the soil based on acceptable concentration of the chemical in the groundwater due to leaching.

Cleanup goals were calculated under both methods at the Kalama Site with the more conservative cleanup goal retained. The remedial goals and quantitative cleanup standards for the Kalama Site are attached to this Record of Decision as Tables 7-1 and 7-2. Further discussion of how the standards were derived is contained in Chapters 8 and 9 of this Record of Decision. Health based target levels for soil clean-up (Table 7-3) and soil cleanup goals based on leaching (Table 7-4) were the basis for the final soil cleanup levels.

7.2 Development of Remedial Alternatives

In the Feasibility Study, separate remedial alternatives were developed and evaluated for control of soil/sediment contamination and groundwater contamination. To formulate the cleanup alternatives, all of the possible technologies, processes and methods which could be utilized in a cleanup effort were evaluated, and those which could not be used at the Kalama Site were screened out. The screening criteria employed are primarily Site-specific factors that make some technologies or processes ineffective, difficult to implement, or infeasible. Such factors include soil type, geology/hydrogeology, Site location, and the area or volume of contaminated media. Technologies and processes considered to be potentially useful were then grouped together into various combinations of soil/sediment contamination remedial alternatives (also identified as source controls) and groundwater remedial alternatives (migration controls). Then, the viable combinations of alternatives were evaluated and compared against one another in detail.

7.3 Source Control Alternatives

This section provides a description of the seven alternatives (SC-1 & SC-1A through SC-6) for source control (contaminated soils and sediments). Table 7-5 summarizes the Source Control Alternatives.

7.3.1 SC-1 - No-Action

The no-action source control alternative provides a baseline by

Tables 7-1 and 7-2

Table 7-1

REMEDIAL GOALS FOR KSCI STUDY AREA

GROUNDWATER

- On site contaminants reduced to MCLs and a chronic hazard index of less than 1.
- Exposure to contaminated groundwater which presents an unacceptable risk is prevented.

SOILS/SEDIMENTS

- Migration will be prevented by removal, treatment or in-place capping of identified source areas.
- Contact with or ingestion of the remaining contaminated soils that present an unacceptable risk is prevented.

Table 7-2

REMEDIAL GOALS FOR PRINCIPAL CONTAMINANTS OF CONCERN

Chemical	Groundwater (ug/l)	Soil/Sediment (mg/kg)
VOCs		
Benzene	5	ND
Toluene	-	4
Ethylbenzene	700	7
Xylenes	10,000	60
1,2-Dichloroethane	5	ND
Methylene Chloride	5	ND
Vinyl Chloride	-	ND
1,1-Dichloroethene	7	0.023
SEMI-VOCs		
Benzoic Acid	-	25,000
METALS		
Antimony	-	3
Chromium	-	40
Lead	-	500
Nickel	-	140
Mercury	-	2

Remedial goals shown in one significant figure, refer to tables 2-12 and 2-13 for calculated values.

NOTE:

ND: Calculated value below respective method detection limit and/or MCL. Non-detect results obtained from validated CLP protocol will serve as cleanup goal.

Table 7-3

Cleanup Goals for Organic Compounds in Soil
Based on Leaching of C ›ntaminants from Soil into Groundwater
At the KSCI Study Area

Chemical	Drinking Water MCL (mg/l)	Soil-Water Equil. Coef. Kd (l/kg)	Potential Target Soil Concentration (mg/kg)
Acetone	N/A	0.0023	N/A
Benzene	0.005	0.24	0.0073
Benzoic Acid	N/A	0.16	N/A
Bis(2-Ethylhexyl)Phthalate	0.004 *	30	0.73
Butanone,2-	N/A	0.59	N/A
Carbon Disulfide	N/A	---	N/A
Carbon Tetrachloride	0.005 *	0.58	0.018
Chlorobenzene	0.1	---	N/A
Chloroethane	N/A	0.11	N/A
Chloroform	0.1	0.083	0.050
Chloromethane	N/A	0.11	N/A
Dichloroethane,1,2-	0.005	0.091	0.0027
Dichloroethene,1,1-	0.007	0.55	0.023
Dichloroethene,1,2-	0.07	0.098	0.042
Di-N-Butylphthalate	N/A	---	N/A
Dinitrophenol	N/A	---	N/A
Ethylbenzene	0.7	1.59	6.7
Fluoranthene	N/A	49	N/A
Methylene Chloride	0.005 *	0.061	0.0018
Phenanthrene	N/A	---	N/A
Pyrene	N/A	---	N/A
Tetrachloroethene	0.005	0.76	0.023
Toluene	1	0.61	3.7
Trichloroethane,1,1,1-	0.2	0.39	0.47
Trichloroethene	0.005	0.38	0.011
Vinyl Chloride	0.002	1.74	0.021
Xylene-m	10 **	1.44	87
Xylene-o	10 **	0.91	55
Xylene-p	10 **	1.36	82

Target soil concentrations based on attainment of ARARs in groundwater.

Assumptions:

Qp = volumetric flowrate of infiltration (ft3/day) = 28.6
Qgw = volumetric flow rate of groundwater (ft3/day) = 144
Soil MCL = MCLgw * Kd*(Qp + Qgw)/Qp

Notes: * = Proposed MCL
** = MCL for total xylenes

N/A denotes chemical which does not have an established MCL or PMCL: therefore, the compound was not carried through this evaluation.

Table 7-4

**POTENTIAL HEALTH BASED TARGET LEVELS FOR SOIL
RESIDENTIAL FUTURE USE CONDITIONS FOR DIRECT CONTACT
KSCI STUDY AREA**

A. POTENTIAL CARCINOGENS

COMPOUND	SLOPE FACTOR (MG/KG/DAY)-1	TARGET SOIL CONCENTRATION (mg/kg) TARGET RISK LEVEL (10-6)
Benzene	2.9E-02	0.558
Bis(2-Ethylhexyl)Phthalate	1.4E-02	1.155
Chloroform	6.1E-03	26.529
Dichloroethane-1,2	9.1E-02	0.178
Dichloroethene-1,1	6.0E-01	0.027
Methylene chloride	7.5E-03	2.157
Vinyl Chloride	1.9E+00	0.008

B. NONCARCINOGENS

COMPOUND	REFERENCE DOSE (MG/KG/DAY)	TARGET SOIL CONCENTRATION (mg/kg)
Acetone	1.0E-01	692.191
Antimony	4.0E-04	2.768
Arsenic	3.0E-04	2.076
Barium	5.0E-02	346.095
Benzoic Acid	4.0E+00	27687.646
Bis(2-Ethylhexyl)Phthalate	2.0E-02	138.438
Butanone-2	5.0E-02	346.095
Cadmium	5.0E-04	3.461
Chlorobenzene	2.0E-02	138.438
Chloroform	1.0E-02	69.219
Chloromethane	1.0E-03	6.921
Chromium	5.0E-03	34.609
Dichloroethene-1,1	9.0E-03	62.297
Di-N-Butylphthalate	1.0E-01	692.191
Dinitrophenol	2.0E-03	13.843
Ethyl benzene	1.0E-01	692.191
Fluoranthene	4.0E-02	276.876
Manganese	1.0E-01	692.191
Mercury	3.0E-04	2.076
Methylene chloride	6.0E-02	415.315
Nickel	2.0E-02	138.438
Phenanthrene	6.8E-02	470.690
Pyrene	3.0E-02	207.657
Toluene	2.0E-01	1384.382
Trichloroethane-1,1,1	9.0E-02	622.972
Vanadium	7.0E-03	48.453
Xylenes	2.0E+00	13843.823
Lead	—	500.00

Lead value from EPA guidance.

Table 7-5

SUMMARY OF ALTERNATIVE COMPONENTS SCREENING
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

SOURCE CONTROL

Alternative Component	Description	Effectiveness	Implementability	Cost		
				Capital	Total O&M	Present Worth
SC-1	No Action	Not effective for protection of human health and the environment	Can be implemented	-0-	-0-	-0-
SC-1A	Limited Action	May be effective for protection of human health on site but not the environment	Can be implemented	$15,000	-0-	$15,000
SC-2	Construct RCRA cap on source soils, fill ditch	Effective and reliable with certain land restrictions	Can be implemented	$195,000	$5,000	$200,000
SC-3	Construct RCRA cap and slurry wall	Effective and reliable with certain land restrictions, slurry wall effectiveness questionable due to depth required	Slurry wall may not be effective because of depth to confining layer	$605,000	$5,000	$610,000
SC-4	Soil and sediment excavation, enhanced volatilization and solidification	Effective and reliable. Certain land restrictions may apply to solidified soils	Can be implemented	$189,000	$45,000	$234,000
SC-5	Soil and sediment excavation; off-site disposal in RCRA landfill	Effective and reliable for study area. No effective reduction of contaminant volume or concentration	Can be implemented but costly	$495,000	$5,000	$500,000
SC-6	*In situ* soil treatment for volatile organic compounds	Effective in removing volatile organics; not effective in removing non-volatile fraction	Can be implemented	$141,000	$100,000	$241,000[1]

[1] Does not include cost for MM-3 which must be used in combination with this component.

which other source control components can be compared and is a requirement of the National Contingency Plan (NCP). Under this technology, no removal or treatment of the contaminated soil will occur. No additional management controls, such as building permit restrictions, will be implemented beyond the existing chain link fence around the former operations area. No-action would not be effective in reducing the toxicity, mobility, and volume of the contaminants within the soil. The source areas could continue to release contaminants into the surrounding groundwater. The no-action alternative would not attain remediation goals for soils. The risk of current and future exposures to contaminated soil due to direct contact would continue. In the long term, no-action would not be effective in protecting on-Site workers and the public from future direct contact with the affected media.

7.3.2 SC-1A - Limited Action, Rezoning to Prohibit Residential Development

The limited action source control alternative would not involve any removal or treatment of contaminated soil. Additional management controls, such as rezoning from the current residential zoning and building permit restrictions, would be implemented to reduce the potential future exposure of on-Site workers. The source areas could continue to release contaminants into the surrounding groundwater. Limited action would not attain remediation goals for soils. The management controls would reduce but not eliminate risk of current and future exposures of individuals to contaminated soil. Rezoning, deed restrictions, and building restrictions would have to be implemented at the local government level, with a present worth cost (PW) of $15,000.

7.3.3 SC-2 - RCRA Cap on Source Soils/Fill In Ditch

Alternative SC-2 would use containment technologies to control exposure to the soils in the former operations area and the sediments in the "L-shaped" ditch. The cap over the soils that are contaminated with VOCs and metals would be designed to meet the requirements of the Resource Conservation and Recovery Act (RCRA). The sediments are not considered a source; therefore, the clay cap would fulfill the intended function, which is to prevent contact with the sediments. SC-2 would be effective for reducing risks in the study area by eliminating or greatly limiting exposure to the chemicals of concern in the soil. Contaminated soils would be covered, eliminating the risk of dermal contact, ingestion, or inhalation of wind blown dust. This alternative protects human health and the environment.

The clay cap over the soils in the former operations area would help limit mobility of the contaminants by eliminating infiltration of rainfall through the area of soil contamination.

Leaching of the chemicals would be greatly reduced or eliminated except where the water table is in contact with the contaminated soils. Some continued leaching could be expected, hindering groundwater remediation if such groundwater remediation is used in combination with this alternative. The volume and toxicity of the chemicals of concern would not, however, be reduced by this alternative. This alternative would be effective in both the short and long term so long as the clay cap is maintained.

This alternative is readily implementable with currently available technology. Clay caps covered with soil have been installed in many places, especially at landfills. However, to minimize wetlands effects, capping and filling of the ditch would require careful study. The PW cost of this alternative is $200,000.

