United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R04-92/117
July 1992

EPA

Superfund
Record of Decision:

Ciba-Geigy (McIntosh Plant), AL

NOTICE

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R04-92/117	2.	3. Recipient's Accession No.
4. Title and Subtitle SUPERFUND RECORD OF DECISION Ciba-Geigy (McIntosh Plant), AL Third Remedial Action - Final			5. Report Date 07/14/92 6.
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15. Supplementary Notes

PB93-964002

16. Abstract (Limit: 200 words)

The 1,500-acre Ciba-Geigy site is an active chemical manufacturer in an industrial area in McIntosh, Washington County, Alabama. A wetlands area borders the site property, and part of the site lies within the floodplain of the Tombigbee River. From 1952 to 1965, Ciba-Geigy, formerly Geigy Chemical Corporation, manufactured primarily DDT and BHC. After 1965, when the production of DDT and BHC were ceased, Ciba-Geigy began to manufacture laundry products, herbicides, insecticides, agricultural chelating agents, sequestering agents, plastic resins and additives, anti oxidants, and specialty chemicals. In 1982, during an investigation of an adjacent chemical company, EPA identified onsite contamination in a drinking water well on the Ciba-Geigy property. In 1985, EPA issued a RCRA permit that included a corrective action plan requiring Ciba-Geigy to remove and treat ground water and surface water contamination at the site. Further investigations by EPA revealed 11 former waste management areas of potential contamination onsite. These areas contain a variety of waste, debris, pesticide by-products and residues. In 1987, Ciba-Geigy installed an additional wastewater treatment system and four ground water monitoring wells. Two previous RODs in 1989 and 1991 addressed the contaminated shallow alluvial aquifer and contaminated

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Ciba-Geigy (McIntosh Plant), AL
Third Remedial Action - Final
Contaminated Media: soil, sludge, debris
Key Contaminants: VOCs (benzene, toluene, xylenes), other organics (pesticides), metals (arsenic, chromium, lead), inorganics (cyanides)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 68
	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)

sludge and soil at 10 of the 11 former waste management areas. This ROD addresses a final remedy for OU4, which includes contaminated soil and sludge in former waste management Area 8 and the upper dilute ditch. A future ROD will address OU3, the contamination within the floodplain and lower portions of the dilute ditch. The primary contaminants of concern affecting the soil, sludge, and debris are VOCs, including benzene, toluene, and xylenes; other organics, including pesticides; metals, including arsenic, chromium, and lead; and inorganics, including cyanide.

The selected remedial action for this site includes removing nonchemical construction/ demolition debris from the surface of Area 8, excavating approximately 63,000 cubic yards of contaminated soil and sludge from the areaas possible until concrete structures, the water table, or the iron slurry waste are encountered, or to a depth of 20 feet; solidifying or stabilizing approximately 46,000 cubic yards of soil that contains less than 2,500 mg/kg total organics and no gamma-BHC; using an innovative thermal technology to treat approximately 17,000 cubic yards of soil, sludge, and other waste, which is not amenable to other treatment; fixing/stabilizing approximately 46,000 cubic yards of iron slurry waste in-situ, monitoring air emissions and ground water; backfilling and establishing a vegetative cover over excavated areas; disposing all treated soil, sludge, slurry waste, and debris residuals onsite in a RCRA land vault; and implementing institutional controls, including deed and ground water use restrictions. In areas where clean-up levels are not attained, but no further excavation can occur, the technology(s) to be used will be based on treatability and leachability studies to be conducted during the RD stage. The estimated present worth cost for this remedial action is $49,723,000, which includes an unspecified O&M cost for 30 years.

<u>PERFORMANCE STANDARDS OR GOALS</u>: Chemical-specific soil and sludge clean-up goals are based on health-risk levels to assure that drinking water MCLs would not be exceeded in the ground water as a result of contaminants leaching through soil or sludge. Actual clean-up levels to be used will be determined for atrazine, diazinon, prometon, simazine, 4,4-DDD, 4,4-DDT, 4,4-DDE, and bladex using the summers and pest and models, and based on the proximity of the waste to the ground water table. It is anticipated that site contaminants that do not have specified clean-up levels in this ROD will be reduced to acceptable levels when established clean-up levels are met for the most toxic and mobile contaminants.

DECLARATION
of the
RECORD OF DECISION
OPERABLE UNIT FOUR

Site NAME AND LOCATION

Ciba-Geigy Site
McIntosh, Washington County, Alabama

STATEMENT OF BASIS AND PURPOSE

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

This decision is based on the administrative record for the Ciba-Geigy Site.

The State of Alabama has concurred on the selected remedy.

ASSESSMENT OF THE Site

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

DESCRIPTION OF SELECTED REMEDY

This operable unit is the third of four proposed operable units. The first operable unit at this Site addressed contamination of the shallow (alluvial) aquifer. Operable unit two addressed a principal threat, the highly contaminated soils and sludges at ten of the eleven former waste management areas. Operable unit three will address contamination within the floodplain including the effluent ditch (previously called the lower portions of the dilute ditch) and areas in the Tombigbee River within close proximity to the Site. Operable unit four, which is the subject of this Record of Decision, addresses contamination in former waste management area 8 (the area not addressed in OU#2).

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

- Excavation of approximately 63,000 cubic yards of contaminated soils and sludges until established cleanup levels are reached or until excavation limits are reached.

- Solidification/stabilization of up to 46,000 cubic yards of moderately contaminated soils and sludge containing no gamma-BHC and less than 2,500 ppm total organics, as an innovative application of this technology which may be proven effective during the remedial design;

- Utilization of an innovative thermal technology or dechlorination if proven effective during the remedial design for treatment or pretreatment to LDR treatability variances of contaminated soils;

- On-site thermal treatment of approximately 17,000 cubic yards of highly contaminated soils and sludge and of waste not amenable to final treatment using the innovative technology dechlorination or the innovative application of solidification/stabilization (up to 46,000 cubic yards);

- Disposal of treated soil and residual ash from the thermal treatment process in an on-site RCRA Minimum Technology Subtitle C landvault(s);

- In-situ stabilization/fixation treatment of approximately 46,000 cubic yards of iron slurry waste;

- In-situ soil flushing combined with isolation walls and extraction wells to remediate areas where the risk based cleanup levels are not achieved before excavation is terminated. Innovative technologies (in-situ vacuum extraction or in-situ bioremediation) may also be used in addition to or instead of in-situ soil flushing, if during the remedial design either technology is found to be effective in reducing contaminant concentrations in the soil and is cost effective. If either technology is proven to be more effective than in-situ soil flushing in reducing the concentrations of the contaminants in the soil and more cost effective, it will be used instead of in-situ soil flushing. If either technology is not as effective as in-situ soil flushing in reducing the concentration of the contaminants in the soil it will not be utilized in place of in-situ soil flushing, however, it may be used in concert with in-situ soil flushing if the combination enhances the remediation in reaching cleanup levels and is cost effective.

- Issuing a public notice in a local newspaper and sending a fact sheet to persons on the mailing list at the completion of the 30% design report. The purpose of the fact sheet and the public notice would be to inform the public of the technologies selected that were proven effective during the treatability studies conducted during the remedial design;

- Backfilling the excavated area with common fill, vegetating the area and the establishment of a suitable vegetative cover;

- Operation and maintenance of landvault(s) for a minimum of thirty years; and

- Institutional controls for land use and groundwater use restrictions.

STATUTORY DETERMINATIONS

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

Because this remedy will result in hazardous substances remaining on-site at the areas addressed by operable unit four above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Patrick M Tobin
for GREER C. TIDWELL, REGIONAL ADMINISTRATOR

7-14-92
DATE

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

CIBA-GEIGY Site

OPERABLE UNIT FOUR

McINTOSH, WASHINGTON COUNTY, ALABAMA

PREPARED BY:
U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

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Ciba-Geigy Site
McIntosh, Alabama

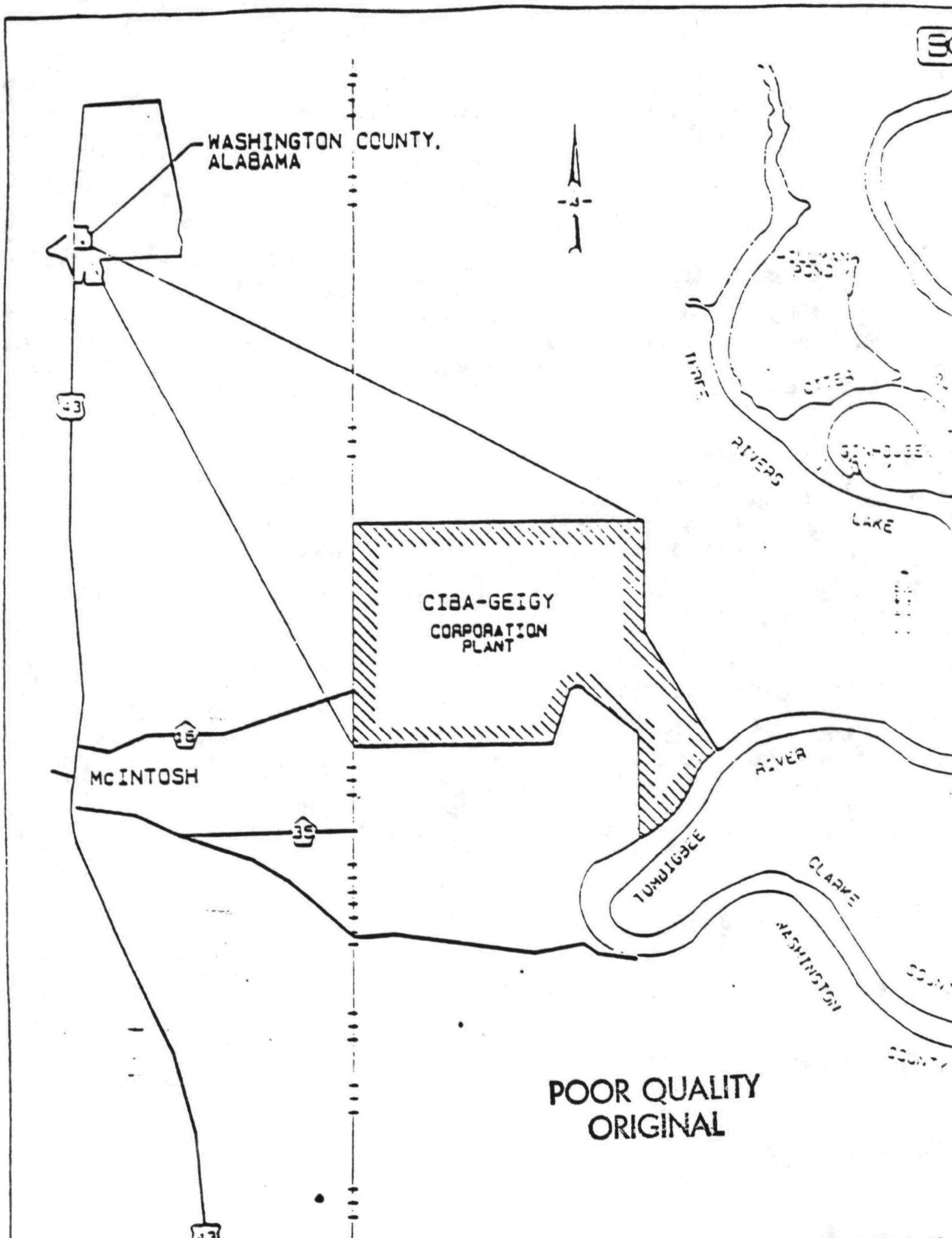
1.0 Site LOCATION AND DESCRIPTION

The Ciba-Geigy Corporation McIntosh facility is located in southern Washington County, northeast of McIntosh, Alabama, approximately 50 miles north of Mobile, Alabama (Figure 1). The operating facility is located at 31° 15'00" north latitude and 87° 58'00" west longitude. The operating facility, which encompasses approximately 2.4 square miles, is situated between the Southern Railroad right-of-way on the west and extends nearly to the escarpment separating the upland terrace from the floodplain of the Tombigbee River. The property boundaries extend beyond the railroad westward toward U.S. Highway 43. The northern edge of the property merges into an undeveloped pine forest. To the south the property is bounded by an Olin Corporation facility which has also been identified as a Superfund Site. The southeastern portion of the property extends to the banks of the Tombigbee River.

The facility is located in an industrial setting. The Ciba-Geigy Superfund Site ("Site") is contiguous with the facility boundary. The Areas of Contamination (AOCs) addressed by CERCLA are located on the McIntosh facility due east of the current production area. The AOCs are roughly divided by the river water reservoir (see Figure 2). Area 8, which is addressed by this ROD, is located in the southern half of the AOC to the east of the reservoir. The nearest population center is the town of McIntosh, which is located approximately two miles to the southwest.

1.1 Site HISTORY AND ENFORCEMENT ACTIVITIES

The Ciba-Geigy McIntosh facility, formerly owned by Geigy Chemical Corporation, began operations in October 1952, with the manufacture of one product, dichlorodiphenyl-trichloroethane (DDT). Through 1970, Geigy expanded its McIntosh facilities by adding the production of fluorescent brighteners used in laundry products; herbicides; insecticides; agricultural chelating agents; and sequestering agents for industry.



POOR QUALITY ORIGINAL

McINTOSH ALA. PLANT

CIBA-GEIGY CORPORATION

REMEDIAL INVESTIGATION / FEASIBILITY

FIGURE 1

VICINITY MAP

In 1970, Geigy merged with Ciba (Chemical Industry in Basel, Switzerland), forming the Ciba-Geigy Corporation. Since then Ciba-Geigy has continued to expand its operations with the added production of resins and additives used in the plastics industry, anti-oxidants, and small-volume specialty chemical products (i.e. water treatment chemicals and fire fighting foams). The present facility occupies approximately 1,500 acres and employs about 1,200 workers.

The EPA Region IV Environmental Services Division of Athens, Georgia (ESD) conducted an investigation in August 1982 of the Olin Chemical Company located adjacent to the Ciba-Geigy Site. As a part of the investigation, ESD sampled a drinking water well on Ciba-Geigy property. This sampling indicated the presence of hazardous substances which warranted further evaluation of the contamination problem at Ciba-Geigy. In June 1983, the Hazardous Ranking System (HRS) survey was completed and the Site was assigned a ranking of 53.42. The Ciba-Geigy McIntosh Plant was included on the National Priorities List (NPL) in September 1983.

In October 1985, EPA issued Ciba-Geigy a RCRA permit, which included a corrective action plan requiring Ciba-Geigy to remove and treat contaminated groundwater and surface water at the site. The corrective action plan stipulated that Ciba-Geigy would prepare a Remedial Investigation/Feasibility Study (RI/FS) for the disposal areas being studied by the Superfund program. Figure 2 depicts the location of CERCLA areas within the Ciba-Geigy Site.

