United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R05-92/217
September 1992

EPA

Superfund Record of Decision:

American Chemical Service, IN

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/R05-92/217	2.	3. Recipient's Accession No.

4. Title and Subtitle
SUPERFUND RECORD OF DECISION
American Chemical Services, IN
First Remedial Action - Final

5. Report Date
09/30/92

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Orgainization Name and Address

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered
800/000

14.

15. Supplementary Notes
PB93-964125

16. Abstract (Limit: 200 words)

The 36-acre American Chemical Services (ACS) site is a chemical manufacturing facility in Griffith, Indiana, which was formerly involved in solvent recovery. Land use in the area is predominantly residential and industrial with a wetlands area located north of the Chesapeake and Ohio railway on the west of the site. Nine upper aquifer wells and 16 lower aquifer wells are located within 1/2 mile of the site, with area residents using most of the lower aquifer wells for drinking water. From the late 1960's to early 1970's, ACS manufactured barium naphtherate, brominated vegetable oil, lacquers and paints, liquid soldering fluid, and polyethylene solutions in polybutene. Two onsite incinerators burned still bottoms, nonreclaimable materials generated from the site, and offsite wastes; however, in the 1970's, the incinerators were dismantled, the shells were cut up and scrapped, and the burners and blowers remain onsite. From 1970 to 1975, batch manufacturing expanded, and additives, lubricants, detergents, and soldering flux were manufactured. In 1980, a 31-acre part of the property to the west of the offsite containment area was sold to the City of Griffith to expand the City's

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - American Chemical Services, IN
First Remedial Action - Final
Contaminated Media: soil, debris, gw
Key Contaminants: VOCs (benzene, TCE, toluene, xylenes), other organics (PAHs, PCBs, phenols), metals (arsenic, chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 90
	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)

municipal landfill. Solvent recovery operations continued until 1990 when ACS lost interim status under RCRA regulations because of failure to obtain required insurance policies. Three identified disposal areas on the ACS property are the Onsite Containment Area, where approximately 400 drums containing sludge and semi-solids of unknown types were reportedly disposed of; the Still Bottoms, Treatment Lagoon #1, and adjacent areas, which received still bottoms from the solvent recovery process, including a pond and lagoon that were taken out of service in 1972, drained, and filled with an estimated 3,200 drums containing sludge materials; and the Offsite Containment Area and Kapica/Pazmey property, which was used as a waste disposal area and received wastes that included onsite incinerator ash, general refuse, a tank truck containing solidified paint, and an estimated 20,000 to 30,000 drums that were reportedly punctured prior to disposal. Disposal practices in the Offsite Containment Area ceased in 1975. This ROD addresses a final remedy for the buried drums, as well as waste, contaminated soil, debris, and ground water. The primary contaminants of concern affecting the soil, debris, and ground water are VOCs, including benzene, TCE, toluene, and xylenes; other organics, including PCBs, PAHs and phenols; and metals, including arsenic, chromium, and lead.

The selected remedial action for this site includes excavation and offsite incineration of approximately 400 intact buried drums, decontaminating and disposing of miscellaneous debris offsite; treating contaminated soil using in-situ vapor extraction; conducting an in-situ vapor extraction pilot study for Onsite Area buried waste; excavating and treating buried waste or PCB-contaminated soil onsite using low temperature thermal treatment, with vapor emission control during excavation, and possible immobilization of inorganics after treatment; depositing the treated residuals that meet health-based levels onsite and covering the area with a soil cover; pumping and onsite treatment of contaminated ground water along with wash water from the decontamination processes and condensate from the soil treatment processes using a method to be determined during the RD phase, with onsite discharge of the treated water to surface water and wetlands; continuing to evaluate and monitoring wetlands, with mitigation of affected wetlands if necessary; controlling and monitoring air emissions from excavation and treatment processes; conducting long-term ground water monitoring; and implementing, to the extent possible, institutional controls including deed restrictions, and site access restrictions such as fencing. The estimated present worth cost for this remedial action ranges from $37,800,000 to $46,800,000, which includes an annual O&M cost of $17,670,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific soil clean-up goals are based on risk-based levels and include benzene 1.0 mg/kg; toluene 167-5,000 mg/kg; xylenes 867-26,000 mg/kg; PCBs 10 mg/kg (with 10-inch soil cover); chromium 47-1,400 mg/kg; and lead 500 mg/kg. The lead clean-up level for soil is based on the Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites and the PCB clean-up level for soil is based on TSCA policy for unrestricted access. Chemical-specific ground water clean-up goals are based on risk-based levels, SDWA MCLs, and include benzene 5 ug/l; PCE 5 ug/l; PCBs 0.06 ug/l; and arsenic 8.8 ug/l.