7.3.4 SC-3 - Clay Cap and Slurry Wall/Fill In Ditch

SC-3 adds additional source control for leaching to the controls proposed in SC-2 by adding a soil bentonite slurry wall. The components of this alternative, except for the slurry wall, were described under SC-2. A circumferential vertical barrier or cut-off wall would be constructed to surround the area of soil contamination west of the former reactor pad. The wall would extend vertically from land surface to an approximate depth of 75-85 feet. The clay cap would extend over the edge of the slurry wall, thus preventing infiltration of rainwater. Vertical barriers can be constructed from various low-permeability materials. For the depth needed at the Site, a soil-bentonite slurry wall is deemed to be the best option. This option would be effective in providing protection for human health and the environment by preventing or greatly reducing exposure to the chemicals of concern. Soils would be covered, preventing dermal contact, ingestion or inhalation of dust. It also would be more effective in reducing the mobility of the contaminants than SC-2 because the chemicals in the soil would be prevented from directly contacting the uncontaminated groundwater in the water table aquifer. Mobility of the contaminated groundwater beneath the soil would be greatly reduced in the horizontal plane due to the low permeability of the material in the slurry wall. Because the contaminated groundwater beneath the cap accounts for only one percent of the total plume volume these flows would not be significant. Like SC-2, this alternative would not reduce the toxicity or volume of the chemicals of concern. The total initial project cost for Alternative 3 is estimated to be $610,000.

7.3.5 SC-4 - Soil/Sediment Excavation and Treatment

This alternative would remove and treat the source soils and sediments, preventing contact with the chemicals of concern and eliminating further leaching into the groundwater. Soils in the study area are contaminated with volatile organic chemicals of concern (VOCs) and metals of concern (lead, mercury, and nickel). SC-4 would excavate these sources and the VOCs would be treated to reduce the contaminant levels to safe levels or non-detection. An estimated 604 cubic yards of soil would be excavated and treated along with the 80 cubic yards of sediments in the L-shaped ditch requiring excavation. Because the organic chemicals of concern are volatile, on-Site treatment methods that bring air in contact with the soil piles could be employed to treat them. The treated soils would be replaced into the excavations. About 50 cubic yards of new fill also would be required. Any soils contaminated with excessive levels of the metals of concern would be solidified (chemically fixed) aboveground and replaced into the excavation. This source control alternative would be effective in protecting human health and the environment because it would eliminate dermal contact with chemicals of concern in the soils/sediments and prevent further introduction of contaminants into the groundwater system through leaching.

The mobility, toxicity, and volume of the VOC contaminants in the soils would be eliminated by this remedial action alternative. Solidification of the soils would fix the metals, eliminating their mobility but not their volume or toxicity. Dermal contact, ingestion or inhalation of dust would be very unlikely with the solidified mass. Sediments in the ditch could become recontaminated if this alternative is not used in combination with a component that controls groundwater contamination. High groundwater levels are thought to be the source of sediment contamination in the ditch. Excavation as a means of source remediation is a technology that has been widely used at contaminated Sites and can be accomplished with ordinary earthmoving construction equipment such as a backhoe or trackhoe in combination with dump trucks. Treating the soils by enhanced volatilization transfers contaminants to the air. Treatment units for the air emissions, such as scrubbers, can be added, if necessary, to meet ambient air quality standards. It is not currently anticipated that such treatment will be necessary. Above ground solidification for fixing metals contamination is a proven technology that is readily implementable. Long-term reliability of this method is not well known. Leaching tests intended to simulate long-term conditions have indicated acceptable results. Total capital costs for SC-4 are estimated to be $234,000. This alternative was retained for the detailed analysis.

Because of comments received during the public comment period, a contingency soil remedy has been retained (SC-5). SC-4 has been modified to: excavation of the wastes and then a determination if the waste should be treated on-Site with replacement into the excavation, or disposed of in a RCRA landfill pursuant to soil alternative SC-5 below. This alternative was retained for the detailed analysis. There is concern that while alternative SC-4 appears to be less costly than SC-5 and offers on-Site treatment to the wastes, that the relatively low estimated volume of contaminated soils (770 cubic yards), may not attract competitive bidders for the remediation. Therefore, a contingency soil treatment alternative (SC-5) has been retained by modifying SC-4 to allow for the disposition of the contaminated soil to be determined after excavation and field testing.

7.3.6 SC-5 -- Soil/Sediment Excavation and Disposal in RCRA Landfill

This alternative for source control would excavate the soils in the former operations area that are contaminated with VOCs and metals, and sediments in the "L-shaped" ditch that are contaminated with VOCs. These materials would be transported to a RCRA landfill such as Pinewood, South Carolina, for disposal. Like SC-4, this alternative would provide human health and environmental protection for the Site by eliminating exposure to the chemicals of concern in the soils. It also would prohibit further leaching into the groundwater. SC-5 is readily implementable both technically and administratively.

A RCRA landfill, such as the one at Pinewood, South Carolina, is permitted to accept soils that are contaminated with VOC's and metals. Soils and sediments from the KSCI study area could be landfilled at Pinewood without pretreatment under the facility's present permit conditions. The Pinewood facility, as of August 1993, is closed to Superfund wastes and location of another RCRA landfill utilized for any disposal of contaminated soils from the Kalama Site may be necessary if Pinewood remains closed (and the contingency soil remedy SC-5 is selected).

Total initial project costs for SC-5 are estimated to be $500,000. This alternative would be ineffective at meeting the stated program goal of minimizing untreated waste and is more costly than SC-4, which does meet the goals. Thus, it was not initially selected. As indicated above in SC-4, SC-5 is retained as the contingency soil alternative providing disposal off-Site. This alternative was retained for the detailed analysis.

7.3.7 SC-6 - In-situ Soil Treatment for VOCs

The in-situ vacuum extraction system alternative for the study area, SC-6, would consist of one vapor extraction well located in the former operations area near sampling point B-5A. The well would be connected to a high vacuum pump discharging directly to the atmosphere. It is anticipated that air quality could be maintained at the Site without treatment of emissions. It would be necessary to conduct air dispersion modeling of the anticipated emissions prior to construction to ensure compliance with South Carolina Air Pollution Control standards. Institutional controls, such as fencing, would be used to prevent access to the area of contaminated soils.

The high groundwater table and the low permeability of the soils at the KSCI study area would greatly limit the effectiveness of a conventional vacuum extraction system. Under these Site conditions, a dual extraction system that produces a drawdown of the water table with a groundwater extraction well while the vacuum system is operating in the unsaturated zone, must be used for effective removal of VOCs. Groundwater pump, treat and discharge (PTD) option MM-3, described later in this Record of Decision, must be used in combination with SC-6 in order for SC-6 to be effective.

It is anticipated that the vacuum extraction system would operate for eight months to one year to reach the remediation goals for VOCs in soils. Total initial project costs for SC-6 are estimated at $241,000. This alternative was retained for the detailed analysis in combination with MM-3 (PTD at hot spots) and MM-4 (PTD to MCLs).

A summary table of the Source Controls with descriptions, effectiveness, implementability, and cost is attached as Table 7-5.

7.4 Groundwater (Migration Management) Alternatives

This section provides a description of the five migration alternatives, MM-1 & MM-1A through MM-4, and various methods to control migration of contaminants in the groundwater. Table 7-6 attached, lists all groundwater (migration management) alternatives.

7.4.1 MM-1 -- No-Action

This no-action alternative would involve no attempt to control migration of contaminated groundwater. The no-action alternative would not involve any additional management controls, except periodic groundwater monitoring. Under this alternative, a groundwater monitoring program would be implemented to track water quality and movement of the plumes. Selected existing monitor wells and surface waters would be sampled quarterly for the constituents of concern. The groundwater/surface water monitoring program would be instituted at the study area for a maximum of 30 years, which is consistent with the long-term monitoring requirements for closure at RCRA facilities.

The no-action alternative would not be effective in reducing the toxicity, mobility, and volume of the contaminants within the groundwater. Therefore, the contaminants could continue to migrate into the surrounding aquifer or drainage ditches. This could result in unacceptable risks to public health. Hence, the no-action activities would not attain any of the remediation

Table 7-6

SUMMARY OF ALTERNATIVE COMPONENT SCREENING
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

MANAGEMENT OF MIGRATION

Alternative	Description	Effectiveness	Implementability	Cost		
				Capital	Total O&M	Present Worth
MM-1	No Action	Not effective	Can be implemented	-0-	$325,124	$325,124
MM-1A	Limited action	Somewhat effective in reducing risk but does not meet goals	Can be implemented	$15,000	$325,000	$340,000
MM-2	Slurry wall; pump, treat and discharge to MCL (30 years, 20 gpm)	Effective in preventing migration and reducing overall groundwater contamination	Can be implemented	$3,041,640	$1,851,527	$4,893,167
MM-3	Pump, treat, discharge hot spots (1 year) concurrent with *in situ* soil treatment	Partially effective in reducing overall groundwater contamination	Can be implemented	$542,000	$386,000	$928,000
MM-4	Pump, treat, discharge to MCL (30 years, 20 gpm)	Effective in reducing overall groundwater contamination	Can be implemented	$1,417,000	$1,851,500	$3,268,500

goals for groundwater. As a result, it would not be effective. The estimated present worth (PW) cost associated with no action is $325,124 for monitoring and reporting.

The no-action alternative would not be effective, because it does not attain remediation goals, protect the environment, or achieve a reduction in toxicity, mobility, or volume. It is retained as a baseline consideration, as required by the NCP.

7.4.2 MM-1A -- Limited Action, Deed Restrictions and Plume Monitoring

Under this alternative, no removal or treatment of the contaminated groundwater would occur. The limited action alternative would include some minimal actions consisting of management controls, such as deed and well installation restrictions. In addition, the periodic groundwater monitoring program described in MM-1 would be implemented. The management controls would decrease the risk of current and future exposures to contaminated groundwater. This limited action alternative by itself, however, would not be effective in reducing the toxicity, mobility, and volume of the contaminants within the groundwater. Therefore, the contaminants could continue to migrate into the groundwater and into the "L-shaped" ditch. This could result in an unacceptable risk to public health. This limited action would not attain any of the remediation goals for groundwater.

Deed and well permit restrictions also would require the cooperation of the local government. The estimated PW cost associated with limited action is estimated at $340,000.

7.4.3 MM-2 -- Slurry Wall, PTD to MCL

This migration management alternative would include installation of a slurry wall around the plume to retard contaminant migration and recovery of groundwater via extraction wells. The groundwater would be treated and discharged until the MCL concentrations for contaminants of concern are reached. A low permeability soil-bentonite slurry wall, approximately 5,000 feet long and 80 feet deep, would be installed around the plume. The slurry wall would reduce the mobility of the plume during the pump and treat period. It is estimated that one to ten extraction wells with a total flow of 20 gpm would be installed within the wall. The extraction well system will be designed to reverse the downward gradients, especially in the 1,2-dichloroethane (DCA) plume, and effectively capture the constituents in the plume. This design will eliminate flow into the limestone aquifer. Pump tests and additional monitoring wells during the RD/RA will determine the most effective system.

The water would be treated on-Site by two air stripping towers connected in series. The water effluent from the towers would then be polished by granular activated carbon (GAC). Effluent from the treatment system would be disposed of in an on-Site infiltration gallery or spray field, or be discharged to the "L-shaped" ditch downstream of station SW-5. MM-2 would operate until the MCLs for the groundwater contaminants of concern are reached. Based on the calculation of the number of pore volumes required to achieve a cleanup of the plumes, the remediation time is estimated to be 30 years. The slurry wall may not increase the effectiveness of the overall alternative if a properly designed extraction network is implemented. MM-4 is the same alternative without a slurry wall.

This alternative would be effective for protecting human health and the environment because it would virtually eliminate the mobility, toxicity, and volume of the contaminated groundwater. By reversing the downward component of flow in the water table aquifer, the migration or potential migration of contaminants into the limestone aquifer would be eliminated. It would be a permanent solution in that it would satisfy the remediation goals for the study area, including prevention of groundwater contaminated above MCLs from migrating off-Site. This alternative can be implemented. Direct discharge of the treatment groundwater to an on-Site sprayfield or the ditch will require compliance with South Carolina and federal discharge standards. Air emissions from the stripping towers must meet South Carolina's emission standards for air toxics. Total PW for MM-2 is estimated at $4,893,167. This alternative is the most expensive one screened, but was retained for the detailed analysis.