The ten units closed under the RCRA permit include:

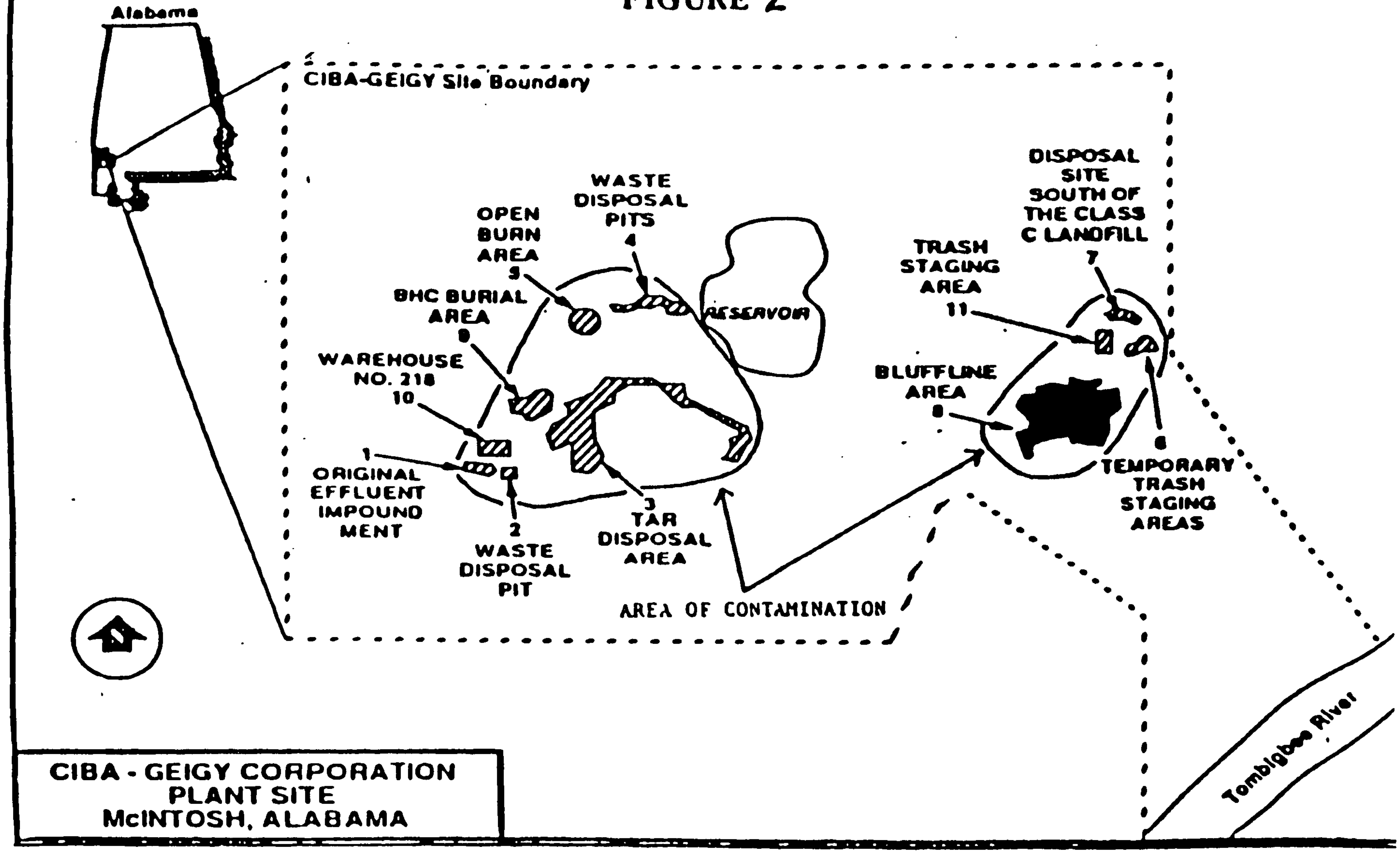
- Diazinon Wastewater Sewer: Utilized to pipe Diazinon waste to the Diazinon Destruct Impoundment. Closure under post closure care in 1976.

- Triangular Impoundment: Constructed in the 1970s to decompose Diazinon residues. Closure during interim status completed in 1986.

- Rectangular Impoundment: Constructed in 1972-1973 to hold sludge from the dilute impoundment. Closure during interim status completed in 1987.

- Class C Landfill: Permitted by Alabama in 1973 and permitted under RCRA Interim Status regulations. Closure during interim status completed in 1987.

FIGURE 2


Alabama
CIBA-GEIGY Site Boundary
WASTE DISPOSAL PITS 4
OPEN BURN AREA 5
BHC BURIAL AREA 9
WAREHOUSE NO. 218 10
1 ORIGINAL EFFLUENT IMPOUND MENT
2 WASTE DISPOSAL PIT
3 TAR DISPOSAL AREA
RESERVOIR
DISPOSAL SITE SOUTH OF THE CLASS C LANDFILL 7
TRASH STAGING AREA 11
BLUFFLINE AREA 8
6 TEMPORARY TRASH STAGING AREAS
AREA OF CONTAMINATION
Tombigbee River
CIBA - GEIGY CORPORATION
PLANT SITE
McINTOSH, ALABAMA

- Biological Sludge Landfill: Permitted by Alabama in 1978 and later operated under RCRA Interim Status for disposal of dewatered sludge. Closure during interim status completed in 1987.

- Diazinon Destruct Impoundment: Constructed in 1965. Closure under post closure care completed in 1989.

- GM-44 Impoundment: Put into service in early 1970s. Constructed for the GM-44 wastes high in nitrogen compounds. Its use was discontinued in the late 1970s. Closure under post closure care completed in 1989.

- Effluent Diffuser Line: Constructed in late 1968 to convey effluent for discharge into the Tombigbee River. Taken out of service in 1973 due to a change in the wastewater treatment system, closure of RCRA impoundments, and a change in the NPDES permit.

- Effluent Disposal Well: Installed in 1971. Used for the injection of biotreated effluent to reduce the quantity of NaCl discharged into the river. The use of the well was unsuccessful and it was plugged in 1983. ADEM required no post-closure monitoring.

- Dilute Ditch: This ditch collected dilute wastewater and surface water runoff to be conveyed to the Dilute Impoundment. Use ceased in 1971. Continued monitoring of this ditch under a RCRA Corrective Action permit.

Pursuant to the Corrective Action portion of the permit, in 1987, Ciba-Geigy installed a groundwater pumping system to intercept and remove contaminated groundwater from the shallow alluvial aquifer. The water removed from these wells was treated in the plant's existing on-site wastewater treatment system until fall 1988, when the plant's new biological wastewater treatment system was completed and used to treat the groundwater. The treated water is discharged into the Tombigbee River in compliance with appropriate National Pollutant Discharge Elimination System (NPDES) Regulations.

Ciba-Geigy has installed four (4) corrective action monitoring wells along the southern boundary of the property to monitor the effectiveness of the pumping well system. The effectiveness of the pump and treat system in preventing the migration of contaminated groundwater off-site and reducing the concentrations of contaminants in the groundwater is well established.

EPA completed the Superfund decision document (the Record of Decision or ROD) for operable unit one in September 1989 after public comments were carefully considered. The ROD identified the EPA selected remedy, "No Further Action". This selection was based on the established effectiveness of the groundwater pump and treat system already installed under the RCRA permit to address groundwater contamination in the shallow aquifer at the Site.

In accordance with the corrective action plan, Ciba-Geigy retained BCM, a technical consultant, to perform the RI/FS. Field work, which began in October 1985, was conducted by BCM on Ciba's behalf, with EPA's oversight. The principal finding of the RI study was the definition of the extent of contamination from eleven additional waste management areas within the study area that will be addressed under CERCLA.

The CERCLA Site has been grouped and divided into two Areas of Contamination (AOC) based on their relative proximity to each other. The AOCs are roughly separated by the reservoir (See Figure 2).

In January 1990, Ciba-Geigy submitted the FS report. This report identified and screened alternatives for cleanup at the eleven former waste management areas. In September 1991, EPA issued a ROD addressing soil contamination at 10 of eleven 11 former waste management areas, (OU2), at the Site.

The major components of the selected remedy for OU2 include:

- Excavation of contaminated soils and sludges until established cleanup levels are reached or until site specific excavation limits are reached.

- On-site thermal treatment of approximately 65,000 cubic yards of highly contaminated soils and sludge;

- Solidification/stabilization or the utilization of an innovative technology proven effective during the remedial design, of approximately 62,300 cubic yards of moderately contaminated soils and sludge;

- Disposal of treated soil and residual ash from the thermal treatment process in an on-site RCRA Minimum Technology Subtitle C landvault(s);

- In-situ soil flushing combined with isolation walls and extraction wells to remediate areas where the risk based cleanup levels are not achieved before, excavation depth of 20 feet is reached. Innovative technologies (in-situ vacuum extraction or in-situ bioremediation) may also be used in addition to or instead of in-situ soil flushing, if during the remedial design either technology is found to be effective in reducing contaminant concentrations in the soil and is cost effective.

- Issuing a public notice in a local newspaper and sending a fact sheet to persons on the mailing list at the completion of the 30% design report. The purpose of the fact sheet and the public notice would be to inform the public of the technologies selected that were proven effective during the treatability studies conducted during the remedial design;

- Backfilling the excavated areas with common fill and vegetating the area and the establishment of a suitable vegetative cover,

- Operation and maintenance of landvault(s) for a minimum of thirty years; and

- Institutional controls for land use and groundwater use.

EPA will continue its CERCLA enforcement activities and will notify Ciba-Geigy prior to the initiation of the remedial design for participation in the selected remedial action. Should Ciba-Geigy decline to conduct future remedial activities, EPA will either take additional CERCLA enforcement actions or provide funding for these activities while seeking cost recovery for all EPA-funded response actions at this Site.

2.0 HIGHLIGHTS OF COMMUNITY RELATIONS

The RI for the Ciba-Geigy Site was released to the public in August 1988. The FS and the Proposed Plan for the Ciba-Geigy Site addressing Operable Unit 2, were released to the public on July 30, 1990. An addendum to the FS addressing the contamination in Area 8 (OU#4), was released to the public in April 1992. The Proposed Plan addressing OU#4 was released to the public on April 30, 1992. These documents were made available by placement in both the administrative record docket and the information repository maintained at the EPA docket room at Region IV Headquarters in Atlanta, Georgia and at the McIntosh Town Hall, in McIntosh, Alabama. Pursuant to regulations, a public comment period was held from April 30, 1992 through May 29, 1992.

A notice was placed in the Mobile Press Register on April 30, 1992 announcing the comment period. In addition to the public comment period and the administrative record files, a public meeting was held on May 19, 1992 in McIntosh Alabama. At this meeting representatives from EPA answered questions and addressed community concerns.

A response to all significant comments received during the public comment periods is included in the Responsiveness Summary (Appendix A), which is a part of this Record of Decision.

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

3.0 SCOPE AND ROLE OF OPERABLE UNITS

Due to the size of the facility, the number of areas and the variety of contaminants, the problems at the Ciba-Geigy Site are complex. As a result EPA has organized the work into four (4) operable units (OUs). The operable units at this Site as identified in the ROD issued for Operable Unit Two in September 1991 are:

OU #1 Contamination of the shallow (Alluvial) groundwater aquifer.

OU #2 Contamination of soils at ten of eleven former waste management areas.

OU #3 Contamination within the floodplain, the effluent ditch (previously called the lower portion of the dilute ditch) and areas in the Tombigbee River within close proximity to the Site.

OU #4 Contamination of soils in former waste management Area 8 and the dilute ditch (previously called the upland portion of the dilute ditch).

This Operable Unit (OU #4), addresses the contamination of soils at former waste management area 8. The Dilute Ditch was closed in accordance with an approved RCRA Closure Plan. The ditch, as well as other closed units, was excavated, capped and is being maintained through RCRA Post-Closure care. Upon further evaluation, EPA has decided to continue addressing the Dilute Ditch under RCRA authority, as administered through the HSWA Permit.

The January 1990 Draft Feasibility Study Report and the February 1992 addendum to the Feasibility Study Report submitted by Ciba-Geigy document the development, screening and detailed evaluation of potential alternatives for remediation of former waste management area 8 identified and initially characterized during the Remedial Investigation. EPA has evaluated the alternatives and the risk posed by the contaminants as they relate to the "CERCLA" Site. Based on this evaluation, EPA has determined the alternative or combination of alternatives which will achieve the CERCLA cleanup objective, to remediate the source of contamination and prevent current or future exposure to contaminated groundwater at former waste management area 8. This operable unit is consistent with past work conducted at the Site and future work to be conducted.

4.0 SUMMARY OF Site CHARACTERISTICS

4.1 GEOLOGY/SOILS

The Ciba-Geigy property is located within the Southern Pine Hills, which are elevated features that regionally slope southward toward the Gulf of Mexico. These hills are dissected by various river systems that feed into the Gulf. The plant is located upon a low terrace adjacent to the Floodplain of the Tombigbee River. The property lies within the boundaries of the Mobile Graben, a downthrown fault block paralleling the river.

The surficial and shallow geology can be broken into three distinct features. The uppermost layer is a relatively continuous clay layer containing sand and silty sand lenses and clay layers that range from only a few feet to over 50 feet in thickness. Underlying the clay layer are Pleistocene-age alluvium and low terrace deposits of interbedded gravel, silt, and clay with thicknesses ranging from 60 to 100 feet. These deposits outcrop throughout the area.

Underlying the low terrace deposits are alternating layers of Miocene-age gravels, sands, and clays. Regionally, Upper Miocene clay hydraulically separates the Miocene and Pleistocene deposits (See Figure 3).

Erosion and redeposition of these sediments reflect dynamic depositional environments which are common on a regional scale. This has resulted in a complex subsurface stratigraphy.

Variations of physical characteristics (e.g. porosity, grain size, hydraulic conductivity) both vertically and laterally within the strata complicate the movement of water in the subsurface.

Nine different soil series are located within the area of the plant. These soils are generally loamy clays and sands that range from well drained to poorly drained. Permeability of the soil ranges from moderate to low.

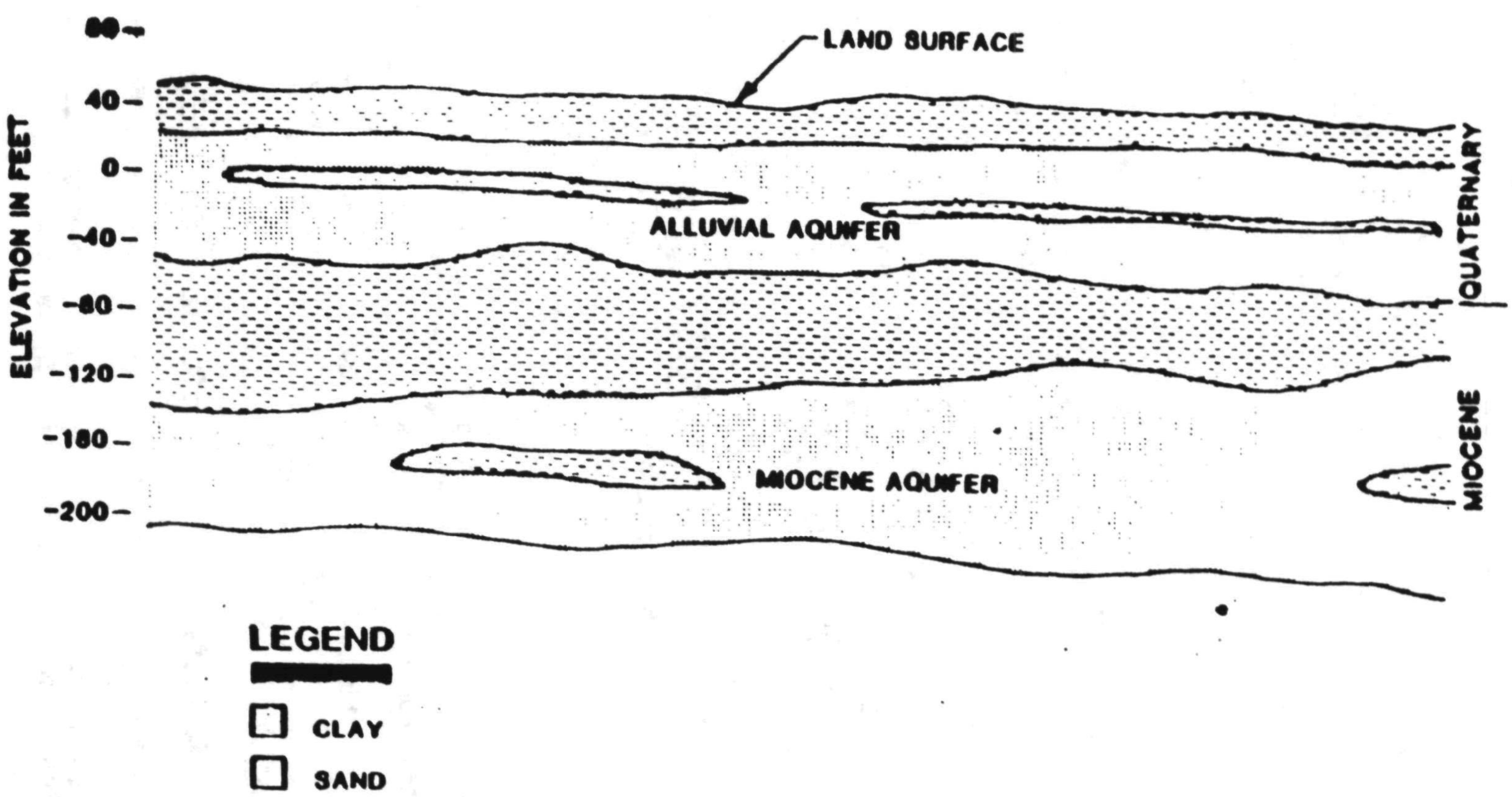
4.2 HYDROGEOLOGY

Both the Pleistocene and Miocene strata are water bearing and represent two distinct aquifers, the Alluvial and Upper Miocene. They are separated by a number of shale and clay aquitards and aquicludes.