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

American Chemical Services
Griffith, Indiana

STATEMENT OF BASIS AND PURPOSE

This decision document represents the selected remedial action for the American Chemical Services (ACS) site located in Griffith, Indiana. This action was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, with the National Oil and Hazardous Substances Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The State of Indiana concurs with the selected remedy.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE REMEDY

The major components of the selected remedy include:

- Ground water pumping and treatment system to dewater the site and to contain the contaminant plume with subsequent discharge of the treated ground water to surface water and wetlands;

- Excavation of approximately 400 drums in the On-site Containment Area for offsite incineration;

- Excavation of buried waste materials and treatment by low-temperature thermal treatment (LTTT);

- On-site treatment or off-site disposal of treatment condensate;

- Vapor emission control during excavation and possible immobilization of inorganic contaminants after LTTT;

- Off-site disposal of miscellaneous debris;

- In-situ vapor extraction pilot study of buried waste in On-site Area;

- In-situ vapor extraction of contaminated soils;
- Continued evaluation and monitoring of wetlands and, if necessary, remediation;
- Long term ground water monitoring;
- Fencing the site and possible implementation of deed and access restrictions and deed notices; and
- Private well sampling with possible well closures or ground water use advisories.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfies the statutory preference for remedies which employ treatment that reduces toxicity, mobility, or volume as a principal element.

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

September 30, 1992
Date

Valdas V. Adamkus
Valdas V. Adamkus
Regional Administrator, Region V

DECISION SUMMARY
AMERICAN CHEMICAL SERVICES

I. SITE LOCATION AND DESCRIPTION

The American Chemical Services Superfund site (ACS), located at 420 S. Colfax Ave., Griffith, Indiana, (Fig. 1) includes ACS property (19 acres), Pazmey Corp. property (formerly Kapica Drum, Inc, now owned by Darija Djurovic.; two acres) and the inactive portion of the Griffith Municipal Landfill (approximately 15 acres) (Fig. 2). The ACS Superfund Site includes all these properties. ACS began as a solvent recovery facility in May 1955. ACS ceased solvent reclaiming activities in 1990 after losing interim status under RCRA. ACS currently operates as a chemical manufacturer.

Land around the site is used for single family residences and industrial purposes. The site is bordered on the east and northeast by Colfax Avenue. The Chesapeake and Ohio railway bisects the site in a northwest-southeast direction, between the fenced On-site Area and the Off-site Area. On the west and northwest, south of the Chesapeake and Ohio railway, the site is bordered by the abandoned Erie and Lackawanna railway and the active portion of the Griffith Municipal Landfill. North of the Chesapeake and Ohio railway, the site is bordered on the west by wetland areas. The northern boundary of the site is formed by the Grand Trunk railway.

The site is underlain by unconsolidated glacial deposits approximately 130 feet thick. The deposits have been divided into an upper sand and gravel aquifer, an intermediate clay, a lower sand and gravel aquifer, and a lower clay till directly overlying Devonian Detroit River and Traverse System Limestones. Using U.S. EPA guidelines for ground water classification, both the upper and lower aquifers are currently used or potentially available for drinking water or other beneficial uses and are therefore considered Class II for the purposes of this remedial action. Surface water runoff is generally to the west and south. Surface water runoff appears to be confined to the site by drainage to the wetlands and subsequent infiltration. There appears to be no direct connection between site surface water drainage and local streams, however, ground water does discharge to the wetlands and the wetlands are ultimately drained by Turkey Creek, approximately 1 1/2 miles south of the site.

The nearest residents to the site are located approximately 150 feet east of the Off-site Area. The nearest potential receptors to potentially contaminated ground water through ingestion and to volatile compound emissions through inhalation are employees of the businesses located approximately 100 feet east, on Colfax Avenue. To the south and west of the site, the nearest potential receptors are the employees of the Griffith Municipal landfill,