7.4.4 MM-3 -- Short-Term PTD of Groundwater Concurrent with Vacuum Extraction of Soils at Hot Spots

In order for vacuum extraction to be effective as a soil treatment technique at the KSCI study area, groundwater would have to be withdrawn continuously for one year to increase the depth of the unsaturated zone. This alternative has the soil treatment elements of SC-6, and adds groundwater treatment. Groundwater would be recovered from the former operations area near sampling point B-5A and from hot spots near monitor wells MW-46 and MW-49. These areas contain high levels of VOC's. The groundwater would be treated on Site by precipitation/filtration, air stripping and carbon adsorption, then discharged. The three new extraction wells would have a total withdrawal rate of 9 gpm. Effluent from the treatment system would be discharged to either an on-Site infiltration gallery, an on-Site sprayfield, or to the "L-shaped" ditch downstream of station SW-5.

Groundwater extraction wells would be located and designed to maximize recovery rates for the contaminants. The controlling contaminant for the design of the treatment system is 1,2-DCA.

It is not anticipated that treatment of the emissions from the air stripper would be required to maintain air quality during remediation, but provisions would be made to treat off-gases, if necessary. The groundwater extraction and treatment system would be operated for the time required to complete the soil cleanup, estimated to be one year. This alternative could provide a long-term permanent solution by removing and treating a high percentage of the contaminants in the groundwater at the Site. This alternative will provide some protection for the public, but would not achieve the goals of groundwater quality and management of migration. Discharge of the treated groundwater would result in a small increase in the contaminants of concern downstream. However, this discharge would have been treated sufficiently to protect human health and the environment and to comply with water quality requirements.

This alternative would reduce the volume and concentrations of contaminants of concern in groundwater. The proposed treatment facilities have no unusual construction or operation requirements. The estimated PW for this alternative is $928,000.

Although the actions taken under MM-3 would not achieve all the remediation goals and, therefore, would not be totally effective, this alternative offers increased protection of public health from ingestion of contaminated groundwater. MM-3 also would be necessary for dual vacuum extraction and, thus, is retained for further analysis.

7.4.5 MM-4 -- PTD to MCL Concentration

This migration management alternative would be the operation of a groundwater pump, treat and discharge system until reduction of the contaminants of concern to MCLs. It is estimated that groundwater would be withdrawn from extraction wells pumping a total of 20 gpm. The exact number, locations and design of the extraction wells will reverse the downward contaminant movement, especially in the 1,2-Dichloroethane (DCA) plume, and effectively capture the contaminants in the plume. This design will eliminate flow into the limestone aquifer. Pump tests and additional monitoring wells during the RD/RA will determine the most effective system.

The water would be treated on-Site by a system like that previously described in MM-2. Discharge could be to either an on-Site sprayfield, an infiltration gallery, or the "L-shaped" ditch downstream of station SW-5. This alternative would operate until the MCL concentrations are reached for the groundwater contaminants of concern. Based on an analysis of the recovery well locations and the number of pore volumes required to achieve a cleanup of the plumes, the remediation time is estimated at 30 years. The air stripping and activated carbon technology, preceded by chemical precipitation/filtration, would be effective at protecting human health and the environment because it would eliminate or greatly reduce the mobility, toxicity, and volume of the contaminated groundwater. It would provide a permanent solution by satisfying the remediation goals for the study area, including prevention of groundwater contaminated above MCLs from migrating off-Site. This alternative would provide significant protection over a no-action alternative, at a total present worth (PW) for MM-4 estimated at $3,268,500. Figure 7-1 shows potential locations of groundwater extraction wells.

Attached Table 7-6 lists the migration management (groundwater) alternatives with their descriptions and a discussion of their effectiveness, implementability, and costs.

7.5 Source and Migration Management Control Alternative Combinations

Seven combinations of the seven source control alternatives and the five groundwater migration-control alternatives were initially retained for thorough analysis in the Feasibility Study (FS). Of the twenty total combinations of valid source and groundwater migration control alternatives, thirteen (13) were dropped from further consideration after an initial screening of their anticipated effectiveness and implementability. A contingency alternative was developed for this ROD after comments were received during the Public Comment Period. The seven remedial action alternatives that were retained for the detailed analysis and the contingency alternative are described as follows:

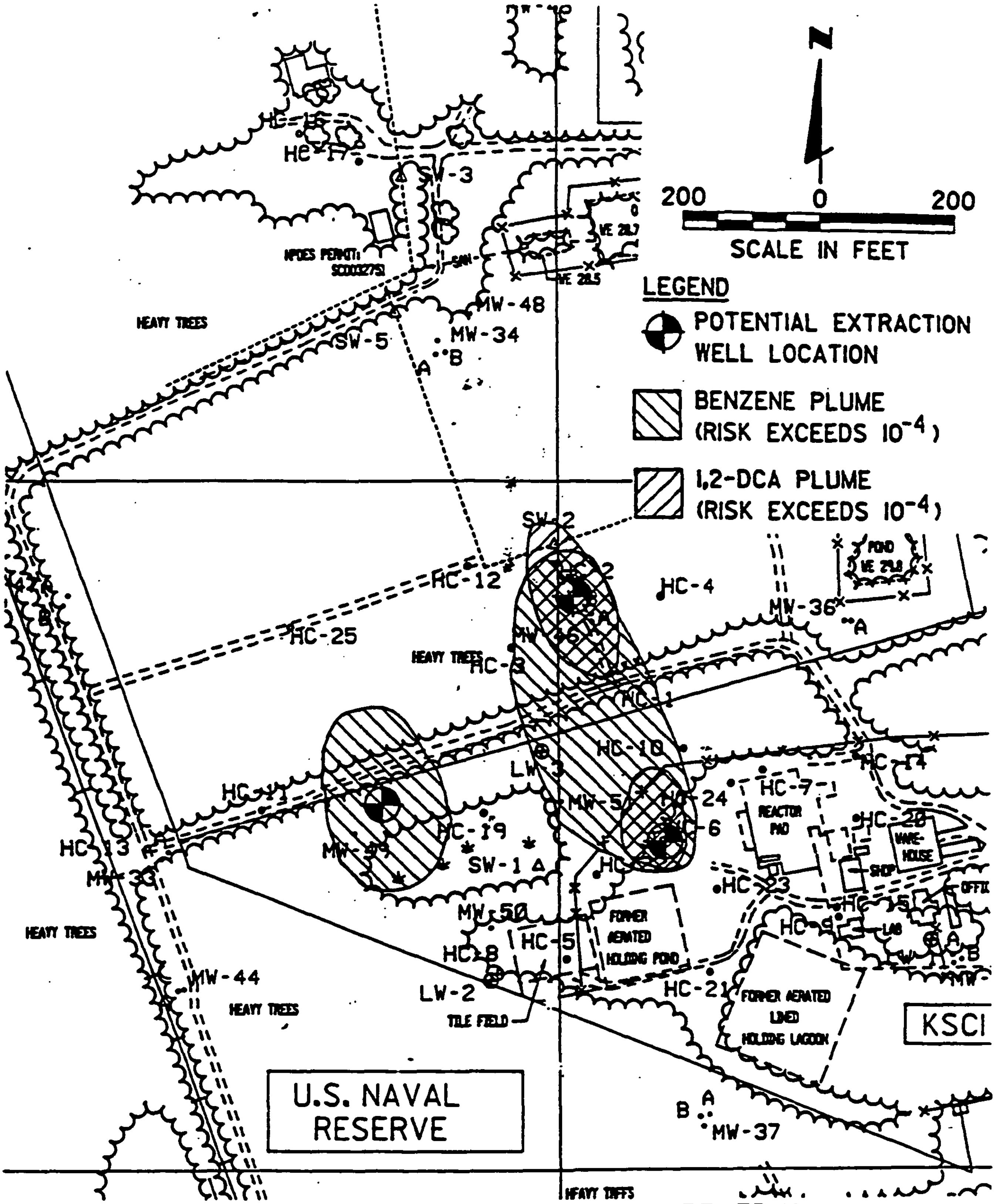
<u>Alternative 1 (SC-1/MM-1)</u>: No source control action; monitor the groundwater plumes. Estimated PW cost of Alternative 1 is $325,124.

<u>Alternative 2 (SC-2/MM-1A)</u>: Fill the "L-shaped" ditch on the Benton Property. Construct a RCRA clay cap over the contaminated soils in the former operations area. Implement deed restrictions. Rezone the property and monitor the plumes. The total PW cost of Alternative 2 is $524,848.

<u>Alternative 3 (SC-4/MM-1A)</u>: Excavation and treatment of soils/sediments for VOCs and metals by enhanced volatilization and stabilization/solidification. Replace the treated soils into the excavations. Implement deed restrictions. Rezone the property and monitor the plumes. Total PW cost of Alternative 3 is $558,653.

<u>Alternative 4 (SC-4/MM-2)</u>: Install slurry wall around plume. Extraction and treatment of groundwater to the MCLs for chemicals of concern. Excavation and treatment of soils/sediments for VOCs and metals by enhanced volatilization and stabilization/solidification. Total PW cost of Alternative 4 is

Figure 7-1



POTENTIAL WELL LOCATIONS FOR REMEDIAL ACTION COMPONENT MM-3 (3 WELLS; 9 gpm TOTAL)

$5,127,167.

Alternative 5 (SC-6/MM-3): Treatment of soils contaminated with VOCs by in-situ vacuum extraction. Extraction and treatment of groundwater in the area of soil contamination (Dual Vacuum Extraction) and in the "hot-spots" of groundwater contamination. Rezone the property. Deed restrictions on water wells and monitor the plumes. Total PW cost for Alternative 5 is $1,170,000.

Contingency Alternative (SC-5/MM-4): Excavation and off-Site disposal of soils. Extraction and treatment of groundwater to the MCLs for chemicals of concern. Estimated PW is $3,768,500..

Alternative 6 (SC-4/MM-4): Excavation and treatment of soils/sediments for VOCs and metals by enhanced volatilization and stabilization/solidification. Extraction and treatment of groundwater to the MCLs for chemicals of concern. Total present worth cost of the Alternative 6 is $3,502,197.

Alternative 7 (SC-6/MM-4): Treatment of soils for VOCs by in situ vacuum extraction (Dual Vacuum Extraction). Extraction and treatment of groundwater to the MCLs for chemicals of concern. Total present worth cost of Alternative 7 is $3,509,217.

The "O&M cost" included for each alternative refers to the costs of operating and maintaining the treatment described in the alternative, for an assumed period of 30 years. All alternatives include sampling to ensure that all contaminated groundwater at concentrations exceeding the remediation goals will not migrate beyond Site boundaries. Additionally, all alternatives include necessary Five Year Reviews to be conducted during the respective 30-year O&M period. The costs, including professional reports and supporting inspections, sampling, and analytical work are contained in the Operation and Maintenance Costs (O & M) of each Alternative and were calculated using the same five percent discount factor as other O&M costs.

8.0 Summary of Comparative Analysis of Alternatives

8.1 Evaluation of Remedial Alternatives

EPA uses the following evaluation criteria for Superfund Sites to select preferred remedial alternatives. The first seven criteria are used to evaluate all the alternatives, based on environmental protection, cost, and engineering feasibility issues. Table 8-1 graphically depicts how well each combination of source and groundwater controls meets the seven criteria. The preferred alternative is further evaluated based on the final two criteria, State and Community Acceptance.