The Alluvial aquifer is composed of the recent and Pleistocene terrace and alluvial deposits. The thickness of the aquifer and the water level depend on the thickness and configuration of the overlying clay layer. Under natural, semi-confined conditions, the saturated thickness of the Alluvial aquifer ranges from less than 30 feet to over 50 feet. Recharge of the Alluvial aquifer comes locally, from rainfall, streams, and reservoirs. High floods in the river floodplain also recharge the aquifer.

The groundwater flow of the Alluvial aquifer normally slopes gently to the south-southeast toward the Tombigbee River. However, the flow of groundwater is modified by the pumping and capture of contaminated groundwater by the plant and recharge from the Site reservoir. This system was designed to reduce the level of contaminants in the groundwater below the facility and prevent further migration of the contaminated groundwater. The concentrations of contaminants present in the groundwater has decreased and the operation of the intercept wells has reversed the direction of groundwater flow as a result of the pumping.

The Upper Miocene underlying the plant is a confined aquifer of sands and gravels capped by a clay layer about 100 to 130 feet in thickness. Recharge of this aquifer is believed to come from regional infiltration in outcrop areas up-dip to the north. In contrast to the Alluvial aquifer, the quality of Upper Miocene water can be effected by regional influences such as salt domes or saltwater intrusion from the Gulf of Mexico.



NOTES:

1. ELEVATIONS RELATIVE TO MEAN SEA LEVEL
2. BASED ON SOIL BORING DATA FROM PELA 1984a

REM II

GENERALIZED GEOLOGIC CROSS SECTION

CIBA-GEIGY INC.

McINTOSH, ALABAMA

FIGURE NO.

3

Paleo-channeling has been found to exist in the surface of the Miocene clay. However, during the investigation for the Groundwater Corrective Action Program, and as a part of the RI/FS, it was determined that the two aquifers are not hydraulically connected.

4.3 SURFACE WATER

The Ciba-Geigy facility property lies within the Tombigbee River Basin which has a drainage area of 8,378 square miles. The Tombigbee River flows past the Site, converging further south with the Alabama River to form the Mobile River.

Surface water features at the Ciba-Geigy plant include the diverted Johnson Creek on the northern edge of the property, and a large, man-made reservoir between the manufacturing area and the waste management facilities. Surface water runoff on the northern, undeveloped corner of the property drains off-site through ditches into the Tombigbee River. The surface water system south of Johnson Creek has undergone extensive change. In addition to a new wastewater treatment system, a new stormwater management system has been constructed to replace the old combined dilute wastewater/stormwater system, which used stormwater sewers, open surface ditches, and the dilute ditch to convey mixed dilute wastewater and stormwater to the dilute impoundment.

The new system segregates all wastewater, dilute and process, to the wastewater collection and transfer system and then on to the biological wastewater treatment system. All stormwater sewers have been renovated and all open ditches have been replaced with stormwater sewers draining to stormwater retention tanks capable of holding a one-inch rainfall over the entire developed manufacturing area of the plant. All initial rainwater retained is transferred to the biological wastewater treatment plant. All stormwater overflow (rainfall above one inch) is diverted to established drainageways discharging to the Tombigbee River.

4.4 SAMPLE RESULTS FROM FORMER WASTE MANAGEMENT AREA 8

The primary emphasis for analytical testing during the RI was to determine the nature and extent of the soil contamination at the Site. As a result, soil and waste samples were collected and analyzed to determine the chemical contamination present at the

Site. The following is a brief description and a volume estimate of former waste management area 8 to be addressed in operable unit four, under CERCLA authority.

Table 4-1 summarizes the maximum, and minimum concentrations and detection frequency for the contaminants found in the soil throughout the Site.

During the development of this ROD it was determined, based on toxicity, mobility, and frequency of detection, that if certain contaminants were excavated and remediated to acceptable levels, the remaining contaminants would also be excavated and remediated to acceptable levels. The selected contaminants of concern for area 8 are presented in Table 4-2 (also see section 5.1).

AREA 8 (Bluffline Area)

Area 8 is located along a bluffline constructed by the United States Corps of Engineers and is currently grassed with the bluffline escarpment stabilized with rip-rap to minimize soil erosion. The bluffline contains massive quantities of non-chemical construction/demolition rubble such as concrete fragments (some very large), piles of crushed concrete, bricks, stone fiberglass, asbestos, metal debris and alternate layers of residues from open burning, all covered with clay fill. The estimated volume of contamination in Area 8 is 128,000 cubic yards.

5.0 SUMMARY OF Site RISKS

CERCLA directs the Agency to conduct a baseline risk assessment to determine whether a Superfund Site poses a current or potential threat to human health and the environment in the absence of any remedial action. The baseline risk assessment provides the basis for determining whether or not remedial action is necessary and the justification for performing remedial action.

TABLE 4-1

CHEMICALS OF POTENTIAL CONCERN IN STUDY-WIDE SOILS
CIBA-GEIGY McINTOSH FACILITY

Analytes	Concentrations (mg/kg) Minimum	Maximum	Detection Frequency (a)
Volatile Organics			
Acetone	0.0145	664	79 - 94
Benzene	BMDL	5650	32 - 94
Carbon disulfide	BMDL	162	6 - 94
Chlorobenzene	BMDL	414	49 - 94
Chloroform	0.0067	16600	18 - 94
Ethylbenzene	BMDL	72300	26 - 94
m-Xylene	BMDL	184000	29 - 94
Methylene chloride	BMDL	373	66-- 94
o+p-Xylenes	BMDL	67100	27 - 94
Tetrachloroethylene	0.0053	2070	5 - 94
Toluene	BMDL	6360	38 - 94
Base/Neutral Extractables			
1,2,4-Trichlorobenzene	BMDL	81	22 - 89
1,2-Dichlorobenzene	BMDL	107	23 - 89
1,4-Dichlorobenzene	BMDL	546	31 - 89
Aniline	BMDL	1100	7 - 89
Nitrobenzene	BMDL	746	20 - 89
Acid Extractables			
2,4,6-Trichlorophenol	0.729	120	5 - 92
2,4-Dichlorophenol	0.111	11.5	6 - 92
Chlorinated Pesticides			
4,4'-DDD	BMDL	8560	50 - 89
4,4'-DDE	0.255	8410	40 - 89
4,4'-DDT	BMDL	3780	41 - 89
Alpha-BHC	BMDL	4370	34 - 89
Beta-BHC	BMDL	751	19 - 89
Gamma-BHC	BMDL	753	14 - 89
Manufactured Pesticides			
Ametryn	BMDL	310	19 - 94
Atrazine	BMDL	4310	24 - 94
Chlorobenzilate	BMDL	650	34 - 94
Chloropropylate	0.2	522	22 - 94
Cyanazine	BMDL	960	20 - 94
Diazinon	BMDL	786	36 - 94
Galecron	BMDL	750	14 - 94
Methidathion (Supracide)	BMDL	47	13 - 94
Metolachlor (Dual)	BMDL	150	17 - 94
Prometon	BMDL	64	35 - 94
Prometryn	BMDL	410	28 - 94
Propazine	BMDL	117000	11 - 94
Simazine	0.14	1100	32 - 94
Terbumeton	BMDL	8700	22 - 94
Terbutryn	0.1	557	19 - 94
Terbuthylazine	BMDL	327	24 - 94
Tolban	BMDL	15200	36 - 94
Metals			
Arsenic	BMDL	150	84 - 91
Chromium	1.3	1490	91 - 91
Copper	0.99	2250 (b)	91 - 91
Lead	BMDL	180	91 - 91
Cyanides			
Cyanide, Total	BMDL	10.5	94 - 94

BMDL = Below method detection limit

(a) Represents the number of samples in which the chemical was detected per the total number of analyzed samples.

(b) The maximum copper concentration in study-wide soils shown in the RI Report (BCM 1988) and presented on page A-3 in Appendix A is 131,000 mg/kg. This value was based on the analysis of waste in a drum in Zone 8. This waste [illegible]

POOR QUALITY ORIGINAL

TABLE 4-2
CHEMICALS OF POTENTIAL CONCERN IN SITE 8 SOIL

	Geometric Mean Concentration mg/kg	Maximum Concentration mg/kg	Detection Frequency (a)
Volatile Organics			
Benzene	0.0414	1.01	7 - 17
Chlorobenzene	0.0618	1.98	11 - 17
Chloroform	0.0220	0.372	5 - 17
m-Xylene	0.247	2410	13 - 17
o+p-Xylenes	0.179	1200	13 - 17
Toluene	0.197	3150	14 - 17
Base/Neutral Extractables			
1,2,4-Trichlorobenzene	0.337	1.36	2 - 17
Nitrobenzene	0.136	0.269	1 - 17
Chlorinated Pesticides			
4,4'-DDD	2.2	42	7 - 17
4,4'-DDE	1.72	27.8	5 - 17
4,4'-DDT	1.06	47.8	3 - 17
Manufactured Pesticides			
Ametryn	0.905	310	5 - 17
Atrazine	1.4	17	7 - 17
Cyanazine	0.537	74.2	4 - 17
Diazinon	2.48	720	7 - 17
Galecron	0.843	750	7 - 17
Methidathion (Supracide)	0.44	41	4 - 17
Metolachlor (Dual)	1.84	150	10 - 17
Prometon	0.88	9.9	7 - 17
Prometryn	1.76	410	12 - 17
Propazine	1.07	1180	3 - 17
Simazine	28.3	1100	15 - 17
Terbumeton	2.0	42	6 - 17
Terbutryn	1.22	75.5	8 - 17
Terbuthylazine	2.76	280	14 - 17
Tolban	1.50	3.9	1 - 17
Metals			
Arsenic	13.4	150	15 - 17
Chromium	135	1490	17 - 17
Copper	164	22.5	17 - 17
Lead	55	180	17 - 17
Cyanides			
Cyanide, Total	0.421	10.5	17 - 17

(a) Represents the number of samples in which the chemical was detected per the total number of analyzed samples.

5.1 CONTAMINANTS OF CONCERN

The majority of the wastes and residues generated by production operations at the facility have been managed, treated, and disposed of on-site throughout the Site's history. The waste disposed of in Area 8 are covered with 4-8 feet of fill material and sod. There is no evidence of contaminated surface material in this area. Therefore, the media of concern is subsurface soil. The classes of chemicals measured in the various environmental media in the Remedial Investigation were evaluated for inclusion as chemicals of potential concern in the risk assessment by application of screening criteria.

The criteria which resulted in elimination of chemicals included: Site contaminant concentrations below background concentrations; measurements below quantitation limits; a combination of low toxicity and low concentration or low persistence and low concentration and low frequency of detection.

The chemicals of concern for the Site include high molecular weight chlorinated pesticides (BHC isomers), Site-manufactured pesticides (atrazine, diazinon, prometryn, simazine), volatile solvents (chloroform, toluene, xylenes) and metals (copper, lead, arsenic, chromium and an iron slurry waste). The media of concern for this operable unit is contaminated subsurface soil. The maximum and minimum concentrations of analytes found in the subsurface soil throughout the Ciba-Geigy Site are contained in Table 4-1.

The geometric mean and maximum concentrations for the chemicals of potential concern in Area 8 are summarized in Table 4-2.

5.2 EXPOSURE ASSESSMENT

Whether a chemical is actually a concern to human health and the environment depends upon the likelihood of exposure, i.e. whether the exposure pathway is currently complete or could be complete in the future. A complete exposure pathway (a sequence of events leading to contact with a chemical) is defined by the following four elements:

- A source and mechanism of release from the source,
- A transport medium (e.g., surface water, air) and mechanisms of migration through the medium,
- The presence or potential presence of a receptor at the exposure point, and

- A route of exposure (ingestion, inhalation, dermal absorption).

If all four elements are present, the pathway is considered complete.

An evaluation was undertaken of all potential exposure pathways which could connect chemical sources at the Site with potential receptors. All possible pathways were first hypothesized and evaluated for completeness using EPA's criteria. Three current potentially complete exposure pathways and one future exposure pathways remained after screening. The current pathways represent exposure pathways which could exist under current Site conditions while the future pathway represents exposure pathways which could exist, in the future, if the current exposure conditions change. The current exposure pathways were developed for the Ciba-Geigy Areawide Risk Assessment. Since there is no known surficial contamination in Area 8 it is unlikely that the pathways are complete for this Area. Exposure by each of these pathways was mathematically modeled using generally conservative assumptions.

The current pathways are:

- inhalation by nearby residents of contaminated dust particles;
- inhalation by nearby residents of volatile chemicals from subsurface sources in the past waste management area; and
- ingestion of venison by local hunters from deer feeding in vegetated areas of the impacted area.

The future pathway is:

- ingestion of contaminated groundwater.

The exposure point concentrations for each of the chemicals of concern and the exposure assumptions for each pathway were used to estimate the chronic daily intakes for the potentially complete pathways, with the exception of the groundwater pathway. The chronic daily intakes were then used in conjunction with cancer potency factors and noncarcinogenic reference doses to evaluate risk.

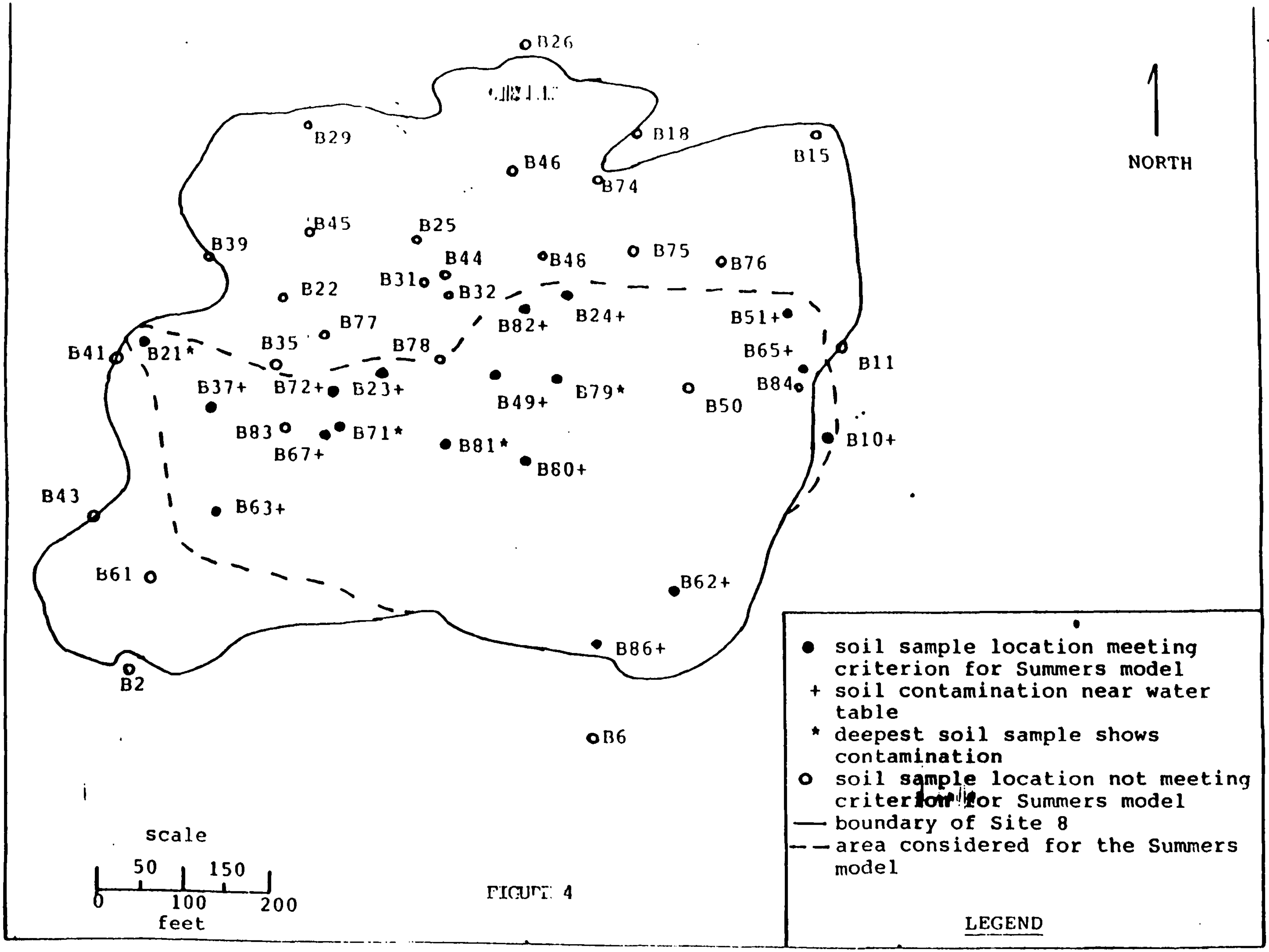
The groundwater at the Ciba-Geigy Site currently contains concentrations of the Site contaminants at levels which would pose an unacceptable risk to human health if the water was being used for human consumption. However, the surficial aquifer is no longer being used as a source of potable water at the Ciba-Geigy plant. Also the ongoing groundwater extraction and treatment system is capturing the contaminated groundwater. As a result, this is not a current complete exposure pathway. The former waste management area 8 is a contributor to the contaminated groundwater.