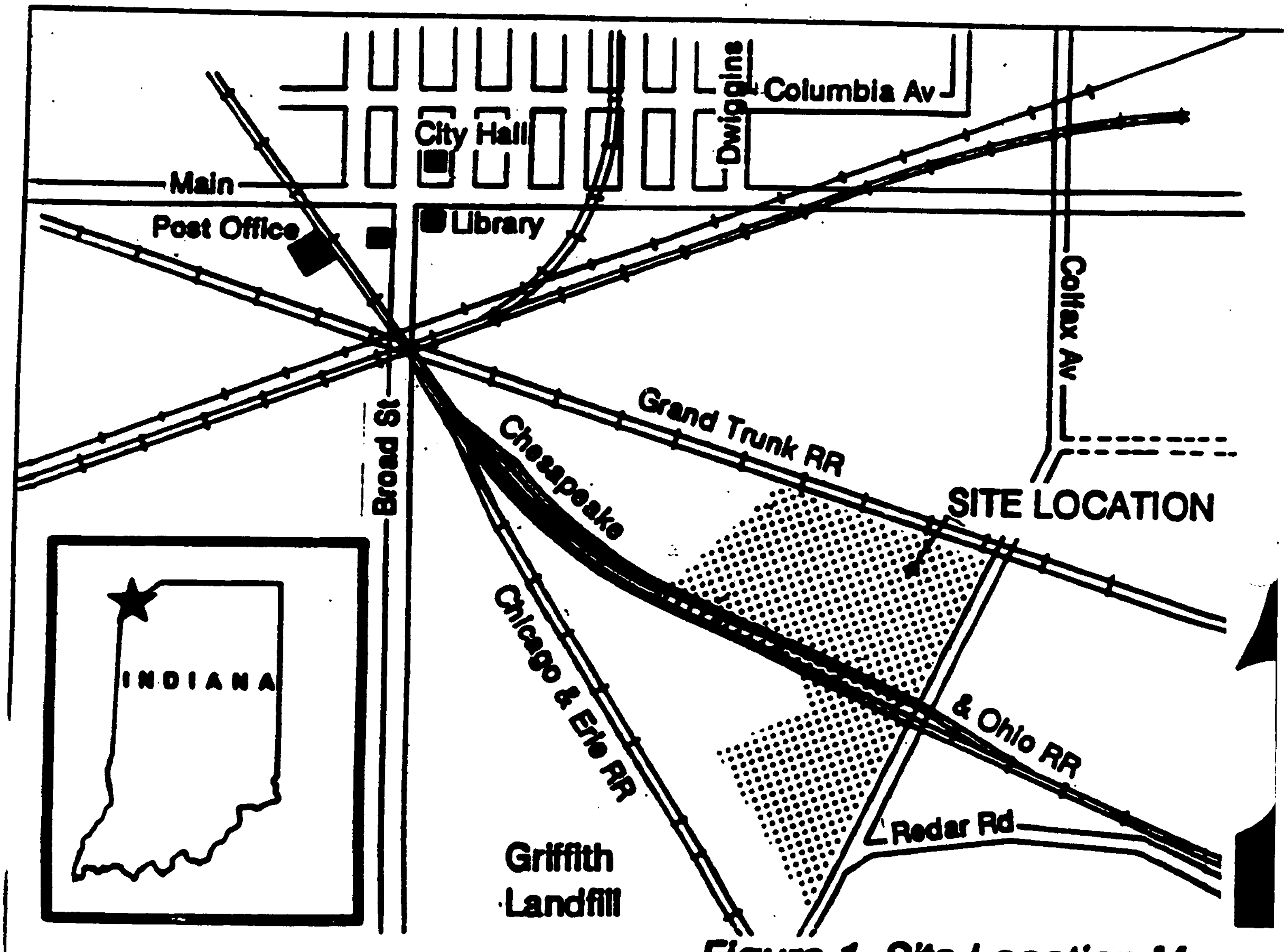


Figure 1, Site Location Map

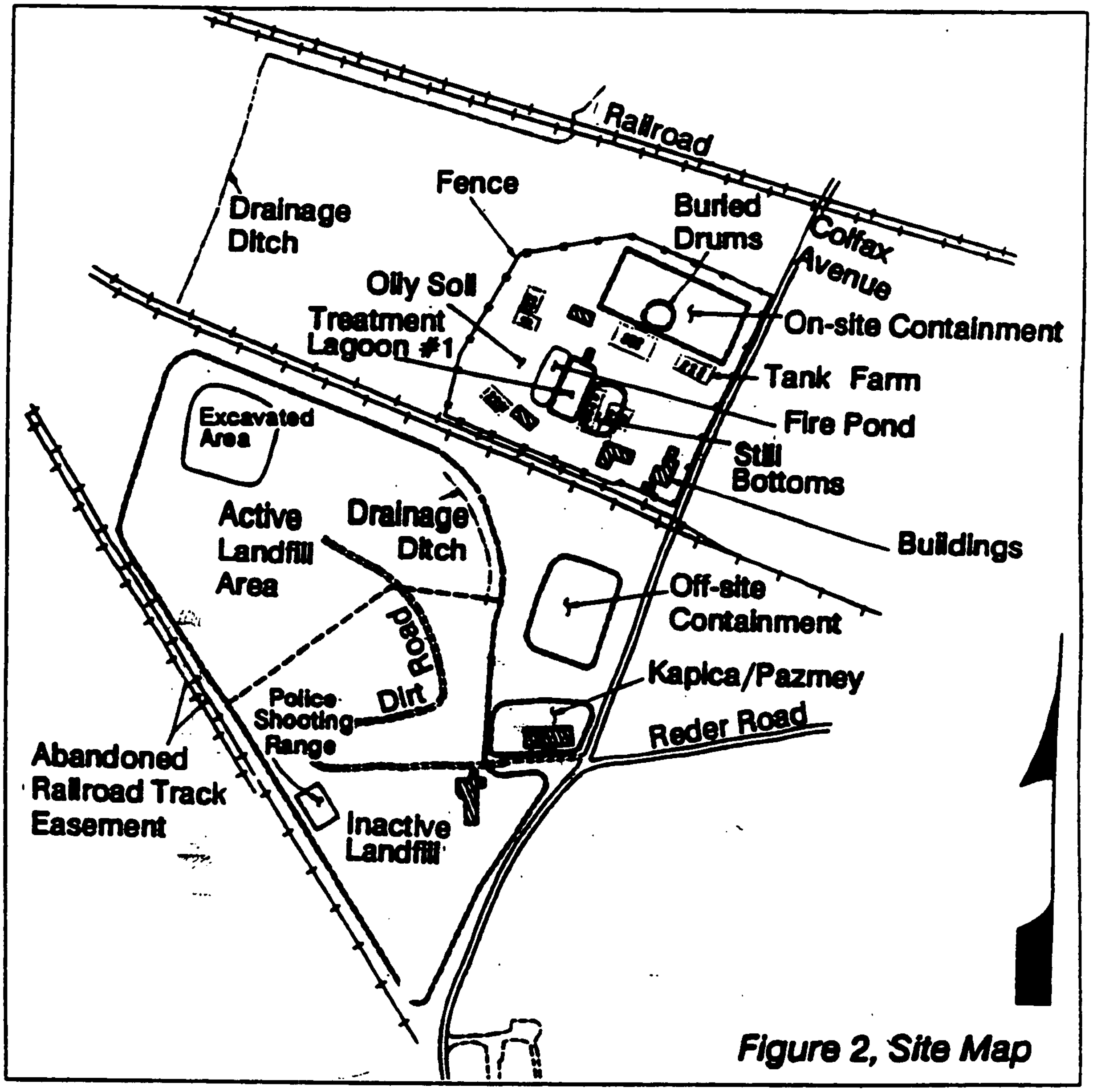


Figure 2, Site Map

and occupants of the residential development approximately 800 feet west of the site boundary. The nearest potential receptors to the north are occupants of the industrial park on Main Street (approximately 1500 feet north of the site boundary).

Ground water contamination has migrated off-site but has not infiltrated local residential wells used for drinking water. Approximately 70 private wells were identified in the immediate vicinity. 9 upper aquifer wells and 16 lower aquifer wells are located within 1/2 mile of the site. The well survey conducted during the remedial investigation found upper aquifer waters to be nonpotable and used by residents for lawn maintenance or other domestic purposes other than consumption. The upper aquifer residential wells were not sampled as part of the remedial investigation. Investigative monitoring wells were installed to evaluate upper aquifer contamination. Most of the 16 lower aquifer wells are used for drinking water. Samples were obtained from 10 lower aquifer private wells during the remedial investigation. With the exception of elevated lead levels found in an unused industrial supply well, no contaminants of concern were found in any lower aquifer water supply well.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

In the late 1960s and early 1970s, small batches of chemicals were manufactured at ACS. Specific chemicals manufactured included barium naphtherate, brominated vegetable oil, lacquers and paints, liquid soldering fluid, and polyethylene solutions in polybutene. These early manufacturing operations also included bromination, treating rope with a fungicide, and treating ski cable.