Table 8-1

SUMMARY OF DETAILED ANALYSIS OF ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC., NPL SITE

Criteria	ALTERNATIVE NUMBER							
	1	2	3	4	5	6	7	Contigency Alternative
PROTECTIVENESS:								
Human Health	XX	XX	XX	XXX	XX	XXX	XX	XXX
Environment		X	XXX	XXX	XXX	XXX	XX	XXX
ARARs:								
Soil		X	XXX	XXX	XX	XXX	XX	XXX
Groundwater				XXX	X	XX	XX	XX
S-T EFFECTIVENESS:								
Community	XXX	XXX	XX	XX	X	XX	XX	XX
Workers	XX	X	X	XXX	XX	XX	XX	XX
Time (years)	1	1	1	30	1	30	30	30
L-T EFFECTIVENESS:								
Residuals Risk			XX	XXX	XX	XXX	XX	XXX
Reliablity		X	XX	XXX	XX	XXX	XXX	XX
REDUCTION IN:								
Toxicity			XX	XXX	XX	XXX	XXX	XX
Mobility		X	XX	XXX		XXX	X	XX
Volume			XX	XXX	XX	XX	XX	XX
IMPLEMENTABILITY:								
Constructability	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Availability	XXX	XXX	XXX	XXX	XX	XXX	XX	XXX
Monitoring	XXX	XXX	XXX	XXX	XX	XXX	XX	XXX
COST (thousands)	$325	$525	$559	$5,127	$1,118	$3,502	$3,509	$3,768

XXX - Completely satisfies criterion
XX - Substantially satisfies criterion
X - Partially satisfies criterion
(blank) - Does not satisfy criterion

8.2 Threshold Criteria

The first two statutory requirements must be met by the alternative:

1. *Overall Protection of Human Health and the Environment* addresses the degree to which an alternative meets the requirement that it be protective of human health and the environment. This includes an assessment of how public health and environmental risks are properly eliminated, reduced or controlled through treatment, engineering controls, or controls placed on the property to restrict access and (future) development.

2. *Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)* addresses whether or not an alternative complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup options at a specific Site. If an Applicable or Relevant and Appropriate Requirement (ARAR) cannot be met, the analysis of the alternative must provide the grounds for invoking a statutory waiver.

In evaluating compliance with ARARs, contaminated soil will be analyzed to determine if it will be categorized as a hazardous waste as defined under RCRA and the South Carolina Hazardous Waste Management Regulations (SCHWMR, 61). Should the contaminated soil fail the Toxicity Characteristic Leaching Procedure (TCLP), then 40 CFR Parts 261, 262, 263, and the corresponding parts under the SCHWMR, will apply. Also, if the contaminated soil fails TCLP and Extraction Procedure (EP) toxicity limits, the land disposal restrictions in 40 CFR Part 268 and SCHWMR 61-79.268 will apply. However, if EP toxicity tests are performed and the contaminated sludge and soils do not exceed EP toxicity limits, then the land disposal restrictions cited above will not apply, even though the contaminated soils fail TCLP.

8.3 Primary Balancing Criteria

These five considerations are used to develop the decision as to which alternative should be selected.

3. *Long-Term Effectiveness and Permanence* refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the cleanup goals have been met.

4. *Reduction of Toxicity, Mobility, and Volume* addresses the statutory preference for selecting remedial actions that employ

treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substance as their principal element.

5. *Short-Term Effectiveness* addresses the impacts of the alternative on human health and the environment during the construction and implementation phase, until remedial action objectives have been met.

6. *Implementability* refers to the technical and administrative feasibility of implementing an alternative, including the availability of various services and materials required for its implementation.

7. *Cost* consists of the capital (up-front) costs of implementing an alternative, plus the costs to operate and maintain the alternative over the long term. Under this criterion, the cost-effectiveness of the alternative can be evaluated.

8.4 Modifying Criteria

These two considerations indicate the acceptability of the alternative to the public, or local or State officials.

8. *State Acceptance* addresses whether, based on its review of the RI, FS, and Proposed Plan, the State concurs with, opposes, or has no comments on the alternative once it is proposed by EPA as the selected alternative (or "remedy"). The State of South Carolina concurs with this remedy. South Carolina's letter of concurrence is provided in Appendix A to this ROD.

9. *Community Acceptance* addresses whether the public agrees with EPA's selection of the alternative. Community acceptance was indicated by the verbal comments received at the Kalama Specialty Chemical, Inc., Site Proposed Plan public meeting, held on July 1, 1993. The public comment period opened on June 22, 1993, and was set to close on July 22, 1993. A request for an extension to the Public Comment Period was received and the comment period was extended 30 days and concluded on August 23, 1993. Several written comments were received concerning the Kalama Site. Those comments and comments expressed at the public meeting are addressed in the Responsiveness Summary attached as Appendix B to this ROD.

8.5 Combined Alternatives Evaluation

The seven combined initial alternatives and the contingency alternative were evaluated based upon the nine criteria set forth in the NCP, 40 C.F.R. § 300.430(e)(9). In the attached Table 8-2, brief summaries are presented of how the combined alternatives were judged against these nine criteria.

Table 8-2, p. 1.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 1 *No-Action*	ALTERNATIVE 2 *RCRA Cap On Source Soils/Fill Ditch*	ALTERNATIVE 3 *Soil and Sediment Excavation/Enhanced Volatilization and Solidification*
1. OVERALL PROTECTIVENESS OF HUMAN HEALTH AND THE ENVIRONMENT:			
Human Health			
- Direct Contact Soil/ Sediment Ingestion	Institutional controls reduce risk of exposure.	Cap reduces risk of exposure to soils; fill reduces dermal contact risk from sediments.	Excavation and treatment of soil reduces risk to within NCP guidelines.
- Leachate Production	No reduction.	Leachate from vertical infiltration is removed, however large natural water table fluctuations will continue to mobilize contaminants in the lower portion of the source volume.	Source of leachate is eliminated or fixed.
- Groundwater Ingestion/Future Users	Institutional controls reduce risk.	Institutional controls reduce risk.	Institutional controls reduce risk.
Environmental Protection	Allows continued contamination of soil and groundwater, continued groundwater migration.	Cap reduces contact with soils. Contaminated groundwater remains and continues to migrate.	Soils are remediated. Contaminated groundwater remains and continues to migrate.
2. COMPLIANCE WITH ARARs:			
Chemical-Specific	Does not comply with ARARs. 30-year groundwater monitoring is planned.	No compliance with groundwater ARARs. 30-year groundwater monitoring is planned.	Attains remediation goals for soil, but not ARARs for groundwater.
Action-and-Location-Specific	Not relevant. No ARARs for institutional controls.	Capping in wetlands must comply with wetland regulations.	Air quality ARARs will be met possibly through treatment. Wetland regulations must be complied with for soil excavation.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 1 No-Action	ALTERNATIVE 2 RCRA Cap On Source Soils/Fill Ditch	ALTERNATIVE 3 Soil and Sediment Excavation/Enhanced Volatilization and Solidification
3. SHORT-TERM EFFECTIVENESS:			
Community Protection	No impacts on community from remedial action.	No impacts on community. Possible dust during capping of soils.	Possible impact from VOC emissions and dust during removal and treatment of soils. VOC emission will be treated.
Worker Protection	Minor risk during maintenance of fence. Health and safety plan required.	Minor risk during installation of cap. Health and safety protection likely required during RCRA cap construction.	Moderate risk to workers from VOCs and dust. Requires sophisticated site health and safety plan.
Environmental Impacts	Minimal, limited to maintenance of fence.	Minimal, construction in wetland will have impact, but, small area (0.5 acres).	Some impacts, but limited to disturbances and traffic during remedial action for soils.
Time to Completion	Less than six months.	Less than six months.	From two to four months.
4. LONG-TERM EFFECTIVENESS:			
Magnitude of Residual Risk			
- Soils	Risk from soils must be managed long-term.	Dermal contact risk reduced significantly. Cap must be maintained long term to control risk from contact/ingestion.	Risks from soil are greatly reduced or eliminated.
- Groundwater	Risks from GW must be managed long term.	Risks from GW must be managed long-term. High water table may periodically flush contaminants into groundwater.	Risk from GW must be managed long-term, but levels should decrease with time.
Adequacy and Reliability of Controls	Reliability of deed restrictions and rezoning depends on enforcement.	Reliability of cap depends on maintenance. Reliability of deed restrictions depends on enforcement.	Treatment is reliable for soil contaminants. Reliability for GW depends on enforcement.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 1 No-Action	ALTERNATIVE 2 RCRA Cap On Source Soils/Fill Ditch	ALTERNATIVE 3 Soil and Sediment Excavation/Enhanced Volatilization and Solidification
5. REDUCTION OF MOBILITY TOXICITY OR VOLUME:			
Soils	No treatment utilized.	No treatment of soil. Mobility of chemicals in soil greatly reduced by cap. No reduction in volume, biodegradable waste will decrease in toxicity with time.	770 yd^3 of soil treated by enhanced volatilization and solidification of metals. VOCs treated to detection level.
Groundwater	No treatment utilized.	No treatment of GW. Cap will reduce but not eliminate source of contamination.	No treatment of GW. Source is eliminated allowing gradual improvement in quality.
6. IMPLEMENTABILITY:			
Availability of Technology	Readily available for numerous sources.	Readily available and widely used.	Readily available and broad experience with implementation.
Reliability	Depends on enforcement of institutional controls.	Depends on inspection and maintenance program.	Highly reliable for VOCs. Long-term reliability of solidification not well established.
Availability of Treatment, Storage, or Disposal Services	None required.	None required.	None required.
Ability to Monitor Effectiveness	Groundwater monitoring will track quality and location of plume.	Groundwater monitoring will track quality and movement of plume.	Sampling will verify attainment of remediation goals for soils. GW will be monitored.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 1 No-Action	ALTERNATIVE 2 RCRA Cap On Source Soils/Fill Ditch	ALTERNATIVE 3 Soil and Sediment Excavation/Enhanced Volatilization and Solidification
7. COST:			
Capital	$0	$196,000	$188,000
Annual O&M	$325,124	$329,000	$371,000
Present Worth	$325,124	$525,000	$559,000