The future groundwater exposure pathway was evaluated by comparing soil concentrations with health-based soil cleanup levels. The health-based soil cleanup levels were calculated using groundwater models, to assure that drinking water maximum contaminant levels (MCLs), as established under the Safe Drinking Water Act or health-based levels would not be exceeded in the groundwater as a result of contaminants leaching through the soil. As with all models, certain assumptions apply. At the Ciba-Geigy Site, some of the wastes extend to or near the groundwater surface while other areas have a significant amount of uncontaminated clay beneath the waste. As a result, two models have been applied to the areas of contamination. The EPA health-based subsurface soil cleanup levels are based on either the Pestan or Summers models, which are used to estimate groundwater contaminant concentrations resulting from migration of contaminants through the soil column. The Pestan and Summers Models incorporate Site-specific aquifer characteristics and chemical-specific soil-water partition coefficients.

The Pestan model would be used in portions of area 8 where Ciba-Geigy can demonstrate to EPA's satisfaction that an uncontaminated zone exists between the contaminated soil and the groundwater surface (See Figure 4 for an estimate of the portion of Area 8 where the models will be applied). The Summers model would be used in areas where contamination has extended to or is near the groundwater surface.

The major assumptions about exposure frequency and duration that were included in the exposure assessment were:

- For the ingestion of venison scenario, it was assumed that a local hunter kills one deer per year and that the venison yield from the deer is 44 kg. This quantity of venison was conservatively assumed to be consumed annually throughout a 70-year lifetime.



B26
B29
B46
B18
B15
NORTH
B74
B45
B25
B39
B44
B46
B75
B76
B31
B22
B32
B82+
B24+
B51+
B77
B35
B78
B41
B21*
B65+
B11
B37+
B72+
B23+
B49+
B79*
B50
B84
B10+
B83
B71*
B81*
B67+
B80+
B43
B63+
B61
B62+
B86+
B2
B6
scale
50
150
0
100
200
feet
● soil sample location meeting criterion for Summers model
+ soil contamination near water table
* deepest soil sample shows contamination
o soil sample location not meeting criterion for Summers model
— boundary of Site 8
-- area considered for the Summers model
LEGEND

FIGURE 4

- For the inhalation of ambient air scenario it was assumed that an individual lives in the nearest residence (2.5 km from the Site) and inhales 20 m^3 of air per day over a 70-year lifetime. All particulate matter at the exposure point was assumed to be respirable and delivered to the pulmonary region of the lung. The chemicals of concern were assumed to be 100 percent bioavailable.

- In all scenarios a standard body weight of 70 kg was used.

5.3 TOXICITY ASSESSMENT

Toxicity values are used in conjunction with the results of the exposure assessment to characterize Site risk. EPA has developed critical toxicity values for carcinogens and noncarcinogens. 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 $(mg/kg/day)^{-1}$, 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 conservative 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. The CPFs for oral ingestion and inhalation exposure to the contaminants of concern for the areawide study are contained in Tables 5-2, and 5-3 respectively.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that

TABLE 5-2

HEALTH EFFECTS CRITERIA FOR ORAL EXPOSURE TO CHEMICALS OF CONCERN

Chemical	Reference Dose (RfD) (mg/kg/day)	Uncertainty Factor (a)	Source (b)	EPA/CAG Cancer Potency Factor (mg/kg/day)-1	Weight of Evidence (c)
Acetone	1E-1	1,000	IRIS	---	---
Ametryn	9E-3	1,000	IRIS	---	---
Aniline	---	---	---	5.7E-3	B2
Arsenic	1.0E-3	---	EPA	1.75	A
Atrazine	5E-4	1,000	IRIS**	---	C
Benzene	---*	---	IRIS	2.9E-2	A
alpha-BHC	---	---	---	6.3	B2
beta-BHC	---	---	---	1.8	C
gamma-BHC	3E-4	1,000	IRIS	1.3*	B2-C
Carbon disulfide	1E-1	100	IRIS	---	---
Chlorobenzene	3E-2*	1,000	HEA	---	---
Chlorobenzilate	---	---	EPA***	5.5E-2	B2
Chloroform	1.0E-2	1,000	IRIS	6.1E-3	B2
Chloropropylate (d)	1E-2	1,000	CIBA-GEIGY	---	---
Chromium III	1	100	IRIS	---	---
Chromium VI	5E-3	500	IRIS	---	---
Copper	3.7E-2	---	HEA	---	---
Cyanazine	2.0E-3	300	IRIS	---	---
Cyanide (as Hydrogen Cyanide)	2.0E-2	100	IRIS	---	---
Diazinon	9.0E-4	10	EPA	---	---
DDD	---	---	---	---	---
DDE	---	---	---	---	---
DDT	5E-4	100	IRIS	3.4E-1*	B2
1,2-Dichlorobenzene	9E-2	100	HEA	---	---
1,4-Dichlorobenzene	1.0E-1	1,000	HA	2.4E-2	B2
2,4-Dichlorophenol	3E-3	100	IRIS	---	---
2,4-Dinitrotoluene	---	---	EPA	0.68	B2
2,6-Dinitrotoluene	---	---	ORNL	4.83	---
Ethylbenzene	1E-1	1,000	IRIS	---	---
Galecron	---	---	NAS	9.4E-1	B2
Lead	6E-4	---	MCLG	---	---
Methidathion	1E-3	100	IRIS	---	C
Methylene chloride	0.06	100	IRIS	7.5E-3	B2
Metolachlor	1.5E-1	100	IRIS	---	C
Nitrobenzene	5E-4	10,000	IRIS	---	---
Prometon	1.5E-2	1,000	IRIS	---	---
Prometryn	4E-3	1,000	IRIS	---	---
Propazine	2E-2	300	IRIS	---	---
Simazine	5E-3	1,000	IRIS	---	---
Simetryn	---	---	---	---	---
Terbumeton (d)	7.5E-2	100	CIBA-GEIGY	---	---
Terbutryn	1.0E-3	100	IRIS	---	---
Terbuthylazine (d)	3.5E-3	100	CIBA-GEIGY	---	---
Tetrachloroethylene	1.0E-2	1,000	IRIS	5.1E-2*	B2
Tolban (d)	2.5E-3	100	CIBA-GEIGY	---	---
Toluene	3.0E-1	100	IRIS	---	---
1,2,4-Trichlorobenzene	2.0E-2	1,000	IRIS	---	---
2,4,6-Trichlorophenol	---	---	---	2.0E-2	B2
Xylenes (mixed)	2	100	IRIS	---	---

(a) Uncertainty factors used to develop reference doses consist of multiples of 10, each factor representing a specific area of uncertainty inherent in the data available. The standard uncertainty factors include:
- . A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- . A 10-fold factor to account for the uncertainty in extrapolating animal data to the case of humans;
- . A 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs and;
- . A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) Source of Reference Doses: IRIS = chemical files of the Integrated Risk Information System; MCLG = Maximum Contaminant Level Goal; HEA = Health Effects Assessment; HA = Health Advisory; NAS = National Academy of Science; ORNL = Oak Ridge National Laboratories.

(c) Weight of evidence classification scheme for carcinogens: A--Human Carcinogen, sufficient evidence from human epidemiological studies; B1--probable Human Carcinogen, limited evidence from epidemiological studies and adequate evidence from animal studies; B2--Probable Human Carcinogen, inadequate evidence from epidemiological studies and adequate evidence from animal studies; C--Possible Human Carcinogen, limited evidence in animals in the absence of human data; D--Not Classified as to human carcinogenicity; and E--Evidence of Noncarcinogenicity.

(d) Acceptable daily intake derived by Ciba-Geigy from the results of unpublished studies performed by Ciba-Geigy.

* = Review pending.

** = Extra safety factor of 10 was applied to account for possible carcinogenicity (verbal communication - Ted Farber 1988)

*** = Health and Environmental Effects Profile (HEEP) 1984 and verbal communication - Bob McGaughy 1988.

TABLE 5-3

HEALTH EFFECTS CRITERIA FOR INHALATION EXPOSURE TO CHEMICALS OF CONCERN

Chemical	Reference Dose (RfD) (mg/kg/day)	Uncertainty Factor (a)	Source (b)	EPA/CAG Cancer Potency Factor (mg/kg/day)-1	Weight of Evidence (c)
Acetone	---	---	---	---	---
Ametryn	---	---	---	---	---
Aniline	---	---	---	---	---
Arsenic	---	---	---	50	A
Atrazine	---	---	---	---	---
Benzene	---	---	---	2.9E-2	A
alpha-BHC	---	---	---	6.3	B2
beta-BHC	---	---	---	1.8	C
gamma-BHC	---	---	---	---*	---
Cyanazine	---	---	---	---	---
Carbon disulfide	---	---	---	----	---
Chlorobenzene	5E-3	10,000	HEA	---	---
Chlorobenzilate	---	---	---	---	---
Chloroform	---	---	---	8.1E-2	B2
Chloropropylate	---	---	---	---	---
Chromium III	5.1E-3	---	HEA	---	---
Chromium VI	---	---	---	41	A
Copper	1.0E-2	---	HEA	---	---
Cyanide (as Hydrogen Cyanide)	---	---	---	---	---
Diazinon	---	---	---	---	---
DDD	---	---	---	---	---
DDE	---	---	---	---	---
DDT	---	---	---	3.4E-1*	B2
1,2-Dichlorobenzene	4E-2	1,000	HEA	---	---
1,4-Dichlorobenzene	---	---	---	---	---
2,4-Dichlorophenol	---	---	---	---	---
2,4-Dinitrotoluene	---	---	---	---	---
2,6-Dinitrotoluene	---	---	---	---	---
Ethylbenzene	---	---	---	---	---
Galecron	---	---	---	---	---
Lead	4.3E-4	---	NAAQS	ND	B2
Methidathion	---	---	---	---	---
Methylene chloride	---	---	---	1.4E-2	B2
Metolachlor	---	---	---	---	---
Nitrobenzene	6.0E-4	10,000	HEA	---*	---
Prometon	---	---	---	---	---
Prometryn	---	---	---	---	---
Propazine	---	---	---	---	---
Simazine	---	---	---	---	---
Simetryn	---	---	---	---	---
Terbumeton	---	---	---	---	---
Terbutryn	---	---	---	---	---
Terbuthylazine	---	---	---	---	---
Tetrachloroethylene	---	---	---	3.3E-3*	B2
Tolban	---	---	---	---	---
Toluene	1	100	HEA	---	---
1,2,4-Trichlorobenzene	3E-3	1,000	HEA	---	---
2,4,6-Trichlorophenol	---	---	---	2E-2	B2
Xylenes (mixed)	4E-1	1,000	HEA	---	---

(a) Uncertainty factors used to develop reference doses consist of multiples of 10, each factor representing a specific area of uncertainty inherent in the data available. The standard uncertainty factors include:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolating animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from less than chronic NOAELs to chronic NOAELs; and;
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) Source of Reference Doses: HEA = Health Effects Assessment; NAAQS = National Ambient Air Quality Standard.

(c) Weight of evidence classification scheme for carcinogens: A--Human Carcinogen, sufficient evidence from human epidemiological studies; B1--Probable Human Carcinogen, limited evidence from epidemiological studies and adequate evidence from animal studies; B2--Probable Human Carcinogen, inadequate evidence from epidemiological studies and adequate evidence from animal studies; C--Possible Human Carcinogen, limited evidence in animals in the absence of human data; D--Not Classified as to human carcinogenicity; and E--Evidence of Noncarcinogenicity.

* = Review pending.
ND = Not determined

the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur. The RfDs for oral ingestion and inhalation exposure to the contaminants of concern for the areawide study are contained in Table 5-2, and 5-3 respectively.

5.4 RISK CHARACTERIZATION

Human health risks are characterized for potential carcinogenic and noncarcinogenic effects by combining exposure and toxicity information. Excessive lifetime cancer risks are determined by multiplying the estimated daily intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has a one in one million additional (above their normal risk) chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the assumed specific exposure conditions at a Site.

The Agency considers individual excess cancer risks in the range of $1x10^{-4}$ to $1x10^{-6}$ as protective; however the $1x10^{-6}$ risk level is generally used as the point of departure for setting cleanup levels at Superfund sites. The point of departure risk level of $1x10^{-6}$ expresses EPA's preference for remedial actions that result in risks at the more protective end of the risk range.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminants's reference dose). A HQ which exceeds one (1) indicates that the daily intake from a scenario exceeds the chemical's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. An HI which exceeds unity indicates that there may be a concern for potential health effects resulting from the cumulative exposure to multiple contaminants within a single medium or across media.

The health risks resulting from exposure to the current pathways are as follows: the upper bound excess lifetime cancer risk associated with inhalation of airborne particulate matter was $1x10^{-8}$; the cancer risk associated with inhalation of volatilized chemicals from the combined source areas was $3x10^{-10}$; and the cancer risk associated with ingestion of venison was $2x10^{-10}$. None of the non-carcinogenic chemicals of potential concern exceeded a hazard quotient of one (1).

The future pathway based on groundwater contamination resulting from leaching of contaminants from the soil was evaluated by comparing the health-based soil cleanup levels and the soil concentration of the contaminants of concern in the former waste management area 8. Table 5-9 contains this comparison. The soil cleanup levels represent the residual soil concentrations that would not cause Federally regulated drinking water standards to be exceeded as a result of contaminants leaching through the soils to the groundwater.

The soil excavation levels for the carcinogenic contaminant of concern (gamma-BHC) is based on the Federal maximum contaminant level (MCL). The model-calculated soil remediation levels for noncarcinogenic contaminants of concern reflect the proposed MCL for simazine and a hazard quotient (HQ) of one (a concentration that will not exceed the chemical-specific acceptable daily intake or reference dose) for the other noncarcinogenic chemicals. In addition this number is reduced to allow for the groundwater to provide only 20% of the acceptable daily intake.

The comparison of the health-based cleanup level concentrations for the protection of groundwater with the actual soil concentrations indicate that the soils in the former waste management area 8, contain concentrations of Site-related contaminants which exceed the health-protective soil levels.

The potential current exposure pathways are not producing an unacceptable level of risk and consequently will not drive the remediation of the former waste management areas. However, since the subsurface soils are either currently contributing or could potentially contribute in the future to unacceptable levels of groundwater contamination, this pathway will dictate the remediation of the contaminated subsurface soils. Although the surface soil is not currently well characterized, the direct contact pathway could potentially require the remediation of some surface soils.