Two on-site incinerators burned still bottoms, non-reclaimable materials generated from the site, and off-site wastes. The first incinerator started operating in 1966, the second in 1969, and burned about two million gallons of industrial waste per year. The incinerators were dismantled in the 1970's. The shells were cut up and scrapped; the burners and blowers remain on-site.

Batch manufacturing was expanded between 1970 and 1975. Additives, lubricants, detergents and soldering flux were manufactured, and an epoxidation plant created a product called a plasticizer. Since 1975, the small batch manufacturing and epoxidation plant operations have remained essentially the same.

Kapica Drum, Inc., was sold to Pazmey Corp. in February 1980, which sold it to Darija Djurovic in March 1987. Kapica/Pazmey has not operated at this location since 1987. In 1980, a 31-acre parcel of property to the west of the Off-site Containment Area was sold to the City of Griffith for an expansion of the City's municipal landfill. The Griffith Municipal Landfill has been an active sanitary solid waste disposal facility since the 1950s. Solvent recovery operations at ACS continued until 1990 when ACS lost interim status under the Resource Conservation and Recovery Act (RCRA) regulations due to the failure of ACS to obtain required insurance policies. Semi-volatile organic compounds (SVOCs) such as phenol, isophorone, napthalene, fluorene, phenanthrene, anthracene, bis (2-chloroethyl) ether, and phthalates were used and discarded at the site throughout its history.