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 4 Soil Excavation/Enhanced Volatilization and Solidification, Slurry Wall, Pump, PTD to MCL	ALTERNATIVE 5 Dual Vacuum Extraction of Contaminated Soils with Short-Term PTD of Contaminated Groundwater "Hot Spots"	ALTERNATIVE 6 Soil Extraction/Enhanced Volatilization and Solidification; PTD of Groundwater to MCL
1. OVERALL PROTECTIVENESS OF HUMAN HEALTH AND THE ENVIRONMENT:			
Human Health			
- Direct Contact Soil/ Sediment Ingestion	Excavation and treatment of soil reduces risk to within NCP guidelines.	Treatment of soils reduces risk by VOCs to within NCP guidelines; metals are not affected.	Excavation and treatment of soils reduces risk to within NCP guidelines.
- Leachate Production	Source of leachate is eliminated or stabilized.	Source of VOC leachate is eliminated.	Source of leachate eliminated (VOCs) or stabilized (metals).
- Groundwater Ingestion/Future Users	Groundwater contamination would be eliminated for future users.	Reduction in risk, however, institutional controls still needed, because some contaminated groundwater remains.	Groundwater contamination would be eliminated for future users.
Environmental Protection	Soils are remediated. Remedation of groundwater eliminates risk for future consumption. Wetlands may be impacted by construction of a slurry wall.	Soil VOC contamination eliminated. Significant improvement in GW quality, with decrease in migration potential. May pass through wetlands with some influent or effluent piping. Some minor air emissions.	Soil contamination removed or fixed. Remedation of GW quality to acceptable risk. Wetlands may be impacted by construction effort. Some minor air emissions.
2. COMPLIANCE WITH ARARs:			
Chemical-Specific	Groundwater treatment complies with ARARs.	Attains remediation goals for soil VOCs. Treats GW, but not to ARARs.	Attains remediation goals for VOCs and metals in soils, and ARARs for GW.
Action-and-Location-Specific	Should comply with ARARs.	Discharge from vacuum extraction and air stripper will meet air standards. Discharge from GW treatment unit will meet MCLs, water quality standards.	Discharge from soil treatment and air stripper will meet air standards. Discharge from GW treatment unit will meet MCLs, water quality standards.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 4 Soil Excavation/Enhanced Volatilization and Solidification, Slurry Wall, Pump, PTD to MCL	ALTERNATIVE 5 Dual Vacuum Extraction of Contaminated Soils with Short-Term PTD of Contaminated Groundwater "Hot Spots"	ALTERNATIVE 6 Soil Extraction/Enhanced Volatilization and Solidification; PTD of Groundwater to MCL
3. SHORT-TERM EFFECTIVENESS:			
Community Protection	Possible impact from VOC emissions and dust during removal and treatment of soils. VOC emission may be treated.	VOC emission from vacuum extraction may be treated. Dust from construction activities will be minimal and short-term.	VOC emission from soil treatment and dust from construction activities will be minimal and short-term.
Worker Protection	Moderate risk to workers from VOCs and dust. Requires sophisticated site health and safety plan.	VOC emission from vacuum extraction may be treated. Emissions from air stripper may require treatment. Health and safety plan required for site work.	VOC emission from soil treatment and emissions from air stripper may require treatment. Health and safety plan required for site work.
Environmental Impacts	Some impacts, but limited to disturbances and traffic during remedial action for soils. Slurry wall will have a potentially major impact on wetlands during construction.	Minor, limited to excavation of soils containing metals during vacuum system installation and well drilling.	Minor, limited to excavation of soils and sediments during construction and well drilling.
Time to Completion	From six months to one year for soil, groundwater remediation may take 30 years.	Soil treatment by *in situ* DVE to last 6 months to one year with concurrent PTD of GW to run during same period.	Soil remediation expected to take six months to one year. PTD of GW will show reductions in contaminants in the short term but overall cleanup will take a much longer time frame.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 4 Soil Excavation/Enhanced Volatilization and Solidification, Slurry Wall, Pump, PTD to MCL	ALTERNATIVE 5 Dual Vacuum Extraction of Contaminated Soils with Short-Term PTD of Contaminated Groundwater "Hot Spots"	ALTERNATIVE 6 Soil Extraction/Enhanced Volatilization and Solidification; PTD of Groundwater to MCL
4. LONG-TERM EFFECTIVENESS:			
Magnitude of Residual Risk			
- Soils	Risks from soil are greatly reduced or eliminated.	Risks from VOCs in the soil are eliminated. Risks from metals in soil remain.	Risk from soils and sediments is eliminated for both VOCs and metals.
- Groundwater	Groundwater remediation eliminates risk for groundwater.	Risk from GW reduced by remediation in hot spots. Time frame for management of GW risk reduced.	Risk from GW reduced to MCL. Long-term risk management not required after remediation.
Adequacy and Reliability of Controls	Treatment is reliable for soil contaminants. Treated groundwater to MCL would need no controls for that medium. Monitoring required to assess effectiveness.	Controls are permanent. Source to GW is remediated so levels should begin to decline.	Controls are permanent.
5. REDUCTION OF MOBILITY TOXICITY OR VOLUME:			
Soils	770 yd^3 of soil treated by enhanced volatilization and solidification of metals. VOCs treated to detection level.	483 yd^3 of soils treated with *in situ* vacuum extraction to remove VOCs to detection levels.	770 yd^3 of soil treated by enhanced volatilization and solidification of metals. VOCs treated to detection level.
Groundwater	Groundwater treatment would eliminate (Destroy) the contaminants.	5 to 10 million gallons of GW treated by air stripping from area of VOC soil contamination and from hot spots in GW plume.	Groundwater treatment would eliminate (destroy) the contaminants.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 4 Soil Excavation/Enhanced Volatilization and Solidification, Slurry Wall, Pump, PTD to MCL	ALTERNATIVE 5 Dual Vacuum Extraction of Contaminated Soils with Short-Term PTD of Contaminated Groundwater "Hot Spots"	ALTERNATIVE 6 Soil Extraction/Enhanced Volatilization and Solidification; PTD of Groundwater to MCL
6. IMPLEMENTABILITY:			
Availability of Technology	Readily available and broad experience with implementation.	All components are readily available from numerous sources.	All components are readily available from numerous sources.
Reliability	Slurry walls are somewhat questionable when installed to a depth of 80 feet. Groundwater treatment highly reliable for contaminants of concern. Long-term reliability of solidification not well established; GW requires long-term treatment but technology is effective.	Groundwater treatment is highly reliable for contaminants of concern. Dual vacuum extraction technology readily available.	Highly reliable for contaminants of concern. Long-term reliability of solidification not well established.
Availability of Treatment, Storage, or Disposal Services	Spent carbon will require treatment.	Spent carbon will require treatment.	Spent carbon will require treatment.
Ability to Monitor Effectiveness	Sampling will verify attainment of remediation goals for soils. GW will also be monitored for effectiveness.	Degree of soil cleanup somewhat difficult to determine with *in situ* treatment process. GW can be readily monitored for cleanup levels.	Soil cleanup can be assessed with confirmation sampling. GW remediation can be assessed by monitoring network already installed.
7. COST:			
Capital	$3,230,640	$683,000	$1,605,640
Annual O&M	$1,896,527	$435,000	$1,896,527
Present Worth	$5,127,167	$1,118,000	$3,502,167

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 7 Dual Vacuum Extraction of Contaminated Soils with PTD of Contaminated GW to MCL	Contingency Alternative Off-Site Disposal of Contaminated Soils PTD of Contaminated GW to MCLs
1. OVERALL PROTECTIVENESS OF HUMAN HEALTH AND ENVIRONMENT:		
Human Health		
- Direct Contact Soil/ Sediment Ingestion	Treatment of soils reduces risk by VOCs to MCL guidelines; metals are not affected.	Excavation and removal of soils reduces Site risk to NCP guidelines.
- Leachate Production	Source of VOC leachate is eliminated.	Source of VOC leachate is eliminated.
- Groundwater Ingestion/Future Users	Elimination of risk via groundwater.	Elimination of risk via groundwater.
Environmental Protection	Soil VOC contamination eliminated. Restoration of GW quality to MCL will eliminate migration potential. Some minor air emissions.	Soil VOC contamination eliminated on-Site. Restoration of GW quality to MCL will eliminate migration potential. Some minor air emissions possible.
2. COMPLIANCE WITH ARARs		
Chemical-Specific	Attains remediation goals for VOCs and for groundwater, but not ARARs for GW.	Attains remediation goals for VOCs and metals on-Site, attains GW ARARs.
Action-and-Location-Specific	Discharge from vacuum extraction and air stripper will meet air standards. Discharge from GW treatment unit will meet MCLs or WQS.	Soil removal off-Site provides ARAR compliance on-Site.

Table 8-2, p. 10.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 7 Dual Vacuum Extraction of Contaminated Soils with PTD of Contaminated GW to MCL	Contingency Alternative Off-Site Disposal of Contaminated Soils PTD of Contaminated GW to MCLs
3. SHORT-TERM EFFECTIVENESS		
Community Protection	VOC emission from vacuum extraction may be treated. Dust from construction activities will be minimal and short-term.	Dust & traffic increases possible during soil removal. Dust will be minimized in short-term with proper construction practices.
Worker Protection	VOC emission from vacuum extraction will be treated. Emissions from air stripper may require treatment. Health and safety plan required for site work.	Minor risk to workers from VOC emissions and dust during soil removal. Emissions from air stripper may require treatment. Health and Safety Plan required for Site work.
Environmental Impacts	Minor, limited to excavation of soils containing metals during vacuum system installation and well drilling.	Some impacts, but limited to minor disturbances and traffic increases during remedial action for soils.
Time to Completion	Soil remediation expected to take six months to one year. PTD of GW to last approximately 30 years.	Soil removal expected to take less than two months. PTD of GW to last approximately 30 years.

Table 8-2, p. 11.

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 7 Dual Vacuum Extraction of Contaminated Soils with PTD of Contaminated GW to MCL	Contingency Alternative Off-Site Disposal of Contaminated Soils PTD of Contaminated GW to MCLs
4. LONG-TERM EFFECTIVENESS:		
Magnitude of Residual Risk - Soils	Risks from VOCs in the soil are eliminated. Risk from metals in soil remain untreated.	Risks from soil eliminated totally on-Site.
- Groundwater	Risks from GW eliminated. Long term management not required after remediation.	Risks from GW eliminated. Long term management not required after remediation.
Adequacy and Reliability of Controls	Controls are permanent. Source to GW is removed. GW cleaned to MCL.	Controls are permanent. Source to GW is removed. GW cleaned to MCLs.
5. REDUCTION OF MOBILITY TOXICITY OR VOLUME:		
Soils	483 yd^3 of soils treated with *in situ* vacuum extraction to remove VOCs to cleanup levels.	No treatment of soils. No reduction in volume of contmainants, although soil is moved off-Site. Removal of soil from Site eliminates contaminant mobility to GW.
Groundwater	Treatment will eliminate mobility, toxicity and volume to acceptable standards (ARARs).	Treatment will eliminate mobility, toxicity and volume to acceptable standards (ARARs).

SUMMARY OF EVALUATION OF REMEDIAL ACTION ALTERNATIVES
KALAMA SPECIALTY CHEMICALS, INC. STUDY AREA

CRITERIA	ALTERNATIVE 7 Dual Vacuum Extraction of Contaminated Soils with PTD of Contaminated GW to MCL	Contingency Alternative Off-Site Disposal of Contaminated Soils PTD of Contaminated GW to MCLs
6. IMPLEMENTABILITY:		
Availability of Technology	All components are readily available from numerous sources.	All components are readily available from numerous sources.
Reliability	Groundwater treatment is highly reliable for contaminants of concern. Dual vacuum extraction technology readily available.	Groundwater treatment is highly reliable for contaminants of concern. Equipment for soil removal readily available.
Ability to Permit	Wetland permit may be required for excavation of soils containing metals. Vacuum unit and air stripper emissions may require treatment to permit.	Wetland permits may be required for soil excavation. Air strippers emissions may require that substantive requirements of permit to be met.
Availability of Treatment, Storage, or Disposal Services	Spent carbon will require treatment.	Landfills available for soil disposal. Spent carbon, if utilized, will require treatment.
Ability to Monitor Effectiveness	Degree of soil cleanup somewhat difficult to determine with *in situ* treatment process. GW can be readily monitored for cleanup levels.	Degree of soil cleanup easily determined by confirmatory sampling. GW can be readily monitored for cleanup levels.
7. COST:		
Capital	$1,606,000	$1,860,283
Annual O&M	$1,902,528	$1,907,528
Present Worth	$3,509,217	$3,768,500

9.0 THE SELECTED REMEDY

9.1 Preferred and Contingency Alternatives

EPA has selected the Remedial Action Alternative 6 as the preferred combination of controls for use at the Kalama Site. Remedial Action Alternative 6 incorporates the components SC-4 and MM-4 to treat soils by excavating, enhanced volatilization and solidification in the source area (or the SC-5 Contingency of off-Site disposal of excavated soil), and to pump and treat groundwater to the MCLs. Alternative 6 requires implementation of the following:

* Treatment of soils and sediments (both on the surface and in the ditch) contaminated with VOCs and metals by excavation, with either 1) volatilization, solidification, and replacement of soils into the excavation OR as a contingency, 2) removal of the excavated soils to a RCRA landfill if soil characteristics and cost effectiveness deem off-Site disposal more feasible;

* Extraction and treatment of groundwater to the MCLs for contaminants of concern; and

* Additional monitoring with new deep wells in the limestone aquifer.

Table 9-1 provides details of a Reasonable Cost Estimate of the Capital and Associated Costs of Alternative 6, assuming on-Site treatment and disposal. The cost for the preferred alternative is $3,502,197. If off-Site disposal of the soils is implemented, the estimated cost of the contingency alternative will be $3,768,500.