5.5 ENVIRONMENTAL RISK

The source area is presently covered with fill and therefore is not easily accessible to certain terrestrial species. For this reason the source areas are not expected to have toxic effects on those terrestrial animals at this time. However, the ecological assessment indicates that the Site may have toxic effects on certain plant species, as well as robins and shrews in the areas of concern in the future. The selected remedy based on protection of human health will eliminate the potential for such toxic effects since the environmental exposure pathways will not exist. The environmental impact for the bottom dwelling aquatic communities in Johnson Creek, the floodplain, and the Tombigbee River will be further evaluated in Operable Unit #3.

5.6 CLEANUP LEVELS

The September 1989 ROD for Operable Unit #1, Groundwater Remediation, addresses the contaminated groundwater exposure pathway. The cleanup levels of the currently operating groundwater pump and treat system which are applied at the Site boundary ensures that concentrations of contaminants in the groundwater do not exceed Maximum Contaminant Levels (MCLs) or Minimum Detection Levels (MDLs) for any future consumers of this water are contained in Table 5-6. The cleanup levels for groundwater in deep soil treatment areas are contained in Table 5-7. The groundwater cleanup levels in the deep soil treatment areas have been generated to ensure localized isolation and treatment of contaminated groundwater near Area 8. These levels are either the Federal MCLs or 1×10^{-4} health based concentrations which were used to determine the soil excavation levels. All cleanup levels applied at this Site are within EPA's acceptable 1×10^{-4} to 1×10^{-6} risk range. The 1×10^{-6} risk level, MCL or MDL was used to calculate acceptable concentrations of contaminants at the Site boundary and for ingestion and inhalation. Subsurface soil and its surrounding groundwater cleanup levels are applied at the 1×10^{-4} risk level since this is an industrial site and in this case it would be more cost effective to let any residual contamination be captured by the currently operating groundwater pump and treatment system. This is consistent with areas in Operable Unit #2 requiring no localized deep soil treatment. Groundwater extracted in the soil flushing portion of the remediation will be treated by the existing pump and treat system.

The ROD for Operable Unit #1 did not address the sources of contamination. Addressing the contamination source will decrease the time required to pump and treat. Cleanup levels for the contamination source (the subsurface soils) for groundwater protection are based on the Federal MCL for the carcinogen (gamma-BHC) and a hazard quotient of 1 for noncarcinogens. This cleanup level provides an acceptable exposure level that is protective of human health. Although there is no evidence that surface soils are contaminated in this area, cleanup levels are provided which should be achieved in the top 12 inches of soil. Cleanup levels for contaminated surface soil are based on a worker exposure scenario and assume a commercial/industrial land use. These levels are based on the ingestion and inhalation exposure routes and represent a $1x10^{-6}$ risk level for carcinogens and a hazard quotient of 1 for noncarcinogens. The cleanup levels for direct contact of surface soils are listed in Table 5-8.

The following groundwater cleanup levels are being applied at the property boundary for groundwater leaving the Site to ensure that any future groundwater consumers will not be exposed to unacceptable concentrations of Site-related chemicals in the groundwater. The concentrations presented represent either the regulated Maximum Contaminant Level (MCL) or the Minimum Detection Level for the constituents listed.

TABLE 5-6

GROUNDWATER CLEANUP LEVELS AS PROVIDED IN ROD ADDRESSING OU#1

Contaminants	Cleanup Goal (ug/l)
Aniline	10
Arsenic	50
Benzene	5
Alpha-BHC	.05
Gamma-BHC	0.2
Carbon Tetrachloride	5
Chlorobenzene	5
Chloroform	5
Cresols (m-p-)	10
Methyl Ethyl Ketone	10
Naphthalene	10
Toluene	2000

For the in-situ remediation processes, the following groundwater cleanup levels would be applied to any groundwater withdrawal wells installed within the RCRA defined point of compliance or within the areas identified during the Remedial Action. The withdrawal wells would be installed in areas where subsurface soil cleanup levels were not achieved before excavation limits were reached.

TABLE 5-7
($1x10^{-4}$ Risk Corresponds)

GROUNDWATER CLEANUP LEVELS FOR DEEP SOIL TREATMENT AREAS

Compound	Cleanup Level (ug/l)
alpha-BHC	0.6
beta-BHC	2.0
Lindane	0.2
delta-BHC	0.2
DDT	10.0
DDD	10.0
DDE	10.0
Diazinon	6.0
Chlorobenzilate	140.0
Ametryn	630.0
Bladex	14.0
Simazine	1.0
Atrazine	3.0
Prometryn	28.0

TABLE 5-8

SOIL CLEANUP LEVELS FOR OU#4
AT THE CIBA-GEIGY Site

The following table provides the direct contact cleanup levels. These levels will be applied to the top 12 inches of soil throughout the area of contamination. The cleanup level for gamma-BHC represents a 10^{-6} risk level. The cleanup levels for the remaining chemicals represent an HQ of one (1).

Contaminant	**1E-6 Risk Direct Contact Pathway (mg/kg)**
Gamma-BHC	4
*Diazinon	1,800
*Atrazine	10,000
*Bladex	4,100
*Simazine	4,100
*Prometryn	8200

* These chemicals are not considered to be carcinogens. Therefore, the cleanup levels do not represent a carcinogenic risk level.

The cleanup levels for gamma-BHC and simazine in the following table are soil levels derived to achieve based on the MCL and proposed MCL, respectively in the groundwater. The cleanup levels for the remaining chemicals represent a concentration which, when combined with the Site specific exposure assumptions, will yield a daily intake which does not exceed the chemical's reference dose (RfD). The RfD is an estimate of the lifetime daily exposure level for humans, including sensitive individuals, which will not produce adverse health effects. In addition the risk based concentration has been reduced to allow groundwater to provide only 20% of the acceptable daily intake.

TABLE 5-9

SUBSURFACE SOIL CLEANUP LEVELS FOR OU#4
DUE TO GROUNDWATER INGESTION PATHWAY

Contaminant	Summer's (mg/kg)	Pestan (mg/kg)	Maximum Concentration Found (mg/kg)
Gamma-BHC	1.0	37	422
*Diazinon	10	10	720
*Bladex	2.0	37	23
*Simazine	3.7	1000	321
*Atrazine	3.6	19	1809
*Prometryn	38.5	1557	4029

* These chemicals are not considered to be a carcinogens. Therefore, the cleanup levels do not represent a carcinogenic risk level.

Although the contaminants of concern are not the only contaminants at the Site, they were chosen based on toxicity, mobility and frequency of detection throughout the Site. It is anticipated that contaminants at the Site which do not have cleanup levels presented in this ROD will be reduced to acceptable levels when cleanup levels are met for the most toxic and most mobile contaminants for which cleanup levels have been established.

The groundwater at the Ciba-Geigy Site currently contains concentrations of Site-related contaminants at levels which would pose an unacceptable risk (cumulative risk in excess of $1x10^{-6}$) to human health if the water was being used for human consumption. 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.

6.0 DESCRIPTION OF ALTERNATIVES

Eleven alternatives for remediation of contaminated soils at Area 8 of the Ciba-Geigy Site were evaluated in the Feasibility Study Report. After reviewing comments received during the initial comment period for OU#2, the concepts of the eleven alternatives were reduced to four alternatives based on the similarities in their technologies.

6.1 ALTERNATIVE NO. 1 - No Action

The no action alternative is carried through the screening process as required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This alternative is used as a baseline for comparison with other alternatives that are developed. Under this alternative, EPA would take no further action to minimize the impact soil contamination would have on the groundwater. Contaminants in the soil would continue to leach into the groundwater at levels which would exceed groundwater protection standards. The overall remedial action levels would not be achieved within 100 years by utilizing this alternative. There is no cost associated with this alternative since no additional activities would be conducted.

6.2 ALTERNATIVE NO. 2 - Containment

This alternative consists of placing a soil bentonite slurry wall around the perimeter of the area to prevent lateral migration of contaminants in the groundwater. A multilayered RCRA cap would be placed over the area to minimize the vertical migration of soil contamination. Solidification/stabilization may be required in one portion of the Site containing soft waste to increase the strength of the waste to sufficient levels to support a cap system. The area would be revegetated following construction activities. Soil contamination would not be reduced, but isolated from the environment by the cap and slurry wall. Institutional controls (land and groundwater use restrictions) would be necessary to ensure the integrity of the alternative. Following the construction of the cap and slurry wall, the Site would be monitored to verify the effectiveness of the remedy. The overall remedial cleanup levels as defined in operable unit one, would not be achieved within 100 years by utilizing this alternative. The alternative could be constructed in 10 months. The present worth cost of this alternative, including operation and maintenance, is estimated to be $10,909,000.

Elements Common to Alternatives 3 and 4

The remaining two alternatives involve the excavation of soil which exceeds health-based cleanup levels. Although the actual excavation levels are not Applicable or Relevant and Appropriate Requirements (ARARs), they were established, in part, to ensure that the Federally regulated drinking water standards (ie., Maximum Contaminant Levels), which are ARARS, are not exceeded by contaminants leaching from the soils into the groundwater. Excavation would be conducted using conventional methods. Excavations may be terminated before cleanup levels are reached for any of the following situations (excavation limits for this Site).

1. When large concrete structures are encountered such as building foundations, reinforced concrete slabs and concrete roadway sections connected with reinforcing steel, which require different types of materials handling and excavation methods;

2. When the water table is encountered. This means that soil removal methodologies would change and further pretreatment would be required for the thermal treatment process of those soils. Depending on the volume of soils removed from below the water table, there could be an adverse effect on the existing pump and treatment system.

3. When a depth of 20 feet is reached. Below this depth, excavation poses additional hazards to workers requiring different OSHA standards and increasing the cost of excavations.

4. When the iron slurry waste is encountered. This material will be treated by in-situ stabilization/fixation. Cost effectiveness and implementability were considerations in the decision(s) to halt excavation.

The four situations above have been defined as excavation limits.

6.3 ALTERNATIVE NO. 3 - Removal, Solidification/stabilization, and On-Site Disposal

This alternative consists of the excavation of contaminated soil and sludge within the Site until the established cleanup levels or excavation limits are reached (see section 6.2, Elements Common to Alternatives 3 and 4). The excavated material would be solidified/stabilized.

After solidification/stabilization, the material would be disposed of in an on-site landvault after RCRA LDR treatment standards, pursuant to a treatability variance, are met. In accordance with Superfund Land Disposal Restriction (LDR) Guidance #6A, for herbicides, which are similar and are applicable to Site contaminants, a treatability variance requires that the selected technology must demonstrate a 90-99.9 percent reduction in the contaminants of concern.

Uncertainty exists regarding the effectiveness of solidification/stabilization of material contaminated with elevated concentrations of organic contaminants. Therefore, treatability studies would be conducted to determine the effectiveness of this alternative in meeting the legislated treatment standards. Solidification/stabilization would be utilized for soils where it is proven effective in reducing the contaminated soil concentrations to Land Disposal Restrictions (LDRs) treatability variance levels. This area also contains an iron slurry waste that is completely unsuitable for pugmill stabilization. This waste would be treated by the utilization of an in-situ fixation process which would achieve the leachate requirements of LDR. The NCP establishes a presumption that treatment to the legislated standards based on the Best Demonstrated Available Technology is generally inappropriate for CERCLA contaminated soil and debris (55 FR 8758-62, (March 8, 1990)). Therefore, compliance with the land disposal treatment standards would be achieved pursuant to a treatability variance for CERCLA contaminated soil and debris. This treatability variance would be granted upon ROD signature. The landvault would be designed in accordance with applicable RCRA regulations. The areas would be backfilled following excavation activities. Following Site remediation, the excavated areas would be vegetated. If the subsurface excavation levels are not achieved before excavation limits are reached, institutional controls (i.e., land and groundwater use restrictions) would be necessary to restrict exposure to the contaminated subsurface soil and to prevent exposure to contaminated groundwater. The overall remedial action levels would not be achieved within 100 years by utilizing this alternative. Alternative 3 could be constructed in 12 months. The present worth cost of this alternative is estimated at $30,359,000.

6.4 ALTERNATIVE NO. 4 - Removal, On-Site Thermal Treatment, Solidification/stabilization and On-Site Disposal

This alternative consists of:

1. The Excavation Process

The excavation of contaminated sludge and soil within the Site until the established cleanup levels or excavation limits are reached.

2. Application of Innovative Technologies to Excavated Materials

Treatability studies would be conducted during the Remedial Design to determine the effectiveness of selected technologies on soils at the Site. Three potential pre-treatment options include:(1) solvent extraction, followed by liquid injection incineration; (2) low temperature thermal desorbtion, followed by treatment of desorbed volatile organics/air mixture and (3) critical fluid injection followed by liquid injection incineration. These options for pre-treatment would be evaluated during the design to determine if the main thermal treatment process and/or cost effectiveness can be enhanced while still meeting levels as adjusted by the treatability variance. Treatability studies would be conducted to determine if the contaminated soils are amenable to treatment or pretreatment by dechlorination to treat the waste to LDR treatability variance levels or to improve the performance of the Primary Treatment. These studies may also be used to determine if such treatment or pretreatment will improve the performance of the solidification/stabilization of wastes containing no gamma-BHC or organic content less than 2500 ppm.

Finally, treatability studies would be conducted to determine whether solidification/stabilization might be an effective treatment technology for soils containing no gamma-BHC and containing less than 2,500 ppm total organics. This is an innovative application of the solidification/stabilization process. If this technology is proven effective, it will be used for these soils rather than the Primary treatment.

3. Innovative Application of Solidification/Stabilization Technology

According to results from subsurface soil borings collected by Ciba-Geigy during RI/FS field activities, portions of Area 8 may contain manufactured pesticides that exceed the health-based cleanup levels requiring them to be excavated, but are not mixed with a RCRA waste. The manufactured pesticides of concern are toxicity characteristic analytes and therefore have no toxicity characteristic regulatory levels. Although no regulatory levels are exceeded for any toxicity characteristic analytes and it has been determined that the soil is not a RCRA hazardous waste, these manufactured pesticides exceeded the health-based cleanup levels, requiring that they be excavated and treated.

All soils which are mixed with a RCRA waste that exceed the cleanup levels will undergo thermal treatment or dechlorination and be treated to legislated (LDR) treatment standards, as adjusted by a CERCLA treatability variance upon signing of the ROD. Additionally, it is anticipated that it will be necessary to thermally treat some of the soil contaminated with manufactured pesticides that exceed the health-based levels which contain a total organic concentrations above 2,500 ppm.

Soils containing less than 2,500 ppm total organics may be amenable to treatment using a solidification/stabilization process. This application would represent an innovative application of this technology since EPA has minimal information on stabilization of manufactured pesticides. The NCP encourages the use of innovative technologies at Superfund sites. For this reason, and because this application may be effective at the Site, solidification/stabilization treatment will be evaluated during the treatability studies for these waste. If the stabilization process is unsuccessful, thermal treatment will be used to treat these waste.

4. Primary Treatment: On-site Thermal Destruction

The primary treatment technology for the contaminated excavated material not amenable to final treatment by the innovative technologies would be on-site thermal destruction. The contaminated soil may require pretreatment to remove debris present before the thermal treatment process. The excavated soil would be blended in a tank which meets the definition of a tank in Section 260.10 of the Code of Federal Regulations (40 CFR). The purpose of the blending is to achieve a homogeneous mixture prior to thermal treatment to ensure proper incinerator operations and to comply with operating conditions determined in the trial burn.

5. Management of Treatment Residuals and Pugmill Wastes

Ash from the thermal treatment process and any material from any technology selected during the Remedial Design would be disposed of in a landvault after RCRA legislated treatment standards, as adjusted by a CERCLA treatability variance, are met. Following excavation, the area would be backfilled and revegetated.

6. In-situ Remediation Processes

If the excavation is terminated before cleanup levels are achieved, in-situ soil flushing would be used. In-situ soil flushing may involve monitoring wells, withdrawal wells, re-injection wells and isolation walls extending from the land surface to the top of the Miocene clay, which would be used to flush contaminants from deep unsaturated sands and decrease the time required to pump and treat contaminated groundwater.