Several areas on the ACS property were used for disposal of hazardous substances. The disposal areas on the ACS Site, depicted in Figure 2, have been consolidated into three identified source areas: 1) the On-Site Containment Area; 2) the Still Bottoms Area, Treatment Lagoon #1 and adjacent areas; and 3) the Off-Site Containment Area and Kapica/Pazmey property. The Off-Site Containment Area is located on the ACS property and is part of the ACS Site. The area is described as off-site since it is separated from the ACS plant by a fence and railroad tracks. The Off-site Area includes the Off-site Containment Area and the Kapica/Pazmey property. The On-site Area includes the On-site Containment Area, the Still Bottoms Area, Treatment Lagoon #1, and adjacent areas (oily soil area designated in Fig. 2).

ACS was placed on the National Priorities List (NPL), a roster of the nation's worst hazardous waste sites targeted for cleanup under Superfund authority, in September 1984. Approximately 400 drums containing sludge and semi-solids of unknown types were reportedly disposed of in the On-site Containment Area. The Off-site Containment Area was utilized principally as a waste disposal area and received wastes that included on-site incinerator ash, general refuse, a tank truck containing solidified paint, and an estimated 20,000 to 30,000 drums that were reportedly punctured prior to disposal. Disposal practices in the Off-site Containment Area reportedly ceased in 1975. Hazardous substances were also disposed directly, and as a result of drum washing operations, on the Kapica/Pazmey property. The Still Bottoms Pond and Treatment Lagoon #1 received still bottoms from the solvent recovery process. The pond and lagoon were taken out of service in 1972, drained, and filled with an estimated 3200 drums containing sludge materials.

Approximately 400 special notice letters were sent out in March 1987 to initiate Remedial Investigation/Feasibility Study negotiations. A Consent Order to perform an RI/FS was signed by the PRP's in June 1988. Under this Consent Order, Warzyn, Inc., a consultant for the PRPs, performed the RI/FS. The RI began in 1989 and the RI/FS was completed in 1992. A portion of the RI, the ecological assessment, was prepared by USEPA due to the PRPs inadequate submittals. Additionally, the PRPs refused to develop clean-up standards so proposed human-health risk based cleanup standards were developed by USEPA to supplement the FS.

USEPA recently issued combination general notice/information request letters to a number of previously unnoticed PRPs. Special notice letters will be issued and negotiations will begin after completion of this Record of Decision.

III. COMMUNITY RELATIONS ACTIVITIES

USEPA has conducted community relations activities at the site since the start of the remedial investigation in 1989. The proposed plan was released to the public (by public notice in a local newspaper) on June 30, 1992, informing residents that the Feasibility Study Report, along with other documents comprising the Administrative Record for the site, were available at the public information repositories at the Griffith Town Hall and the Griffith Public Library. The Administrative Record Index is included as Appendix A. A public comment period was established for June 30, 1992, to July 29, 1992. After public request, the public comment period was extended until August 28, 1992. A public meeting was held at the Griffith Town Hall on July 9, 1992, to discuss the proposed remedial action with residents. Public comments and the USEPA responses are included as Appendix B.

IV. SCOPE AND ROLE OF RESPONSE ACTION

This ROD addresses buried drums, buried wastes, contaminated soil and debris, contaminated ground water and contaminated surface water. This contamination represents the principal threat from the ACS site. Buried wastes and contaminated soil and debris present a threat as a continuous contaminant source to ground water, a direct contact threat should future excavation occur, and a inhalation threat from migration of volatile contaminants through existing cover material and possible dispersion of contaminants to the neighboring community. Contaminated ground water presents a threat to potential users through ingestion, dermal contact, and inhalation.

It is the purpose of this remedy to restore contaminated property to an acceptable level that will allow unrestricted use of the property (within the context of local zoning laws). Cleanup levels included in the ROD would allow future residential use of the property. Ground water use restrictions may be necessary beyond site boundaries until the contaminant plume is verified to be contained at site boundaries. Future use of ground water directly under the site may also be restricted. The LTTT system and ISVE technology will have to undergo treatability testing to determine if they will be able to attain final cleanup levels.

This ROD requires vapor emission controls, if necessary, and ambient air monitoring with the selected treatment technology as well as possible vapor emission control associated with the excavation of VOC contaminated material.

Further evaluation of the onsite wetlands is also necessary. Additional sediment and surface water sampling will be accomplished during pre-design. Because no sampling of nearby upper aquifer private wells was accomplished during the RI, a plan will be developed to sample these wells to assess the need for well closures or use advisories.

V. SITE CHARACTERIZATION

The Remedial Investigation has shown that there are large areas of buried contamination with a wide range of contaminants. Because of the numerous contaminants detected, compounds were grouped together to more easily evaluate contaminant distribution. Total VOCs, PCBs, and lead were chosen as indicators of the extent of wastes and contaminated soils.