9.2 Source Control

This remedy component consists of excavation of contaminated soil, verification sampling, and either on-Site volatization, solidification, and replacement into the excavations, or transport of the soil off-Site to a permitted RCRA hazardous waste landfill. The following subsections describe this remedy component in detail, provide the criteria (ARARs and TBC material) which shall apply, and establish the performance standards for implementation.

For purposes of describing this portion of the remedy and specifying the requirements which shall apply to it, it is assumed that some or all of the contaminated soils to be addressed will be shown by laboratory analysis to be RCRA hazardous wastes. With that assumption, the majority of ARARs apply. It should be noted that to date tests of cuttings have

Table 9-1, p.1

REASONABLE ESTIMATE OF CAPITAL AND ASSOCIATED COSTS
KALAMA SPECIALTY CHEMICALS, INC. - ALTERNATIVE NO. 6

Cost Element	Quantity	Unit Cost	Total Per Element	Totals
Extraction Wells (1-10)	10	$8,900	$89,000	
Storage Tank (25,000 gal)	1	26,100	26,100	
Small Tank (3000 gal)	1	6,500	6,500	
Large tank mixer	1	8,900	8,900	
Small tank mixer	1	6,600	6,600	
Metals Complexing Reagent Syste	1	5,500	5,500	
Submersible and Feed Pumps	13	1,250	16,250	
Air Strippers with Blowers	2	50,000	100,000	
Variable Speed Drives	5	1,800	9,000	
Adsorber Pumps	4	1,250	5,000	
In-line Filters	2	1,100	2,200	
GAC Adsorption Units (10,000 #)	2	55,000	110,000	
Process and Well Piping	all	96,000	96,000	
Subtotal: Equipment (EC)			$481,050	
Labor (50% x EC)			240,525	
Electrical and Instros. (20% x EC)			96,210	
Site Work (5% x EC)			24,053	
Mobilization\Demobilization (10% x EC)			48,105	
Remove and Treat Soils & Sediments (Alt. 3)			67,720	
Subtotal/Total			$476,613	$957,663
Contingency (15%)				143,649
Total Construction Costs (CoC)				$1,101,312
Design Services (15% x CoC)			165,197	
Construction and Start-up Services (10% x CoC)			110,131	
Hydrogeologic and Geotech Services			165,000	
Health and Safety Plan			39,000	
Deed Restriction and Rezoning			15,000	
Permitting			10,000	
Subtotal: Associated Project Costs			$504,328	$504,328
Total Capital Costs				$1,605,640
Total Present Value of Opn & Mtn (Table 4 - 8B)				$1,896,527
Total Present Value of Alternative				$3,502,167

Table 9-1, p.2

REASONABLE ESTIMATE OF OPERATING AND MAINTENANCE COSTS
KALAMA SPECIALTY CHEMICALS, INC. - ALTERNATIVE NO. 6

Cost Element	Estimated 1st Year Amount	Estimated Later Year Basis
Maintenance		
Equipment	$22,900	$22,900
Site	6,000	6,000
Operation		
Labor	62,800	26,800
Utilities	10,000	10,000
Analytical	29,700	13,200
Professional Envr. Report	22,000	*
Miscellaneous - chemicals, etc.	10,000	10,000
Carbon Replacement	20,000	20,000
Total 1st Year	$183,400	$108,900
Total Present Value of Future O & M	$1,713,127	
Total Present Value	$1,896,527	

Note: * Environmental Report is included every five years.

Year	Amount	Present $	Year	Amount	Present $
2	108,900	103,714	16	108,900	52,383
3	108,900	98,776	17	108,900	49,888
4	108,900	94,072	18	108,900	47,513
5	130,900	107,692	19	108,900	45,250
6	108,900	85,326	20	130,900	51,802
7	108,900	81,263	21	108,900	41,043
8	108,900	77,393	22	108,900	39,089
9	108,900	73,708	23	108,900	37,227
10	130,900	84,379	24	108,900	35,455
11	108,900	66,855	25	130,900	40,588
12	108,900	63,672	26	108,900	32,158
13	108,900	60,640	27	108,900	30,627
14	108,900	57,752	28	108,900	29,169
15	130,900	66,113	29	108,900	27,780
			30	130,900	31,802
Subtotals		$1,121,354			$591,773

Discount Rate of 5 percent.

not indicated that hazardous wastes, as defined under RCRA, are present.

9.2.1 Description

On-Site work shall be performed in accordance with the OSHA health and safety standards applicable to remedial activities. Proper materials handling procedures shall be used during the excavation and handling of soil. Such measures may include the use of water to minimize dust emissions during soil excavation, transport, and handling, and the use of tarps or plastic sheeting placed over temporary soil stockpiles to minimize dust emissions and runoff.

Soil in the area of soil contamination shall be excavated until the remaining soil achieves the concentrations established as performance standards as described in Section 9.2.3 of this ROD or the water table is encountered.

Prior to excavation, soil sampling sufficient to confirm the areal extent of soil which exceeds these criteria, shall be conducted at all four compass boundaries of the area shown in Figure 1-2 of this ROD. Verification sampling shall be employed to ensure that all soils contaminated at levels exceeding the performance standards are removed.

After excavation, measurement of the volume of contaminated soils will be made and the characteristics of the soil shall be determined to determine if it is more cost effective to volatilize and solidify the soil on-Site, or remove it to a permitted RCRA landfill. Assuming it is deemed more cost effective to dispose of the soil off-Site, the excavated soil, if necessary, shall be treated, then transported to a permitted RCRA hazardous waste (RCRA Subtitle C) landfill facility for disposal. A RCRA Subtitle C facility is deemed appropriate because of the health risks posed by direct contact with the soils.

Transport shall be accomplished in compliance with DOT regulations governing transportation of hazardous materials.

Excavation work shall be staged and coordinated with backfill/grading/seeding activities to minimize dust production and surface water runoff. The on-Site excavation shall be backfilled with clean soil, properly recompacted, and the land surface regraded to the preexisting natural slope. A vegetative cover will be established to minimize undue surface water runoff and minimize erosion.

9.2.2 Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs originate from applicable requirements, intended to definitely and specifically apply to a remedial action; or relevant and appropriate requirements, which, while not intended to apply to the specific situation in question, EPA judges to be applicable to a remedial action. In addition, when establishing criteria for ensuring the proper implementation of a remedial action, EPA may develop requirements from other guidance documents and criteria, sources often referred to as "To Be Considered" material (TBC).

9.2.2.1 Applicable Requirements

Soil remediation shall comply with all applicable portions of the following Federal and State of South Carolina regulations:

49 CFR Parts 107, 171-179, promulgated under the authority of the Hazardous Materials Transportation Act. Regulates the labelling, packaging, placarding, and transport of hazardous materials off-Site.

40 CFR Parts 261, 262 (Subparts A-D), 263, and 268, promulgated under the authority of the Resource Conservation and Recovery Act. These regulations govern the identification, transportation, manifestation, and land disposal restriction requirements of hazardous wastes. If the contaminated soils fail TCLP, most likely, the land disposal restrictions in 40 CFR Part 268 will apply. However, if EP toxicity tests are performed and the contaminated soils do not exceed EP toxicity limits, then the land disposal restrictions in 40 CFR Part 268 will not apply, even though the contaminated soils fail TCLP. In the event that the Site soils requiring remediation do not test hazardous (i.e., do not fail TCLP), the regulations listed here will be considered relevant and appropriate rather than applicable.

SCHWMR 61-79.124, 79.261, 79.262, 79.263 and 79.268, South Carolina Hazardous Waste Management Regulations, promulgated pursuant to the Hazardous Waste Management Act, SC Code of Laws, 1976, as amended, establishes criteria for identifying and handling hazardous wastes, as well as land disposal restrictions. These regulations also will become relevant and appropriate in the event that the soils requiring remediation do not prove to be hazardous, as described in the above paragraph.

9.2.2.2 Relevant and Appropriate Requirements

The following regulations are "relevant and appropriate" to source control actions (soil remediation) at the Site. Applicability of these air quality control regulations is due to the potential for release of harmful particulates (metals) or VOCs during soil excavation and handling activities.

40 CFR Parts 60 and 61, 42 U.S.C. § 7401 et. seq. promulgated under the authority of the Clean Air Act. Included are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Ambient air quality standards and standards for emissions to the atmosphere fall under these regulations.

SC Reg. 61-62, South Carolina Air Pollution Control Regulations and Standards, promulgated pursuant to the S.C. Pollution Control Act, SC Code of Laws, 1976, as amended. Establishes limits for emissions of hazardous air pollutants and particulate matter, and establishes acceptable ambient air quality standards within South Carolina.

9.2.2.3 "To Be Considered" and Other Guidance

Revised Procedures for Planning and Implementing Off-Site Response Actions, OSWER Directive 9834.11, November 1987. This directive, often referred to as "the off-Site policy," requires EPA personnel to take certain measures before CERCLA wastes are sent to any facility for treatment, storage, or disposal. EPA personnel must verify that the facility to be used is operating in compliance with Sections 3004 and 3005 of RCRA, 42 U.S.C. §§ 6924 and 6925, as well as all other federal and state regulations and requirements. Also, the permit under which the facility operates must be checked to ensure that it authorizes (1) the acceptance of the type of wastes to be sent, and (2) the type of treatment to be performed on the wastes.

40 CFR Part 50, promulgated under the authority of the Clean Air Act. This regulation includes the National Ambient Air Quality Standards (NAAQS), and establishes a national baseline of ambient air quality levels. The state regulation which implements this regulation, South Carolina Reg. 62-61, is applicable to the source control portion of the remedy.

Various TBC materials were utilized in the Baseline Risk Assessment and in the Feasibility Study. Because cleanup standards were established based on these documents, they are considered TBC.

In the Baseline Risk Assessment, TBC material included information concerning toxicity of, and exposure to, Site contaminants. TBC material included the Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST), and other EPA guidance as specified in the Baseline Risk Assessment.

In the FS, soil concentrations protective of human health and the environment were calculated based on the Site-specific risk calculations from the Baseline Risk Assessment, using TBC information as described above. These levels are established as performance standards in Section 9.2.3. There are no established federal or state standards for acceptable levels of Kalama Site contaminants in surface or subsurface soils or sediments.

For soils/sediments, the leachate-based and health-based models were both considered. In order to be most protective, the lower of the two was targeted. The chemical-specific goals produced through the leachate-based model were found to be lower, except for vinyl chloride. Due to the conservative nature of the health-based and the leachate models, certain chemical-specific cleanup goals were calculated below respective method detection limits and MCL values. This is the case with methylene chloride, benzene, vinyl chloride, and 1,2-DCA. None of these compounds were detected in background samples during the RI. Therefore, the remedial goal for these chemicals is a non-detectable result obtained from analyses using validated CLP protocol.

<u>9.2.2.4 Other Requirements</u>

Remedial design often includes the discovery and use of unforeseeable but necessary requirements which result from the planning and investigation inherent in the design process itself. Therefore, during design of the source control component of the selected remedy, EPA may, through a formal ROD modification process such as an Explanation of Significant Differences or a ROD Amendment, elect to designate further ARARs which apply, or are relevant and appropriate, to this portion of the remedy.

<u>9.2.3 Performance Standards</u>

The standards outlined in this section comprise the performance standards defining successful implementation of this portion of the remedy.

<u>Excavation.</u> The soil remediation goals (Table 7-2) are established as performance standards. The performance standards shall control the excavation procedure described above. Additionally, all on-Site excavation work shall comply with 29 CFR § 1910.120, the OSHA health and safety requirements applicable to remedial activities.

<u>Transport of contaminated soil.</u> Transportation shall be accomplished in compliance with the Hazardous Materials Transportation Act (49 CFR §§ 107, 171-179).