In addition to the in-situ soil flushing, innovative technologies (in-situ vacuum extraction or in-situ bioremediation) may also be used in addition to or instead of in-situ soil flushing, if during the remedial design either technology is found to be effective in reducing the concentrations of the contaminants in the soil and is cost effective. This area also contains an iron slurry waste that is completely unsuitable for thermal treatment or pugmill stabilization. This waste would be treated by using an in-situ fixation process which would achieve the leachate requirements of LDR.

This alternative could be implemented in 14 months. The present worth cost of this alternative, including operation and maintenance, is estimated to be $49,723,000. This estimated cost assumes that excavations will continue until cleanup levels are achieved or 20 feet is reached. If excavations are terminated because the groundwater, iron slurry waste or large concrete boulders are encountered, the actual cost to implement the remedy would be reduced.

7.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section of the ROD provides the basis for determining which alternative provides the best balance with respect to the statutory balancing criteria in Section 121 of CERCLA and in Section 300.430 of the NCP. The major objective of the FS was to develop, screen, and evaluate alternatives for the remediation of the contaminated soils at the Ciba-Geigy Site. A wide variety of technologies were identified as candidates for remediating the contaminated soils at the Site. These technologies were screened based on their feasibility with respect to the contaminants present and the Site characteristics. The technologies that remained after the initial screening were combined into potential remedial alternatives and evaluated in detail. The remedial alternatives selected from the screening process were evaluated using the following nine evaluation criteria:

- Overall protection of human health and the environment.
- Compliance with applicable and/or relevant Federal or State public health or environmental standards.
- Long-term effectiveness and permanence.
- Reduction of toxicity, mobility, or volume of hazardous substances or contaminants.
- Short-term effectiveness, or the impacts a remedy might have on the community, workers, or the environment during the course of implementing it.
- Implementability, that is, the administrative or technical capacity to carry out the alternative.
- Cost-effectiveness considering costs for construction, operation, and maintenance of the alternative over the life of the project, including additional costs should it fail.
- Acceptance by the State.

- Acceptance by the Community.

The NCP categorizes the nine criteria into three groups:

(1) Threshold Criteria - overall protection of human health and the environment and compliance with ARARs (or invoking a waiver) are threshold criteria that must be satisfied in order for an alternative to be eligible for selection;

(2) Primary Balancing Criteria - long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability, and cost are primary balancing factors used to weigh major trade-offs among alternative hazardous waste management strategies; and

(3) Modifying Criteria - state and community acceptance are modifying criteria that are formally taken into account after public comment is received on the proposed plan and incorporated in the ROD.

The selected alternative must meet the threshold criteria and comply with all ARARs or be granted a waiver for compliance with ARARs. Any alternative that does not satisfy both of these requirements is not eligible for selection. The Primary Balancing Criteria are the technical criteria upon which the detailed analysis is primarily based. The final two criteria, known as Modifying Criteria, assess the public's and the state agency's acceptance of the alternative. Based on these final two criteria, EPA may modify aspects of a specific alternative.

The following analysis is a summary of the evaluation of alternatives for remediating Operable Unit #4 of the Ciba-Geigy Superfund Site under each of the criteria. A comparison is made between each of the alternatives for achievement of a specific criterion.

Threshold Criteria

7.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

All of the alternatives would provide protection of human health and the environment by minimizing or controlling the risk associated with the contaminated soils through treatment or containment and institutional controls. In Alternative 1, the currently operating groundwater pump and treat system would continue operating. However, contaminants in the soil would continue to leach into the groundwater at unacceptable levels. Cleanup levels for groundwater would not be achieved within 100 years with Alternative 1. Alternative 2 would isolate the contamination from the surrounding uncontaminated area. The alternatives involving excavation, (Alternatives 3 and 4), would minimize the majority of the risk by removing and treating the principal source of the soil and groundwater contamination and use of institutional controls where necessary. However, cleanup levels for the groundwater may not be achieved within 100 years for alternatives that do not include deep soil treatment (Alternatives 1, 2 and 3). Alternative 4 would provide the best overall protection because it removes and treats the principal threats between the land surface and the excavation limits and it provides deep in-situ soil treatment for contaminated soils below the excavation limits.

7.2 COMPLIANCE WITH ARARs

All of the alternatives would comply with all Federal or State ARARs or justify a waiver. Chemical specific ARARs would be met through compliance with the groundwater protection standards (ie., MCLs) at the Point of Compliance as defined in Ciba-Geigy's RCRA permit and through compliance with the NPDES permit conditions for water removed and treated in the waste management areas. The landvault utilized in Alternatives 3 and 4 would be designed in accordance with RCRA regulations. Soils excavated in Alternatives 3 and 4 would be analyzed to determine if they are RCRA hazardous waste. If required, RCRA hazardous waste would be treated to legislated treatment standards pursuant to a treatability variance prior to land disposal. Highly concentrated soils would be treated by a thermal treatment process designed to comply with RCRA regulations for hazardous waste thermal treatment. It is not anticipated Alternative 3 would achieve these standards for many of the contaminants of concern due to the elevated levels present in the contaminated soil. Alternative 4 would be designed to attain these standards as adjusted by the treatability variance .

Air emissions from the Site would be monitored to ensure compliance with the Clean Air Act. Fenceline air monitoring will be conducted to ensure that contaminant concentrations do not exceed levels considered to be safe for human health. If levels are exceeded, mitigative procedures such as dust suppression or vapor capture will be employed to prevent harmful levels of air emissions from leaving the Site. RCRA design standards will be incorporated into the remedial design of all remedial activities. Of the four alternatives, alternatives alternative #4 provides the best compliance with ARARs.

Primary Balancing Criteria

7.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would not provide long-term effectiveness and permanence with respect to the contaminated soils at the Site. Each of the remaining alternatives would provide long-term effectiveness through limiting the migration of contamination or treatment of the contaminated soils at the Site. Over time the effectiveness of Alternative 2 may decrease as a result of cap/slurry wall failure caused by improper construction (i.e., keying of the wall into an unfractured impermeable clay layer) or inadequate operation and maintenance procedures. However, as long as the cap and slurry wall are properly maintained, the alternative would be effective. In Alternative 3, the contaminants are bound to the soil by the treatment process and the solidified material is contained on-site in a RCRA landfill. The long-term effectiveness of Alternative 3 is uncertain since solidifying high level organic contamination has not been demonstrated to be effective in preventing leaching of the waste into the groundwater. Alternatives 4 provides a greater level of long-term effectiveness than Alternatives 2 and 3 because thermal treatment has been demonstrated to effectively destroy contaminants to the levels allowed by the treatability variance. Alternative 4 provides the greatest long-term effectiveness and permanence by the additional treatment of contaminated soils below the excavation limits.

7.4 REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT

Alternative 1 would not reduce mobility, toxicity or volume at the source of the contamination. Alternative 2 would isolate the contamination from the environment, thus minimizing the forces which drive contaminant mobility. However, toxicity and volume would not be affected by Alternative 2. Each of the remaining alternatives would reduce the mobility of the contaminants through treatment. Treatability Studies would be conducted to demonstrate the level of mobility reduction resulting in the solidification/stabilization process proposed in Alternative 3. However, the volume of contaminated material in Alternative 3 would increase due to the stabilization process. Alternative 3 would provide minimal reduction in toxicity. The toxicity of chemical contaminants at the Site would be reduced by the thermal destruction process in Alternative 4. Thermal treatment and destruction of the organic chemical contaminants at the Site through Alternative 4 would virtually eliminate all toxic effects of the excavated soils along with a substantial reduction in volume. Alternative 4 provides the best reduction of toxicity and mobility through treatment by utilizing innovative in-situ treatments for contaminated soils currently below the excavation limits.

7.5 SHORT-TERM EFFECTIVENESS

Alternative 1 would not require construction or excavation that would cause a health risk to workers. However, Alternative 1 would be the least effective in achieving the overall groundwater cleanup levels in the shortest time period. All of the remaining alternatives will require varying amounts of time to implement. None will be immediately effective. No threshold toxicity criteria would be exceeded by implementing Alternatives 2, 3, and 4 and the health risks to remedial workers is unlikely, particularly when appropriate monitoring and engineering controls are applied. Of the alternatives evaluated, Alternatives 3 and 4 are more effective than Alternative 2 because contaminated soil would be removed and treated. Although Alternative 3 requires removal of contaminated soils down to the excavation limits. Alternative 4 would be most effective in the short-term by isolating and treating the contaminated soils below the excavation limits. These soils are causing the most immediate threat because of their proximity to the groundwater.

7.6 IMPLEMENTABILITY

Alternative 1 is currently operating. Technological expertise, services, equipment and materials are adequately available for the implementation of Alternative 2. Due to the uncertainty regarding the effectiveness of solidification/stabilization of material contaminated with elevated concentrations of organic contaminants a treatability study would be conducted. A determination would be made at the completion of the treatability studies, to be conducted during the remedial design, regarding the effectiveness of solidification/stabilization of material contaminated with elevated concentrations of organic contaminants.

Thermal treatment capacity may be limited at the time of implementation of Alternative 4. New equipment may have to be designed and constructed as a part of the overall schedule. However, the technology base does exist for the completion of this requirement. Ash from the thermal treatment process, any solidified/stabilized material or any material from the dechlorination process would be disposed of in a landvault after RCRA legislated treatment standards, as adjusted by a treatability variance granted upon ROD signature, are met. In accordance with Superfund LDR Guidance #6A, for herbicides, which are similar and applicable to Site contaminants, the selected technology must demonstrate a 90-99.9 percent reduction for the contaminants of concern to be granted the variance. All of the alternatives are technically and administratively feasible. However, the results of the treatability studies would determine the effectiveness of Alternative 3 on elevated levels of organics.

7.7 COST

Alternative 1 would not require any additional cost since no treatment of the source is provided. The present worth cost of installing a slurry wall and cap (Alternative 2) is estimated to be $10,909,000. Alternatives 3 and 4 are substantially higher in cost due to increased efforts to permanently treat the contaminated soil. The present worth cost associated with solidification/stabilization of the contaminated soil (Alternative 3) is $30,359,000. Thermal treatment and/or solidification/stabilization of the contaminants in the soil (Alternative 4) would cost approximately $49,723,000. This cost could vary depending on the results of a treatability study to verify the levels of contamination which could be solidified and still achieve RCRA land disposal standards as adjusted by a treatability variance and by the volume of soils which can be excavated before excavation limits are reached. The treatability study would be conducted during the remedial design to verify the level of contamination which could be solidified/stabilized and still achieve RCRA land disposal standards pursuant to a treatability variance. These costs include operation and maintenance during the implementation of the alternative as well as post remediation monitoring.

Modifying Criteria

7.8 STATE ACCEPTANCE

The State of Alabama has concurred with the selection of Alternative 4 to remediate the contaminated soil at the Ciba-Geigy Site.

7.9 COMMUNITY ACCEPTANCE

Based on the favorable comments expressed at the May 19, 1992 public meeting and the lack of negative written comments received during the comment periods, it appears that the McIntosh community generally agrees with the selected remedy.

8.0 SUMMARY OF SELECTED REMEDY

In summary, Alternative 4 will achieve substantial risk reduction through treatment of a principal threat at the Ciba-Geigy Superfund Site. LDR treatment standards will be achieved, as adjusted pursuant to a treatability variance, granted upon ROD signature, prior to placing the treated excavated material in the on-site landvault. As shown in Figure 4, the treatment technology which has been demonstrated to achieve these standards for the RCRA wastes present at the Site is thermal treatment. Thermal treatment in this alternative may also include a pre-treatment phase prior to the main thermal treatment process. Three potential pre-treatment options include: (1) solvent extraction, followed by liquid injection incineration; (2) low temperature thermal, followed by treatment of the desorbed volatile organics/air mixture; and (3) critical fluid injection, followed by liquid injection incineration. These options for pre-treatment will be evaluated during treatability studies to be conducted during the remedial design to determine if the main thermal treatment process and/or cost effectiveness can be enhanced while still meeting levels as adjusted by the treatability variance. If any of the technologies are proven to enhance cost effectiveness or the main thermal process, it will be used.

Under certain circumstances, the pre-treatment option could totally replace the main thermal treatment process. If any of the pre-treatment technologies are proven to be more effective in reducing the contaminant concentrations in the soil and more cost effective, it will be used instead of the main thermal treatment process. Pre-treatment technologies that are not found to be effective in reducing contaminated soil concentrations to levels required pursuant to the treatability variance or that do not enhance cost effectiveness will not be utilized.

Treatability studies will be conducted to determine the effectiveness of solidification/stabilization of soils with low levels of contamination.

According to results from subsurface soil borings collected by Ciba-Geigy during RI/FS field activities, portions of Area 8 may contain manufactured pesticides that exceed the health-based cleanup levels requiring them to be excavated, but are not mixed with a RCRA waste. The manufactured pesticides of concern are toxicity characteristic analytes and therefore have no toxicity characteristic regulatory levels. Although no regulatory levels are exceeded for any toxicity characteristic analytes and it has been determined that the soil is not a RCRA hazardous waste, these manufactured pesticides exceeded the health-based cleanup levels, requiring that they be excavated and treated.

All soils which are mixed with a RCRA waste that exceed the cleanup levels will undergo thermal treatment or dechlorination and be treated to legislated (LDR) treatment standards, as adjusted by a CERCLA treatability variance upon signing of the ROD. Additionally, it is anticipated that it will be necessary to thermally treat some of the soil contaminated with manufactured pesticides that exceed the health-based levels which contain a total organic concentrations above 2,500 ppm.

Soils containing less than 2,500 ppm total organics may be amenable to treatment using a solidification/stabilization process. This application would represent an innovative application of this technology since EPA has minimal information on stabilization of manufactured pesticides. The NCP encourages the use of innovative technologies at Superfund sites. For this reason, and because this application may be effective at the Site, solidification/stabilization treatment will be evaluated during the treatability studies for these waste. If the stabilization process is unsuccessful, thermal treatment will be used to treat these waste.

In order to conduct the solidification/stabilization treatability studies, it will be necessary to identify treatment standards with which to evaluate the effectiveness of the technology. Solidification/stabilization may involve physical/chemical processes that do more than simply entrap the contaminants. Solidification performed in conjunction with stabilization would satisfy the preference for treatment under Superfund and falls within the program's definition of immobilization.

Concerns have been raised regarding the types of immobilization that provide for adequate protection. The principal reason for these concerns rests on the fact that immobilization is not generally considered a destructive technique but rather prohibits or impedes the mobility of contaminants.

Although experts are in general agreement regarding the effectiveness of immobilization for most inorganics and metals, the effectiveness of immobilization for organics cannot be predicted without testing. Furthermore, the testing methods available (i.e. leachability tests) provide different types of information on the mobility of contaminants depending on the test. For these reasons, Superfund has developed general guidelines for evaluation and selecting immobilization taking into consideration the testing methods currently available, scientific understanding to date, and the NCP expectations regarding treatment. The preamble to the NCP (SSFR page 8701, 03/08/90) provides the following guidance regarding treatment effectiveness:

> "... The Superfund program also uses as a guideline for effective treatment the range 90 to 99 percent reduction in the concentration or mobility of contaminants of concern....EPA believes that, in general, treatment technologies or treatment

> trains that cannot achieve this level of performance on a consistent basis are not sufficiently effective and generally will not be appropriate."

The use of any treatment technology, including immobilization, needs to be weighed against this policy and current knowledge regarding the technology application.

SUPERFUND POLICY ON USE OF IMMOBILIZATION

Agency policy on the use of immobilization for treatment in view of concerns that have been raised regarding technology performance primarily for organics is as follows:

> Immobilization is generally appropriate as a treatment alternative only for material containing inorganics, semi-volatile and/or non-volatile organics. Based on present information, the Agency does not believe that immobilization is an appropriate treatment alternative for volatile organics. Selection of immobilization of semi-volatile and non-volatile organics generally requires the performance of a site specific treatability study data generated on waste which is very similar (in terms of type of contaminant, concentration and waste matrix) to that to be treated and that demonstrated through Total Waste Analysis (TWA), a significant reduction (i.e., a 90 - 99 percent reduction) in the concentration of chemical constituents of concern.

The need for treatability study data and the importance of conducting appropriate leachability tests as part of the study are important parts of this policy statement. Treatability studies to demonstrate the effectiveness of treatment of organics is needed since we do not believe that we can predict the degree of performance which may be provided without such testing.