The major categories of wastes include: organic contaminants without polychlorinated biphenyls (PCBs) (approximately 90% of total buried contamination), organic contaminants with PCBs (approximately 7%), and various heavy metals (approximately 3%). These were found in the three identified source areas. The source areas are; the on-site containment area, the still bottoms/treatment lagoon and adjacent areas, and the off-site containment and Kapica/Pazmey area. Buried waste volumes for source areas were based on information collected during the RI.

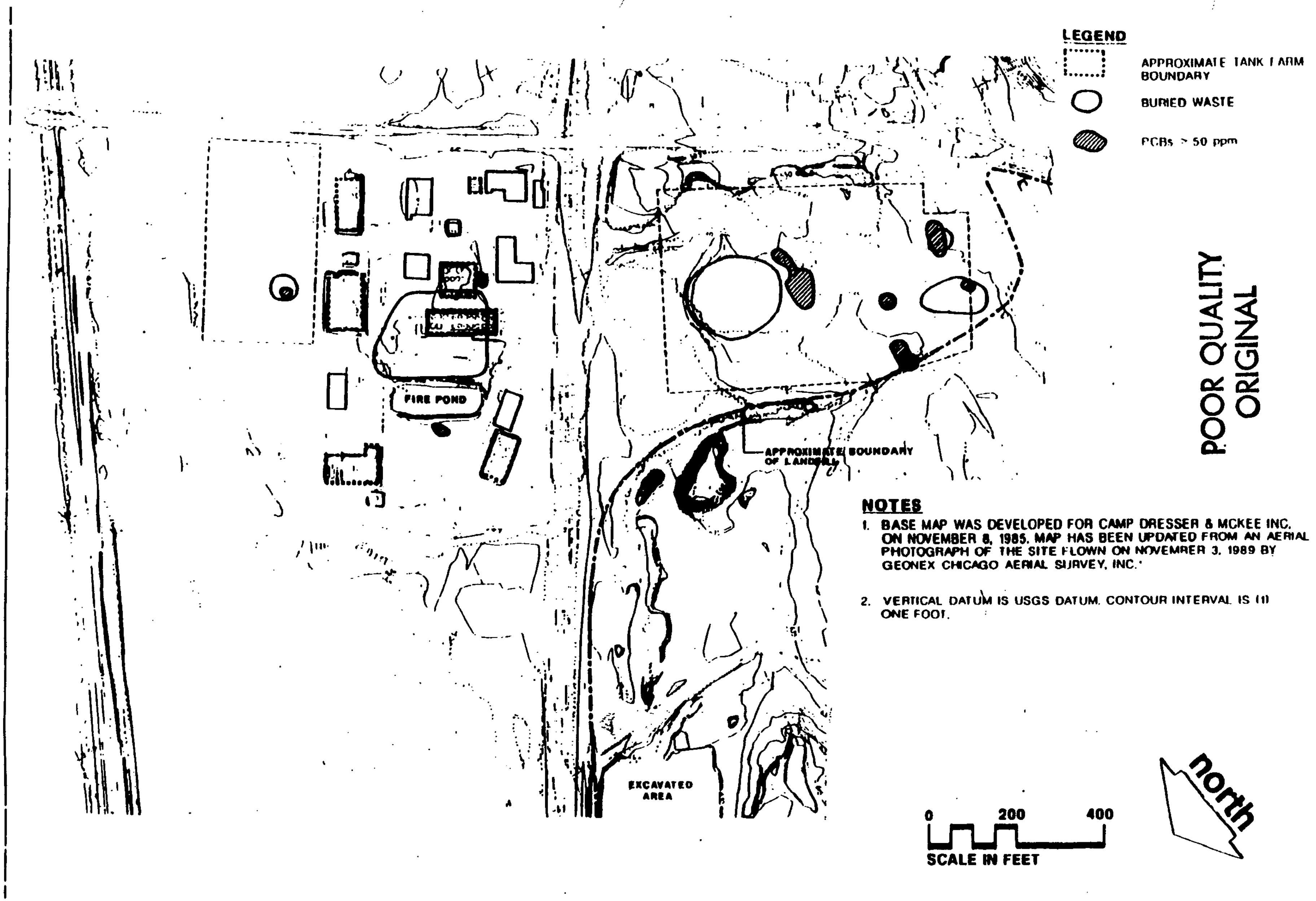
The RI selected 1 ppm total VOCs, 1 ppm PCBs, and 500 ppm lead to represent the extent of buried wastes/contaminated soils at the site. For the purpose of developing FS alternative cost estimates, buried wastes were defined as areas of contamination with total VOCs in excess of 10,000 ppm (Fig. 3). PCB-contaminated soils in excess of 50 ppm were also delineated. Contaminated soils were defined as areas of contamination with total VOCs in excess of 10 ppm (Fig. 4). Soils contaminated with heavy metals (lead greater than 500 ppm was used as an indicator parameter) were also found associated with buried waste areas. Other isolated pockets of metallic contamination (lead greater than 500 ppm) were also identified in the RI.