<u>Disposal of contaminated soil.</u> Disposal of contaminated Site soil shall comply with the applicable, or relevant and appropriate, RCRA regulations (40 CFR Parts 261, 262 (Subparts A-D), 263, and 268). The determination of applicability, versus relevant and appropriate, is described in Section 9.1.2, under

"applicable requirements," where the above regulations are cited. In any circumstance, the disposal of contaminated soils shall be done at a RCRA Subtitle C treatment, storage, and disposal facility.

Whether the Selected or the Contingency Alternative is implemented, confirmation soil sampling will be conducted to insure that all contaminated soil has been excavated.

9.3 Groundwater Remediation

9.3.1 Description

The groundwater component of the remedy includes extraction of contaminated groundwater from the sand aquifer, removal of metals by precipitation and filtration, adsorption with granular activated carbon (GAC) for organic compounds, air stripping to remove organic contaminants, and discharge of the treated water to either an on-Site infiltration gallery or sprayfield, or surface water discharge.

This remedy component consists of the design, construction and operation of a groundwater extraction and treatment system, and development and implementation of a Site monitoring plan to monitor the system's performance. The groundwater treatment specified below shall be continued until the performance standards listed in Section 9.3.3 are achieved at all of the extraction and monitoring wells on or associated with the Site. The point of compliance for this action shall be the entire Site.

Extraction wells shall be used for hydraulic capture of contaminated groundwater from the surface aquifer, following confirmation of the extent of contamination (Section 9.4 below). Preliminary modeling in the FS analyzed scenarios of a single well or three extraction wells. Actual numbers and placement of extraction wells will be determined during the remedial design.

Metal removal then is completed using precipitation and filtration. Phase separation processes typically add polymers to the water to force metal precipitates to clump together to form a floc. Then, a sedimentation process is used to settle out the large floc particles. Finally, the supernatant is filtered to remove any other suspended particles not removed by the sedimentation process. The settled floc particles and the particles removed by the filter are typically transferred to a solids holding tank. Solids from the holding tank are then dewatered via filter press with the liquids usually pumped back to the head of the treatment system. Dewatered solids will be collected and stored on-Site until disposal. These solids may require management as a hazardous waste with disposal in a RCRA-regulated landfill. These actions shall comply with the ARARs described in the following section (Section 9.3.2).

After metals removal, the groundwater will be passed through two air stripping units to remove or reduce the concentrations of VOCs. The final treatment step shall route the water through an activated carbon "polishing" unit to remove any VOCs not stripped out and to provide secondary, back-up capability to the stripping unit. Operation of the stripping unit shall comply with the ARARs described in Section 9.3.2.

Following treatment, the groundwater shall be discharged to either an on-Site infiltration gallery or spray field, or discharged to the "L-shaped" ditch downstream of station SW-5. Discharge of the treated groundwater shall comply with any effluent limits established by EPA or SCDHEC.

Remedial design shall include the design of the treatment system described above, as well as the necessary pipelines, electrical lines, pump systems, treatment equipment, treatment facility, and other appurtenances as required. Additional monitoring wells at varying depths northwest of the MW-46 well cluster and several deep monitoring wells into the limestone aquifer will be installed at locations both on-Site and off-Site.

The goal of this remedial action is to restore the groundwater to its beneficial use as a drinking water source. Based on the information collected during the RI and on a careful analysis of all remedial alternatives, EPA and the State of South Carolina believe that the selected groundwater remedy will achieve this goal. However, the remedy's ability to achieve the remediation goals at all points throughout the area of the plume cannot be determined until the extraction system has been implemented, modified as necessary, and plume response monitored over time.

The selected remedy will include groundwater extraction for an estimated period, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modification may include any or all of the following:

* Pumping may be discontinued at individual wells where cleanup goals have been attained;

* Alternating pumping at wells to eliminate stagnation points;

* Pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater; and

* Installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup goals continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on a regular periodic basis, following discontinuation of groundwater extraction. The intervals between groundwater sampling/analysis events will be established in the Remedial Action Work Plan.

A periodic review of the remedial action (Five Year Review) will occur at five year intervals in accordance with Section 121(c) of CERCLA, 42 U.S.C. § 9621(c).

9.3.2 Applicable or Relevant and Appropriate Requirements (ARARs)

9.3.2.1 Applicable Requirements

Groundwater remediation shall comply with all applicable portions of the following Federal and State of South Carolina regulations:

40 CFR Parts 261, 262 (Subparts A-D), 263, and 268, promulgated under the authority of the Resource Conservation and Recovery Act. These regulations govern the identification, transportation, manifestation, and land disposal restriction requirements of hazardous wastes, and will be applicable to any sludges which may be produced as a result of chemical treatment of groundwater, and to spent carbon generated by the carbon polishing unit. For either of these materials, if the material fails TCLP, most likely, the land disposal restrictions in 40 CFR Part 268 will apply. However, if EP toxicity tests are performed and the material does not exceed EP toxicity limits, then the land disposal restrictions in 40 CFR Part 268 will not apply, even though the material fails TCLP. In the event that either material does not test hazardous (i.e., does not fail TCLP), the regulations listed here will be considered relevant and appropriate rather than applicable, for that material.
SC Reg. 61-79.124, 79.261, 79.262, 79.263 and 79.268, South Carolina Hazardous Waste Management Regulations, promulgated pursuant to the Hazardous Waste Management Act, SC Code of Laws, 1976, as amended, establishes criteria for identifying and handling hazardous wastes, as well as land disposal restrictions. These regulations apply as described above.

49 CFR Part 107, 171-179, promulgated under the authority of the Hazardous Materials Transportation Act, regulates the labelling, packaging, placarding, and transport of hazardous materials off-Site.

40 CFR Parts 60 and 61, promulgated under the authority of the Clean Air Act, includes the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Standards for emissions to the atmosphere fall under these regulations. Applicable to the air stripping unit to be used for groundwater treatment.

SC Reg. 61-62, South Carolina Air Pollution Control Regulations and Standards, promulgated pursuant to the Pollution Control Act, SC Code of Laws, 1976, as amended, establishes limits for emissions of hazardous air pollutants and particulate matter, and establishes acceptable ambient air quality standards within South Carolina. This regulation is applicable in the same manner as the federal regulation cited above.

40 CFR Parts 122, 125, 129, 133 and 136, Clean Water Act Discharge Limitations (CWA § 301), promulgated under the authority of the Clean Water Act, applicable to any point discharges of wastewaters to waters of the United States. These regulations apply to discharge of treated waters. The discharge of the treated groundwater on the Site must substantially comply with the NPDES discharge requirements of these regulations.

40 CFR § 403.5, CWA Pretreatment Standards (CWA § 307), promulgated under the authority of the Clean Water Act. Regulates discharges of water to Publically Operated Treatment Works (POTWs).

SC Reg. 61-68, South Carolina Water Classifications and Standards, promulgated pursuant to the Pollution Control Act, SC Code of Laws, 1976, as amended, establishes classifications for water use and sets numerical standards for protecting state waters.

SC Reg. 61-71, South Carolina Well Standards and Regulations, promulgated under the Safe Drinking Water Act, SC Code of Laws, 1976, as amended, establishes standards for well construction, location and abandonment for remedial work at environmental or hazardous waste Sites.

<u>9.3.2.2 Relevant and Appropriate Requirements</u>

The following regulations are relevant to the groundwater remediation at the Kalama Specialty Chemical, Inc., Site.

40 CFR Part 131, Ambient Water Quality Criteria (CWA § 304), promulgated under the authority of the Clean Water Act, sets numerical criteria for ambient water quality based on toxicity to aquatic organisms and human health.

40 CFR Parts 141-143, National Primary and Secondary Drinking Water Standards, promulgated under the authority of the Safe Drinking Water Act establishes acceptable maximum levels of numerous substances in public drinking water supplies, whether publicly owned or from other sources such as groundwater. Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) are specifically identified in the NCP as remedial action objectives for groundwaters that are current or potential sources of drinking water supplies

(NCP, 40 CFR $ 300.430(a)(1)(iii)(F)). Therefore, MCLs and MCLGs are relevant and appropriate as criteria for groundwater remediation at this Site.

SC Reg. 61-58, South Carolina Primary Drinking Water Regulations, promulgated pursuant to the Safe Drinking Water Act, SC Code of Laws, 1976, as amended, is similar to the federal regulations described above, and is relevant and appropriate as remediation criteria for the same reasons set forth above.

9.3.2.3 "To Be Considered" and Other Guidance

As noted above, TBC criteria were utilized and/or established in the Baseline Risk Assessment and in the Feasibility Study. Groundwater cleanup standards were established based on these documents and both are thus considered TBC.

In the Baseline Risk Assessment, TBC material used included information concerning toxicity of, and exposure to, Site contaminants. Sources of such data included the Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST), and EPA guidance as specified in the Risk Assessment.

In the FS, the remedial goals for the KSCI study area are the reduction of on-Site contaminants to MCLs and a chronic hazard index (HI) of less than one. In conjunction with this chemical-specific goal, there is the goal of preventing any exposure which may present an unacceptable risk. The groundwater remediation goals are established as performance standards in Section 9.2.3.

Other TBC material includes the following:

Guidelines for Ground Water Use and Classification, EPA Ground Water Protection Strategy, U.S. EPA, 1986. This document outlines EPA's policy of considering a Site's groundwater classification in evaluating possible remedial response actions. The groundwater at the Site is classified by EPA as Class II-B and by South Carolina as Class GB groundwater, indicating its potential as a source of drinking water.

National Oceanic and Atmospheric Administration (NOAA) ER-L/ER-M Values. These guidelines were developed as screening criteria for sediment contamination in surface water bodies and are based on toxicity to aquatic life.

40 CFR Part 50, National Ambient Air Quality Standards (NAAQS), promulgated under the authority of the Clean Air Act. This regulation includes the National Ambient Air Quality Standards (NAAQS) and establishes a national baseline of ambient air quality levels. The state regulation which implements this regulation, South Carolina Reg. 62-61, is applicable to the

groundwater portion of the remedy.

Sections 501 and 502 of the Clean Air Act, 1990 CAA Amendments, 42 U.S.C. §§ 7661 and 7661a. These amendments require that all "major sources" and certain other sources regulated under the CAA obtain operating permits. Although Section 121(e) of CERCLA exempts this remedy from requiring such a permit because all activity is to be done on-Site, air stripping at this Site may have to comply with any substantive standards associated with such permits. Regulations have been proposed, but not promulgated, for the operating permit program.

9.3.2.4 Other requirements

As described above in Section 9.2.2.4, remedial design often includes the discovery and use of unforeseeable but necessary requirements. Therefore, during design of the groundwater component of the selected remedy, EPA may, through a formal ROD modification process such as an Explanation of Significant Differences or a ROD Amendment, elect to designate further ARARs which apply, or are relevant and appropriate, to groundwater remediation at this Site.

9.3.3 Performance Standards

The standards outlined in this section comprise the performance standards defining successful implementation of this portion of the remedy.

Groundwater treatment. The groundwater remediation goals in Table 7-2 shall be the performance standards for groundwater treatment.

9.4 Confirm Extent of Groundwater Contamination

Upon initiation of the remedial design, sufficient additional groundwater and surface water data shall be collected to achieve the following objectives:

A. Verify the presence or absence of Site contaminants to the lower limestone aquifer, both on-Site and off-Site. A minimum of four new monitoring wells will be installed.

B. Confirm the areal extent of groundwater contamination in the surface aquifer, and the areal (horizontal) and the vertical extent of contamination in the limestone aquifer off-Site.

Attainment of these objectives must be accomplished during the first portion of remedial design so that design of the extraction and treatment system has, as its basis, an accurate conceptual model of Site conditions. Confirmation of the extent of contamination also will require collection of further information and data for characterizing the specific hydrogeology of the Site, and will include aquifer testing and modeling as appropriate. Confirmation sampling for the soil also will be conducted (Section 9.2.3).