EPA believes that given the uncertainty associated with immobilization of organics, the most stringent leachability test available (i.e. Total Waste Analysis (TWA)) should be used to demonstrate the effectiveness of the technology. A successful demonstration using TWA provides a measure of assurance regarding the leachability of the organics. TWA does not mirror environmental conditions, however, and does not provide information on the protectiveness under specific management scenarios for the immobilized product. One or more leachability tests will be used to evaluate the solidification/stabilization technology.

The 90 - 99 percent reduction in contaminant concentration is a general guidance and may be varied within a reasonable range considering the effectiveness of the technology and the clean-up goals for the Site. Although this policy represents EPA's strong belief that TWA should be used to demonstrate effectiveness of immobilization, other leachability tests may also be appropriate in addition to TWA to evaluate the protectiveness for a specific management scenario.

Since the Solidification/stabilization technology is not a proven treatment technology for organics, treatment effectiveness will be assessed using the TCLP, Multiple Extraction Procedure and Total Waste Analysis methods for the manufactured pesticides at the Site. The stabilized soils from this Site must achieve the following requirements for the technology to be considered effective.

1. The boiling point of the contaminants to be stabilized must be higher than the boiling point of water. During the stabilization process provisions must be made to ensure that none of the contaminants volatilize. The temperature of the process should not exceed 130 degrees F.

2. The TCLP leachate from stabilized/solidified soils would be required to at a minimum, yield a leachate that would not exceed groundwater protection standard multiplied by the most conservative of the dilution factors used (45) to generate cleanup levels for the contaminants of concern at the Site.

3. TWA will be run and compared to the original analysis of waste using the same extraction procedures. A 90% reduction in concentration or mobility of the contaminated soil after treatment is the treatment goal.

4. In addition, the solidification/stabilization mixture would be required to achieve a minimum of 250 psi compressive strength and must demonstrate a permeability of $1x10^{-6}$ or less.

Excavated soil requiring treatment which could not comply with these standards would be thermally treated or treated by dechlorination. During the Remedial Design, the treatment standards would be used to determine the efficiency of the solidification/stabilization technology.

This decision is consistent with Superfund's guidelines for effective treatment which recommends a treatment range of 90 to 99 percent reduction in the concentration or mobility of the contaminants of concern.

REASONS Solidification/Stabilization TREATMENT STANDARDS MUST BE ESTABLISHED FOR OU#4 AT THE CIBA-GEIGY Site:

1. A volume of the waste to be excavated may contain waste (manufactured pesticides) that exceed health-based levels. No legislated treatment standards exist for these manufactured pesticides.

2. The proposed treatment must meet Superfund's effective treatment requirements of 90 - 99 percent reduction in concentration or mobility.

3. The Dilution Attenuation Factor (DAF) of 45 is the more conservative of the dilution factors used in generating the health-based cleanup levels at the Site. The DAF of 45 x the groundwater protection standard is the concentration of leachate EPA has determined to be safe for the groundwater using the Pestan Model. The Pestan Model assumes that an uncontaminated zone a minimum of four (4) feet exist between the contaminated waste and the groundwater surface.

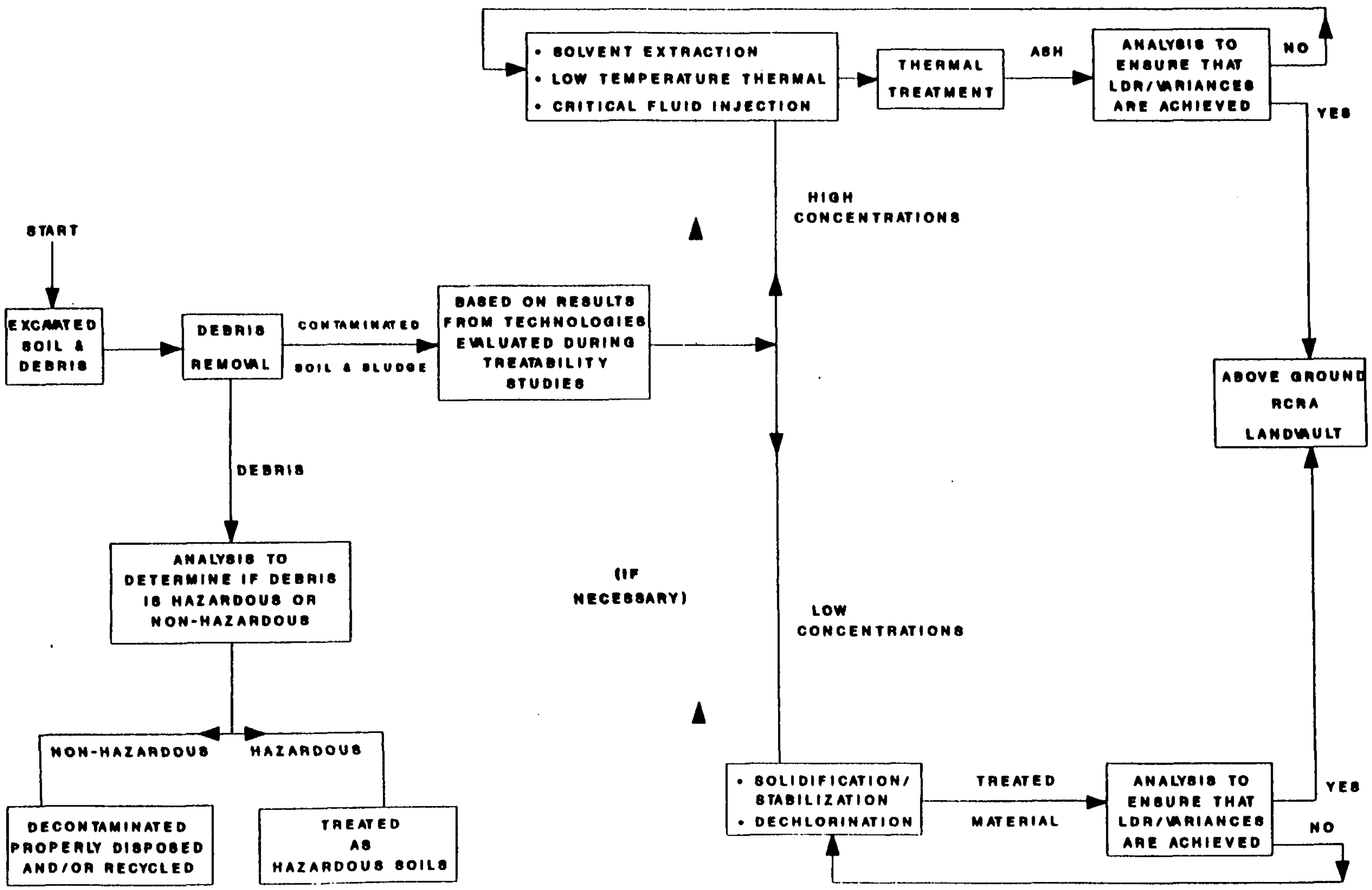
This decision is more conservative than the 1986 TCLP Rule of RCRA, which added 25 new organic constituents to the list of toxic constituents of concern. The 1986 TCLP rule establishes regulatory levels for the organic constituents based on health-based concentrations and a DAF developed using the subsurface fate and transport model. In the 1986 TCLP Rule EPA determined, based on the results of its subsurface fate and transport model, that use of a DAF of 100 is appropriate for setting regulatory levels. (This DAF is sufficient to capture on those waste that are clearly hazardous).

4. In addition, the dilution factor of 45 is more conservative than the DAF of 100 used in the 1986 TCLP Rule.

5. After the material is stabilized/solidified, it will be placed in a RCRA class C landvault which will have a leachate collection system and liner. The landvault will prevent water or any other liquids from contacting the treated material and the treated materials or any potential leachate will not contact the underlying clean soil.

Figure 5

TREATMENT OF EXCAVATED CONTAMINATED SOILS PROCESS FLOW CHART



Solidification/stabilization will be utilized for soils mixed with a RCRA waste where it is proven effective by these treatability studies in reducing the contaminated soil concentrations to LDR treatability variance levels or for soils containing manufactured pesticides that exceed the health-based levels where the performance standards for effective solidification/stabilization are met.

A new innovative chemical treatment technology, dechlorination, may be tested during design and, if found effective, may be used instead of solidification/stabilization for some low level soils. Dechlorination uses a base (i.e., sodium hydroxide) and an organic source of hydrogen and a catalyst to accomplish reductive dehalogenation of halogenated materials. If dechlorination is proven to be more effective in reducing the contaminant concentrations in the soil and is more cost effective, it will be used instead of the solidification/stabilization process. If dechlorination is proven ineffective in reducing contaminated soil concentrations to levels pursuant to the treatability variance and/or does not enhance cost effectiveness it will not be utilized.

The contaminated soil may require pre-treatment to remove debris (i.e., drums, scrap metal, construction rubble etc.) present before the thermal treatment process. At the time of excavation during the remedial activities, the debris may be removed from material that is required to be treated. If drums are encountered, the contents will be removed from the drums and it will be tested to determine if it is hazardous waste. A determination will be made based on a method to be detailed in the remedial design phase of the project as to the hazardous or non-hazardous nature of the debris. If the debris is determined to be of a non-hazardous nature, it may be decontaminated and separated into a category of materials that can be disposed of off-site and/or recycled. Debris that is determined to be of a hazardous nature will be treated in an appropriate manner to be determined at the time of excavation.

The soils to be thermally treated would be blended in a tank which meets the definition of a tank in Section 260.10 of the Code of Federal Regulations (40 CFR). The purpose of the blending is to achieve a homogeneous mixture prior to thermal treatment to ensure proper thermal treatment operations and to comply with operating conditions determined in the trial burn. Ash from the thermal treatment process, any solidified/stabilized material or any material from the dechlorination process will be disposed of in a landvault after RCRA LDR treatment standards, pursuant to a treatability variance granted upon ROD signature, are met. In accordance with Superfund LDR Guidance #6A, for herbicides, which are similar and applicable to Site contaminants, a treatability variance requires that the selected technology must demonstrate a 90-99.9 percent reduction in the contaminants of concern.

In order to provide a constant treatment criterion throughout the remediation process which will ensure compliance with the treatability variance, the concentration of each contaminant of concern in the soil after treatment must be no greater than 10% of the corresponding cleanup level. Adherence to this criterion will ensure a minimum of 90% reduction as required by the treatability variance. The requirement that treated soils contain a concentration less than or equal to a 90% reduction of the cleanup levels is based on the assumption that the cleanup levels are the lowest concentrations of soils that will be excavated. Ensuring that the cleanup levels are reduced by 90% (leaving a maximum of 10%) complies with the lower limit of the percentage reduction allowed by Superfund LDR Guidance 6A. In addition to providing a constant treatment level, the soil before treatment will not have to be analyzed other than for process control.

In some cases treatability variance standards may be more stringent than the upper limit of 99.9% in Superfund LDR Guide #6A. For example, if Gamma-BHC were found at 1000 mg/kg in a Summer's Model area before treatment, requiring that it be reduced to 0.1 mg/kg, as in Table 8-1, would amount to a 99.99% reduction. This percent reduction would still be less stringent than the LDR treatment standards of 0.066 mg/kg and 0.087 mg/kg for BHCs and DDTs respectively. Therefore, the treatability variance will still be applicable.

Table 8-1 provides the treatability variance treatment levels for the contaminants of concern for this operable unit and some additional RCRA waste which are present in other areas at the Site and may be found in low concentrations in this area (no confirmatory data at this time). These treatment levels must be achieved prior to placement of treated soils into the RCRA landvault.

Confirmatory samples will be conducted during the remedial design to ensure that contamination is not present above cleanup levels established in the ROD for surface and subsurface soils.

If confirmatory samples indicate that concentrations of subsurface soils are above cleanup levels, institutional controls, including deed restrictions and/or other measures necessary will be utilized to ensure that any future excavations of the contaminated soil will include the same handling and treatment as set out in the selected remedy.

Following excavation activities, the area will be backfilled and revegetated. As presented in Figure 5 (flow chart), if cleanup levels are not achieved before excavation levels are reached, extraction wells combined with isolation walls extending from the land surface to the top of the Miocene clay and in-situ soil flushing will be utilized to flush contaminants from deep unsaturated soils, thus decreasing the time required to operate the pump and treat system implemented in operable unit one. The contaminated groundwater extracted by these wells will be treated by the currently operating waste water treatment system. Innovative technologies (in-situ vacuum extraction or in-situ bioremediation) may also be used in concert with the soil flushing approach, if during design they are found to be effective in reducing soil concentrations to cleanup levels. Institutional controls, such as deed restrictions, will be established to preclude usage of groundwater and minimize land use until cleanup levels are achieved.

The results of the treatability studies for all technologies tested during the remedial design will be evaluated and the technologies to be used for remediation of the contaminated soils would be determined and noted in the 30% Remedial Design Report. EPA will then issue a public notice in a local newspaper and send a fact sheet to persons on the mailing list to inform the public of the technologies proven effective and which are to be implemented.

TABLE 8-1

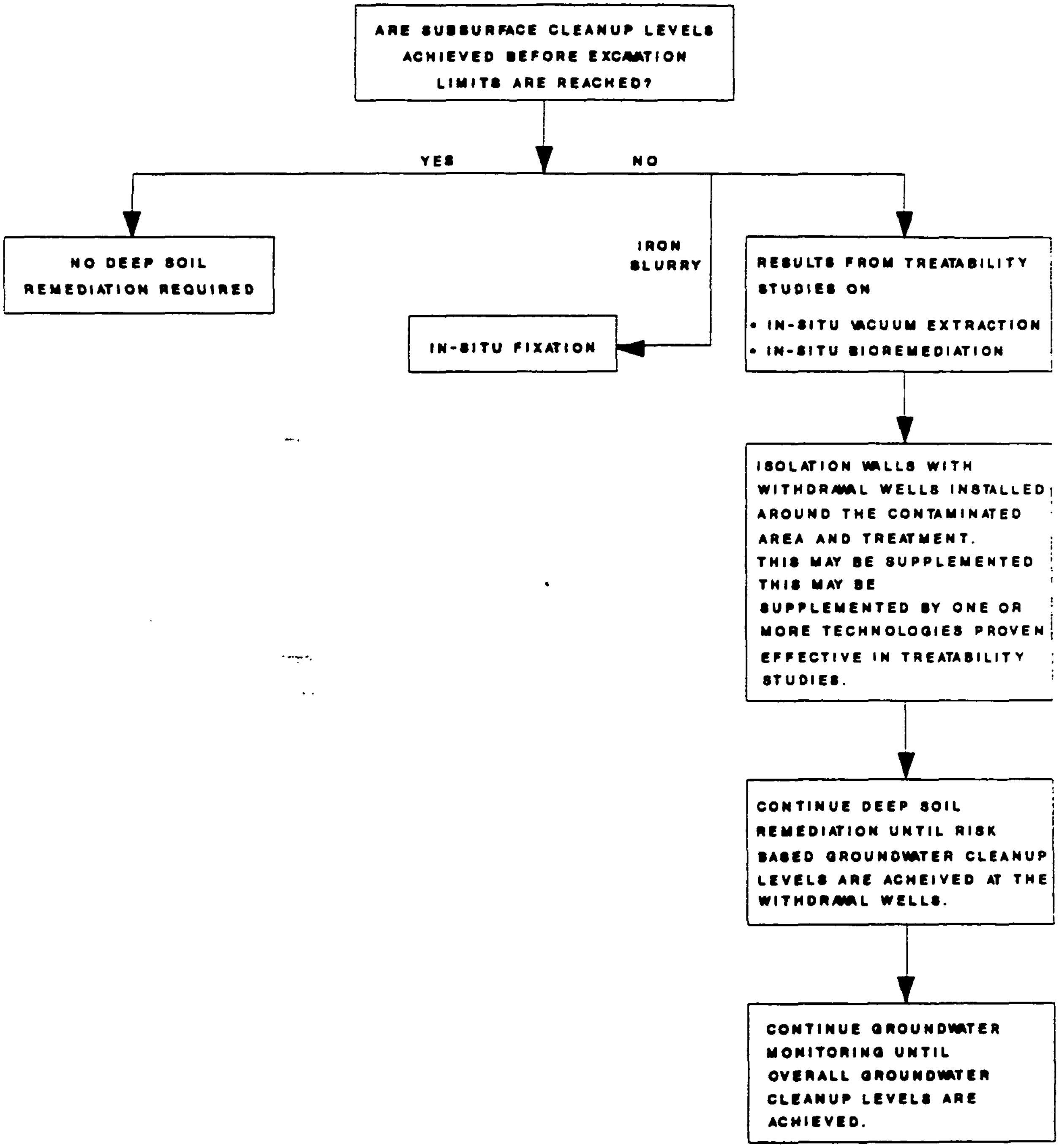
TREATMENT STANDARD FOR SOILS AT THE CIBA-GEIGY Site

The following table provides the maximum concentration allowed in the residuals after treatment for the contaminants of concern.