SOURCE AREAS

<u>On-site Area</u>

The On-site Containment Area contaminants consist predominately of organic contaminants without PCBs (15,000 cubic yards).

FIGURE 3


LEGEND
APPROXIMATE TANK FARM BOUNDARY
BURIED WASTE
PCBs > 50 ppm
FIRE POND
APPROXIMATE BOUNDARY OF LANDFILL
EXCAVATED AREA
POOR QUALITY ORIGINAL
NOTES
1. BASE MAP WAS DEVELOPED FOR CAMP DRESSER & MCKEE INC. ON NOVEMBER 8, 1985. MAP HAS BEEN UPDATED FROM AN AERIAL PHOTOGRAPH OF THE SITE FLOWN ON NOVEMBER 3, 1989 BY GEONEX CHICAGO AERIAL SURVEY, INC.
2. VERTICAL DATUM IS USGS DATUM. CONTOUR INTERVAL IS (1) ONE FOOT.
0
200
400
SCALE IN FEET
north

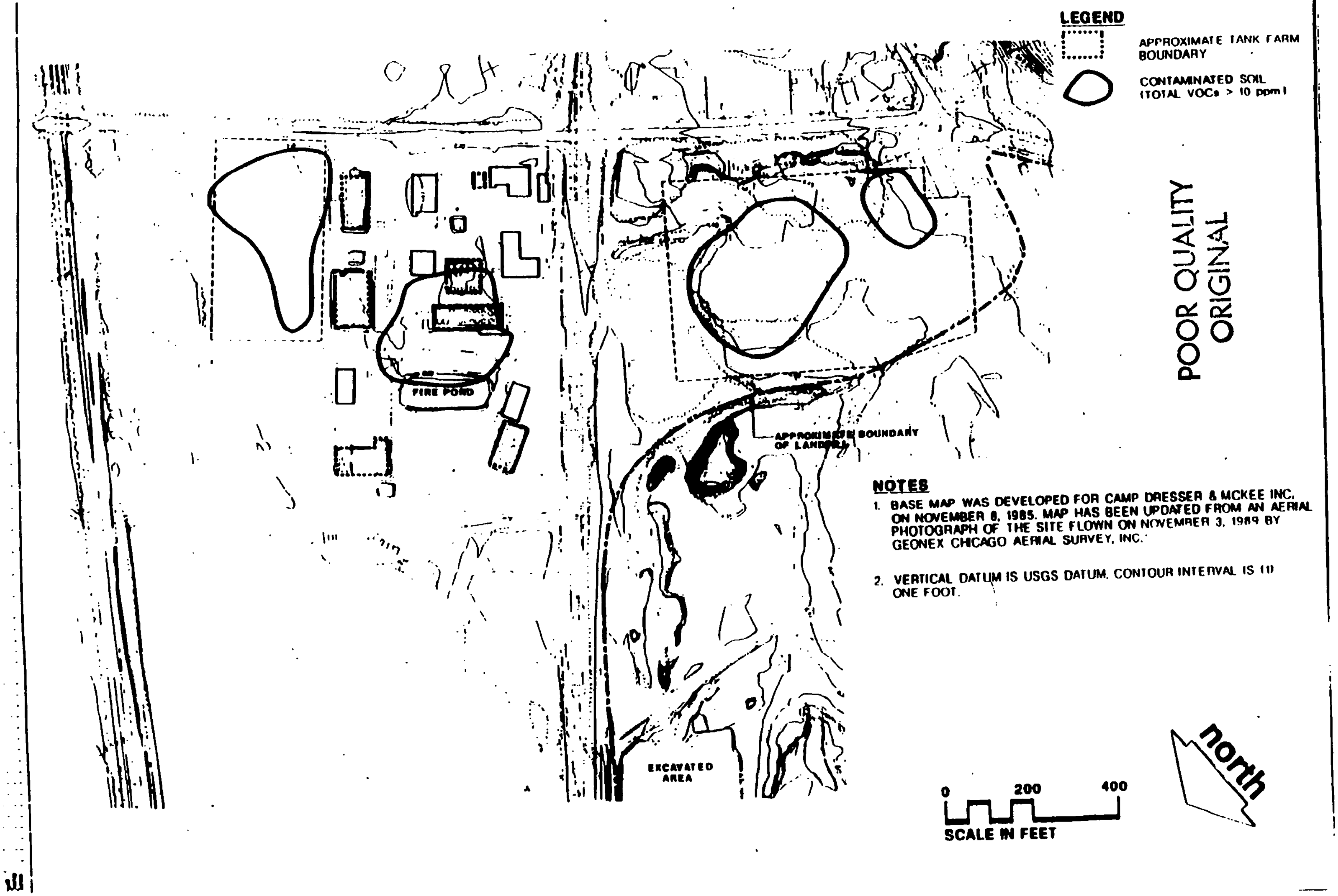

LEGEND
APPROXIMATE TANK FARM BOUNDARY
CONTAMINATED SOIL (TOTAL VOCs > 10 ppm)
FIRE POND
APPROXIMATE BOUNDARY OF LANDFILL
EXCAVATED AREA
NOTES
1. BASE MAP WAS DEVELOPED FOR CAMP DRESSER & MCKEE INC. ON NOVEMBER 8, 1985. MAP HAS BEEN UPDATED FROM AN AERIAL PHOTOGRAPH OF THE SITE FLOWN ON NOVEMBER 3, 1989 BY GEONEX CHICAGO AERIAL SURVEY, INC.
2. VERTICAL DATUM IS USGS DATUM. CONTOUR INTERVAL IS (1) ONE FOOT.
0 200 400
SCALE IN FEET
north
POOR QUALITY ORIGINAL

FIGURE 4

Additional contaminants consist of a 50'x 50' buried drum area (estimated to contain 400 intact drums), and localized areas of organic contaminants with PCBs (980 cubic yards) and soils contaminated with metals (100 cubic yards). Contamination in the On-site Containment Area is summarized below:

	DETECTED RANGE (ug/kg)
BETX	11 - 3,002,000
Chlorinated Benzenes	2 - 10,790
Chlorinated Ethenes	2 - 1,110,000
Chlorinated Ethanes	1 - 11,000
Ketones	4 - 7,400
Phthalates	39 - 15,086
PAHs	50 - 121,338
Phenols	93 - 2,270
PCBs	130 - 26,000
Lead	2900 - 1,440,000

The Still Bottoms/Treatment Lagoon and adjacent area contaminants consist predominantly of organic contaminants without PCBs (22,000 cubic yards) and randomly distributed buried drums (estimated to contain 3200 partially filled drums). Organic contaminants with PCBs were not detected in the treatment lagoon area, but were detected in the still bottoms area (1000 cubic yards). Metals were detected in both the still bottoms and treatment lagoon areas (550 cubic yards). In an adjacent area, west of the existing fire pond, (designated as "oily soils" in Fig. 2) both organic contaminants without PCBs (3400 cubic yards) and organic contaminants with PCBs (300 cubic yards) were detected. Contamination in the still bottoms/treatment lagoon and adjacent areas is summarized below.