9.5 Monitor Site Groundwater and Surface Water

Beginning with initiation of the remedial design, groundwater and surface water samples shall be collected and analyzed on a regular quarterly schedule. Analytical parameters for groundwater and surface water samples will include all the known Kalama Specialty Chemical, Inc., Site contaminants of concern. The specific wells to be sampled and methodology for off-Site sample collection will be determined during design. Surface water samples will be collected, as a minimum, from the "L-shaped ditch" and the ponds on the former Benton Trailer Park, as necessary to monitor the contamination. The analytical data generated from the quarterly sampling events will be used to track the concentrations and movement of groundwater contaminants until a long-term Site monitoring plan is implemented in the remedial action phase.

10.0 STATUTORY DETERMINATIONS

The selected remedy and the contingency remedy for this Site both meet the statutory requirements set forth in 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 both the selected and the contingency remedy fulfill these requirements.

10.1 Selected Remedy (SC-4/MM-4)

Overall Protection of Human Health and the Environment

Alternative 6 reduces exposure to soil contaminants in the source area, with the groundwater remediation continuing until MCLs in groundwater are attained. Alternative 6 also effectively eliminates flow from the water table aquifer to the limestone aquifer. It therefore provides protection of human health and the environment for both VOCs and metals, and attains the remediation goals for the KSCI study area. This alternative enhances both environmental protection and a reduction in the risk to human health.

Compliance with ARARs

This remedial action alternative allows attainment of the goals for soils contaminated with VOCs and metals and, in addition, reaches the goals for groundwater remediation. It also attains the ARARs for contaminants of concern. The discharge from the air stripper may require treatment to attain air ARARs. The groundwater discharge will meet the MCLs.

Short-Term Effectiveness

Impacts on the community are expected to be minimal during the remedial action. The discharge of VOCs from the soil treatment unit and possibly the air stripper may need to be treated. Workers' exposure is not expected to be significant and will be limited to possible volatiles during the well drilling operations and during the installation of the soil treatment system. These exposures can be minimized with a Site Health and Safety Plan.

Alternative 6 includes the excavation of contaminated soils, raising the possibility of community and on-Site worker exposure to the contaminants. Because many of the chemicals of concern are volatile, worker exposure is a real possibility that will require a strict Site Health and Safety Plan with air monitoring and respirators, or other engineering controls to limit exposure. Wind blown dust can be controlled by keeping the material wet or covered. Since the nearest residence is over 100 yards away, community airborne exposure is not expected to exceed safe levels.

The public water supply provides protection during remediation. While a pilot test is needed to better estimate the time required for soil treatment, experience from other Sites where this technology was used suggests a time frame of 12 months or less for soil remediation. Groundwater extraction and treatment is expected to require 30 years to achieve the MCLs for contaminants of concern.

Long-Term Effectiveness

It is estimated to take up to 30 years of pumping 1 to 10 wells at a cumulative pumping rate of 20 gpm to reach the MCLs for contaminants of concern in the groundwater. The treatment of soils will remove residual risks from VOCs and metals exposures. This alternative reduces the risk for ingestion of groundwater and reduces this risk into the range required under the NCP. With the available public water supply, a monitoring system may not be required under this alternative to manage residual groundwater risks. Additional deep wells to the limestone aquifer will be constructed and monitored to ensure no contaminants reach the lower aquifer, thus verifying the effectiveness of the remedy.

Reduction of Mobility, Toxicity or Volume

Alternative 6 reduces the mobility, toxicity and volume of VOCs and the mobility of metals in the soils. The in-place volume is estimated at 770 yds^3. Groundwater remediation under this alternative will reach the ARARs (MCLs). It is estimated that 30 years will be required to reach MCLs for groundwater and that 160 million gallons of groundwater will have to be pumped over that period.

Implementability

All of the elements required under Alternative 6 are readily available from a variety of vendors. The nationwide cleanup program for underground storage tanks and the leakage of solvents such as TCE and PCE from a variety of sources has resulted in broad experience with enhanced volatilization to cleanup soils. The Superfund Program has experience with the fixation of metals in soils. A bench scale test to determine stabilizing agents and mix ratios will be required for this alternative. The long-term reliability of the fixation process is unknown at this time; however, bench scale tests designed to mimic accelerated time frames have predicted good results over the long-term. The effectiveness of the soil treatment in groundwater quality will be determined from water quality monitoring done in the water table.

Emissions from the air stripper must attain ARARs for air. Treatment of the emissions can be undertaken if necessary. Effluent from the groundwater treatment system must meet state and federal standards for discharge.

Confirmation sampling can monitor the effectiveness of the soil cleanup. In addition, groundwater monitoring of the existing wells and new proposed well network can be used to assess the degree of reduction in groundwater contaminant levels.

Cost

Table 9-1 of the ROD presents an itemized breakdown of costs for Alternative 6. Total initial project costs are estimated at $1,605,640. Annual O&M costs are estimated at $1,896,527, resulting in a total present worth in 1992 dollars of $3,502,167 for a 30 year service life and a five percent discount rate.

State Acceptance

The State has concurred with the remedy selected and the State concurrence letter is attached as Appendix B. State concerns regarding sediment remediation in the ditch and construction of new deep wells to the lower aquifer already have been incorporated into this Record of Decision.

Community Acceptance

During the comment period and the extension to the comment period, there was no opposition to the remedy selected by EPA in the Proposed Plan. This Record of Decision includes a Contingency Remedy based on comments received. All comments received and EPA's responses are contained in the Responsiveness Summary, attached as Appendix A.

10.2 Contingency Remedy (SC-5/MM-4)

Overall Protection of Human Health and the Environment

The Contingency Remedy reduces exposure to soil contaminants in the source area, with the groundwater remediation continuing until MCLs in groundwater are attained. The Contingency Remedy also effectively eliminates flow from the water table aquifer to the limestone aquifer. It therefore provides protection of human health and the environment for both VOCs and metals, and attains the remediation goals for the KSCI study area. This alternative enhances both environmental protection and a reduction in the risk to human health.

Compliance with ARARs

This remedial action alternative allows attainment on-Site of the goals for soils contaminated with VOCs and metals with removal of the contaminated soil and, in addition, reaches the goals for groundwater remediation. It also attains the ARARs for contaminants of concern. The discharge from the air stripper may require treatment to attain air ARARs. The groundwater discharge will meet the MCLs.

Short-Term Effectiveness

Impacts on the community are expected to be minimal during the remedial action. The possible discharge of VOCs from the air stripper may need to be treated. Workers' exposure is not expected to be significant and will be limited to possible volatiles during the well drilling operations. Dust particles from soil removal activities will be short term and minimized by proper procedures during the excavation and removal of the soils. There will be secondary impacts caused by an increase in area traffic from trucks removing the contaminated soils. These exposures and impacts can be minimized with a Site Health and Safety Plan.

The Contingency Remedy includes the excavation of contaminated soils, raising the possibility of community and on-Site worker exposure to the contaminants. Because many of the chemicals of concern are volatile, worker exposure is a real possibility that will require a strict Site Health and Safety Plan with air monitoring and respirators, or other engineering controls to limit exposure. Wind blown dust can be controlled by keeping the material wet or covered. Because the nearest residence is over 100 yards away, community airborne exposure is not expected to exceed safe levels.

The public water supply provides protection during remediation. Groundwater extraction and treatment is expected to require 30 years to achieve the MCLs for contaminants of concern.

Long-Term Effectiveness

It is estimated to take up to 30 years of pumping 1 to 10 wells at a cumulative pumping rate of 20 gpm to reach the MCLs for contaminants of concern in the groundwater. The removal of contaminated soils will remove residual risks from VOCs and metals exposures on-Site. This alternative reduces the risk for ingestion of groundwater and reduces this risk into the range required under the NCP. With the available public water supply, a monitoring system may not be required under this alternative to manage residual groundwater risks. Additional deep wells to the limestone aquifer will be constructed and monitored to ensure no contaminants reach the lower aquifer, thus verifying the effectiveness of the remedy.

Reduction of Mobility, Toxicity or Volume

The Contingency Remedy does not reduce the mobility, toxicity and volume of VOCs and the mobility of metals in the soils. It does however remove the contaminated soil from the Site. The in-place volume is estimated at 770 yds^3. Groundwater remediation under this alternative will reach the ARARs (MCLs). It is estimated that 30 years will be required to reach MCLs for groundwater and that 160 million gallons of groundwater will have to be pumped over that period.

Implementability

All of the elements required under the Contingency Remedy are readily available from a variety of vendors. The nationwide cleanup program for underground storage tanks and the leakage of solvents such as TCE and PCE from a variety of sources has resulted in broad experience with enhanced volatilization to cleanup soils. The effectiveness of the soil removal and its impact on groundwater quality will be determined from water quality monitoring done in the water table.

Effluent from the groundwater treatment system must meet state and federal standards for discharge.

Confirmation sampling can monitor the effectiveness of the soil removal. In addition, groundwater monitoring of the existing wells and new proposed well network can be used to assess the degree of reduction in groundwater contaminant levels.

Cost

Total initial project costs for the soil removal portion of the Contingency Remedy are estimated at $495,000 and a one year soil O&M cost of $5000. The total present worth in 1992 dollars is $3,768,500 for a 30 year service life and a five percent discount rate.

State Acceptance

The State has concurred with the Selected and Contingency Remedies and the State concurrence letter is attached as Appendix B. State concerns regarding sediment remediation in the ditch and construction of new deep wells to the lower aquifer already have been incorporated into this Record of Decision.

Community Acceptance

During the comment period and the extension to the comment period, there was no opposition to the remedy selected by EPA in the Proposed Plan. The Record of Decision includes this Contingency Remedy based on comments received. All comments received and EPA's responses are contained in the Responsiveness Summary, attached as Appendix A.

APPENDIX B

STATE OF SOUTH CAROLINA CONCURRENCE LETTER
KALAMA SPECIALTY CHEMICAL, INC., SUPERFUND SITE

South Carolina
DHEC
Department of Health and Environmental Control
2600 Bull Street, Columbia, SC 29201

September 27, 1993

Mr. Patrick Tobin
Acting Regional Administrator
US EPA, Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

RE: Final Record of Decision (ROD)
Kalama Specialty Chemicals NPL Site
Beaufort County

Dear Mr. Tobin:

The Department has reviewed, commented on, and concurs with the Record of Decision (ROD) for the alternatives selected for remedial action at the Kalama Specialty Chemicals NPL Site. The alternatives for remedial activities selected by EPA include excavation and treatment of contaminated soils using volatilization and solidification or as a contingency, the removal of contaminated soils from the site. EPA's selected remedial activities also include extraction and treatment of contaminated groundwater until MCLs are reached.

In concurring with this ROD, the South Carolina Department of Health and Environmental Control (SCDHEC) does not waive any right or authority it may have to require corrective action in accordance with the South Carolina Hazardous Waste Management Act and the South Carolina Pollution Control Act. These rights include, but are not limited to, the right to ensure that all necessary permits are obtained, all clean-up goals and criteria are met, and to take a separate action in the event clean-up goals and criteria are not met. Nothing in the concurrence shall preclude SCDHEC from exercising any administrative, legal and equitable remedies available to require additional response actions in the event that: (1)(a) previously unknown or undetected conditions arise at the site, or (b) SCDHEC receives additional information not previously available concerning the premises upon which SCDHEC relied in concurring with the selected remedial alternative; and (2) the implementation of the remedial alternative selected in the ROD is no longer protective of public health and the environment.

This concurrence with the selected remedy for the Kalama Specialty Chemicals NPL Site is contingent upon the State's above-mentioned reservation of rights. If you have any questions, please feel free to contact Mr. Lewis Bedenbaugh at (803)734-5211.

Sincerely,

R. Lewis Shaw

R. Lewis Shaw, P.E.
Deputy Commissioner
Environmental Quality Control

cc: Hartsill Truesdale
Lewis Bedenbaugh
Keith Lindler
Rebecca Dotterer
Harry Mathis
Charles Gorman
Billy Britton
Jim White

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