Maximum Concentration Allowed After Treatment

Contaminant	1E-4 Risk (mg/kg)	1E-4 Risk Summers (mg/kg)	Pestan
DDT		503	750
DDD		675	750
DDE		1,653	1725
Alpha-BHC		0.4	15.6
Beta-BHC		1.7	15.2
Delta-BHC		0.3	15.4
Gamma-BHC		0.1	3.7
Chlorobenzilate		20.9	34.0
Diazinon		1.0	1.0
Bladex		2.0	37
Simazine		3.7	1000
Atrazine		3.6	19
Prometryn		38.5	1557

Figure 6
IN-SITU SOIL REMEDIATION



Air emissions from the Site will be monitored to ensure compliance with the Clean Air Act. Fenceline air monitoring will be conducted to ensure that contaminant concentrations do not exceed levels considered to be safe for human health. If levels are exceeded, mitigative procedures such as dust suppression or vapor capture will be employed to prevent harmful levels of air emissions from leaving the Site.

All treated wastes will be land disposed in accordance with the substantive requirements of the Land Ban Regulations, pursuant to Section 3004 of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA).

After excavation and treatment, treated wastes will be land disposed when LDR treatment standards for any characteristic waste, listed waste, or regulated hazardous constituent as adjusted by the treatability variance granted upon ROD signature are met. The treatment standards are based on the performance of treatment technologies determined by the Agency to represent Best Demonstrated Available Technology (BDAT) as promulgated on June 1, 1990. Wastes that, as treated, contain RCRA hazardous wastes or hazardous waste constituents, at concentrations which do not exceed the treatment standards, are not restricted from land disposal units.

The selected alternative for the Ciba-Geigy Site is consistent with the requirements of Section 121 of CERCLA and the National Contingency Plan. The selected alternative will reduce the mobility, toxicity, and volume of contaminated soil at the Site. In addition, the selected alternative is protective of human health and the environment, will attain all Federal and State applicable or relevant and appropriate public health and environmental requirements through a LDR treatability variance, is cost-effective and utilizes permanent solutions to the maximum extent practicable. The selected alternative for Operable Unit No. 4 is consistent with previous remedial actions conducted at the Site.

Based on the information available at this time, the selected alternative represents the best balance among the criteria used to evaluate remedies. Alternative 4 is believed to be protective of human health and the environment, will attain ARARs (through application of the treatability variance), would be cost effective, and would utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

9.0 STATUTORY DETERMINATION

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment.

In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that, when complete, the selected remedial action for this Site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified.

The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

9.1 PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment through treating a principal threat remaining at the Site, the contaminated soils at former waste management area 8 addressed in this ROD. The selected remedy provides protection of human health and the environment by eliminating, reducing, or controlling risk through treatment, engineering controls and/or institutional controls.

9.2 ATTAINMENT OF THE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Remedial actions performed under CERCLA must comply with all applicable or relevant and appropriate requirements (ARARs). All alternatives considered for the Ciba-Geigy Site were evaluated on the basis of the degree to which they complied with these requirements. The selected remedy was found to meet or exceed the following ARARs, as discussed below.

Clean Water Act

Perched water at certain areas and stormwater which contacts Site materials during remediation activities will be routed through the existing on-site wastewater treatment plant. In addition, contaminated groundwater extracted by the deep soil treatment technologies and the current pump and treat system, leachate from the landvault and incinerator scrubber water will be treated before discharge into the Tombigbee River through the current NPDES permit.

All current discharge limitations will remain in effect for the total facility discharge. This includes chemical-specific effluent limitations based in the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) Guidelines, as well as the biomonitoring requirements to evaluate compliance with toxicity requirements.

Resource Conservation and Recovery Act

Many RCRA requirements are considered relevant and appropriate for remedial activities proposed at the McIntosh plant. The excavated soils and sludges will be representatively analyzed to determine if they are RCRA hazardous wastes. If RCRA hazardous waste is found it will be disposed of in a landvault after RCRA legislated treatment standards pursuant to a treatability variance, granted upon ROD signature, are met. EP Toxicity and TCLP analyses will be performed to ensure that treatment standards, through a treatability variance, are met. A pilot study and a trial burn will be required to ensure that the incinerator will meet the Destruction Removal Efficiencies for the contaminants at the Site. The primary activities include construction of isolation walls, construction of one or more new landvaults, solidification/stabilization, incineration, groundwater pump and treat, and possibly other innovative technologies. RCRA design standards will be incorporated into the remedial design of all construction activities so that the substantive requirements of all applicable RCRA regulations are met .

Other Guidance To Be Considered

Other Guidance To Be Considered (TBCs) include health based advisories and guidance. TBCs have been utilized in estimating incremental cancer risk numbers for remedial activities at the sites. The risk numbers are evaluated relative to the normally accepted point of departure risk range of $1x10^{-4}$ to $1x10^{-6}$.

Clean Air Act

Air emissions from the remedial activities at the Site, including thermal treatment, would be monitored to ensure compliance with the substantive requirements of the Clean Air Act. Fenceline air monitoring will be conducted to ensure that contaminant concentrations do not exceed levels considered to be safe for human health. If levels are exceeded, mitigative procedures such as dust suppression or vapor capture will be employed to prevent harmful levels of air emissions from leaving the Site.

Chemical-Specific ARARs

Maximum Contaminant Levels (MCLs) and non-zero MCLGs are the Groundwater Protection Standards set out in the Corrective Action Program required by the 1985 RCRA Part B Permit. Those Standards have been incorporated into the CERCLA ROD (September, 1989) for the First Operable Unit, addressing the alluvial aquifer, and are indicated in Table 5-6.

Waivers

No ARAR waivers are being granted however, the selected alternative will comply with the LDRs through a treatability variance for the contaminated soil and debris.

9.3 COST EFFECTIVENESS

The estimated cost of EPA's selected remedy is approximately $49,723,000. This cost would be reduced if excavation limits are reached before cleanup levels are achieved. Cost effectiveness is determined by comparing the cost of all alternatives being considered with their overall effectiveness to determine whether the costs are proportional to the effectiveness achieved. EPA evaluates the incremental cost of each alternative as compared to the increased effectiveness of the remedy. The selected remedy, Alternative 4, although most costly, was chosen for its high degree of effectiveness at reducing the mobility, toxicity, and volume of the contaminants and its long-term protectiveness. EPA has determined that the cost of the selected remedy is proportional to the overall effectiveness; therefore, the remedy is considered cost effective.

9.4 UTILIZATION OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

EPA believes the selected remedy is the most appropriate cleanup solution for Operable Unit 4 of the Ciba-Geigy Site and provides the best balance among the evaluation criteria for the remedial alternatives evaluated. This remedy provides effective protection in both the short-term and long-term to potential human and environmental receptors, is implementable, and is cost-effective.

Thermal treatment of the highly contaminated soils, with pre-treatment options proven effective during the design, and solidification/stabilization or dechlorination of low level contaminated soil, if proven effective during the design, with landvault disposal of the residuals, will effectively reduce and/or eliminate the mobility of hazardous waste and hazardous substances to the environment. Isolation from the groundwater combined with in-situ treatment of any contaminated soils below the depth where excavations are terminated will effectively reduce and/or eliminate the mobility of hazardous waste and hazardous substances to the environment.

9.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The statutory preference for treatment will be met because the selected remedy treats the highly contaminated and most mobile contaminated soils, a principal threat posed by the Site, and isolates and treats the lower contaminated soils.

10.0 DOCUMENTATION OF SIGNIFICANT CHANGES

A change has been made to the Selected Remedy since the Proposed Plan was issued. This change was prompted by comments received during the comment period. Solidification/stabilization was considered in the alternatives for some wastes and will be tested for application to another waste type aside from those discussed previously.

According to results from subsurface soil borings collected by Ciba-Geigy during RI/FS field activities, portions of Area 8 may contain manufactured pesticides that exceed the health-based cleanup levels requiring them to be excavated, but are not mixed with a RCRA waste. The manufactured pesticides of concern are toxicity characteristic analytes and therefore have no toxicity characteristic regulatory levels. Although no regulatory levels are exceeded for any toxicity characteristic analytes and it has been determined that the soil is not a RCRA hazardous waste, these manufactured pesticides exceeded the health-based cleanup levels, requiring that they be excavated and treated.

All soils which are mixed with a RCRA waste that exceed the cleanup levels will undergo thermal treatment or dechlorination and be treated to legislated (LDR) treatment standards, as adjusted by a CERCLA treatability variance upon signing of the ROD. Additionally, it is anticipated that it will be necessary to thermally treat some of the soil contaminated with manufactured pesticides that exceed the health-based levels which contain a total organic concentrations above 2,500 ppm.

Soils containing less than 2,500 ppm total organics may be amenable to treatment using a solidification/stabilization process. This application would represent an innovative application of this technology since EPA has minimal information on stabilization of manufactured pesticides. The NCP encourages the use of innovative technologies at Superfund Sites. For this reason, and because this application may be effective at the Site, solidification/stabilization treatment will be evaluated during the treatability studies for these waste. If the stabilization process is unsuccessful, thermal treatment will be used to treat these waste.

In order to conduct the solidification/stabilization treatability studies, it will be necessary to identify treatment standards with which to evaluate the effectiveness of the technology. Solidification/stabilization may involve physical/chemical processes that do more than simply entrap the contaminants. Solidification performed in conjunction with stabilization would satisfy the preference for treatment under Superfund and falls within the program's definition of immobilization.

Concerns have been raised regarding the types of immobilization that provide for adequate protection. The principal reason for these concerns rests on the fact that immobilization is not generally considered a destructive technique but rather prohibits or impedes the mobility of contaminants.

Although experts are in general agreement regarding the effectiveness of immobilization for most inorganics and metals, the effectiveness of immobilization for organics cannot be predicted without testing. Furthermore, the testing methods available (i.e. leachability tests) provide different types of information on the mobility of contaminants depending on the test. For these reasons, Superfund has developed general guidelines for evaluation and selecting immobilization taking into consideration the testing methods currently available, scientific understanding to date, and the NCP expectations regarding treatment. The preamble to the NCP (SSFR page 8701, 03/08/90) provides the following guidance regarding treatment effectiveness:

> "... The Superfund program also uses as a guideline for effective treatment the range 90 to 99 percent reduction in the concentration or mobility of contaminants of concern....EPA believes that, in general, treatment technologies or treatment trains that cannot achieve this level of performance on a consistent basis are not sufficiently effective and generally will not be appropriate."

The use of any treatment technology, including immobilization, needs to be weighed against this policy and current knowledge regarding the technology application.

SUPERFUND POLICY ON USE OF IMMOBILIZATION

Agency policy on the use of immobilization for treatment in view of concerns that have been raised regarding technology performance primarily for organics is as follows:

> Immobilization is generally appropriate as a treatment alternative only for material containing inorganics, semi-volatile and/or non-volatile organics. Based on present information, the Agency does not believe that immobilization is an appropriate treatment alternative for volatile organics. Selection of immobilization of semi-volatile and non-volatile organics generally requires the performance of a site specific treatability study data generated on waste which is very similar (in terms of type of contaminant, concentration and waste matrix) to that to be treated and that demonstrated through Total Waste Analysis (TWA), a significant reduction (i.e., a 90 - 99 percent reduction) in the concentration of chemical constituents of concern.

The need for treatability study data and the importance of conducting appropriate leachability tests as part of the study are important parts of this policy statement. Treatability studies to demonstrate the effectiveness of treatment of organics is needed since we do not believe that we can predict the degree of performance which may be provided without such testing.

EPA believes that given the uncertainty associated with immobilization of organics, the most stringent leachability test available (i.e. Total Waste Analysis (TWA)) should be used to demonstrate the effectiveness of the technology. A successful demonstration using TWA provides a measure of assurance regarding the leachability of the organics. TWA does not mirror environmental conditions, however, and does not provide information on the protectiveness under specific management scenarios for the immobilized product. One or more leachability tests will be used to evaluate the solidification/stabilization technology.

The 90 - 99 percent reduction in contaminant concentration is a general guidance and may be varied within a reasonable range considering the effectiveness of the technology and the clean-up goals for the Site. Although this policy represents EPA's strong belief that TWA should be used to demonstrate effectiveness of immobilization, other leachability tests may also be appropriate in addition to TWA to evaluate the protectiveness for a specific management scenario.

Since the Solidification/stabilization technology is not a proven treatment technology for organics, treatment effectiveness will be assessed using the TCLP, Multiple Extraction Procedure and Total Waste Analysis methods for the manufactured pesticides at the Site. The stabilized soils from this Site must achieve the following requirements for the technology to be considered effective.

1. The boiling point of the contaminants to be stabilized must be higher than the boiling point of water. During the stabilization process provisions must be made to ensure that none of the contaminants volatilize. The temperature of the process should not exceed 130 degrees F.

2. The TCLP leachate from stabilized/solidified soils would be required to at a minimum yield a leachate that would not exceed groundwater protection standard multiplied by the most conservative of the dilution factors used (45) to generate cleanup levels for the contaminants of concern at the Site.

3. TWA will be run and compared to the original analysis of waste using the same extraction procedures. A 90% reduction in concentration or mobility of the contaminated soil after treatment is the treatment goal.

4. In addition, the solidification/stabilization mixture would be required to achieve a minimum of 250 psi compressive strength and must demonstrate a permeability of $1x10^{-6}$ or less.

Excavated soil requiring treatment which could not comply with these standards would be thermally treated or treated by dechlorination. During the Remedial Design, the treatment standards would be used to determine the efficiency of the solidification/stabilization technology.

This decision is consistent with Superfund's guidelines for effective treatment which recommends a treatment range of 90 to 99 percent reduction in the concentration or mobility of the contaminants of concern.

REASONS Solidification/stabilization TREATMENT STANDARDS MUST BE ESTABLISHED FOR OU#4 AT THE CIBA-GEIGY Site:

1. A volume of the waste to be excavated may contain waste

(manufactured pesticides) that exceed health-based levels. No legislated treatment standards exist for these manufactured pesticides.

2. The proposed treatment must meet Superfund's effective treatment requirements of 90 - 99 percent reduction in concentration or mobility.

3. The dilution factor of 45 is the more conservative of the dilution factors used in generating the health-based cleanup levels at the Site. The DAF of 45 x the groundwater protection standard is the concentration of leachate EPA has determined to be safe for the groundwater using the Pestan Model. The Pestan Model assumes that an uncontaminated zone a minimum of four (4) feet exist between the contaminated waste and the groundwater surface.

This decision is more conservative than the 1986 TCLP Rule of RCRA, which added 25 new organic constituents to the list of toxic constituents of concern. The 1986 TCLP rule establishes regulatory levels for the organic constituents based on health-based concentrations and a Dilution Attenuation Factor (DAF) developed using the subsurface fate and transport model. In the 1986 TCLP Rule EPA determined, based on the results of its subsurface fate and transport model, that use of a DAF of 100 is appropriate for setting regulatory levels. (This DAF is sufficient to capture on those waste that are clearly hazardous).

4. In addition, the dilution factor of 45 is more conservative than the DAF of 100 used in the 1986 TCLP Rule.

5. After the material is stabilized/solidified, it will be placed in a RCRA class C landvault which will have a leachate collection system and liner. The landvault will prevent water or any other liquids from contacting the treated material and the treated materials or any potential leachate will not contact the underlying clean soil.