	DETECTED RANGE (ug/kg)
BETX	66 - 34,670,000
Chlorinated Benzenes	45 - 62,500
Chlorinated Ethenes	31 - 2,000,000
Chlorinated Ethanes	8 - 21,000,000
Ketones	55 - 4,100,000
Phthalates	456 - 4,694,000
PAHs	351 - 1,057,900
Phenols	429 - 19,400
PCBs	330 - 158,000
Lead	21900 - 6,300,000

<u>Off-site Area</u>

The Off-site Containment Area contaminants consist predominantly of organic contaminants without PCBs (51,000 cubic yards).

However, organic contaminants with PCBs (5250 cubic yards) and metals (950 cubic yards) were detected primarily in one area in the northern portion, as well as at a number of small areas in the southern portion. General refuse, an estimated 20,000 to 30,000 drums, and a tank truck partially full of solidified paint were reportedly disposed of in this area. Contamination in the Off-site Containment Area is summarized below.

	DETECTED RANGE (ug/kg)
BETX	17 - 254,000,000
Chlorinated Benzenes	3 - 1,000,000
Chlorinated Ethenes	44 - 65,000,000
Chlorinated Ethanes	8 - 151,000,000
Ketones	52 - 197,000,000
Phthalates	54 - 19,136,000
PAHs	273 - 3,487,700
Phenols	180 - 1,054,000
PCBs	96 - 1,400,000
Lead	2300 - 17,200,000

The Kapica/Pazmey area contaminants consist of organic contaminants without PCBs (7200 cubic yards) and organic contaminants with PCBs (2300 cubic yards) in an area north of the Kapica building. Metal contamination is found in the west (700 cubic yards) and north (200 cubic yards) of the Kapica building. Contamination in the Kapica/Pazmey area is summarized below.

	DETECTED RANGE (ug/kg)
BETX	1 - 46,300,000
Chlorinated Benzenes	18 - 27,000
Chlorinated Ethenes	2 - 960,000
Chlorinated Ethanes	5 - 1,350
Ketones	2 - 367,000
Phthalates	177 - 698,100
PAHs	54 - 157,300
Phenols	280 - 34,300
PCBs	4200 - 329,000
Lead	5000 - 16,200,000

A detailed breakdown of all contaminants detected (including tentatively identified compounds) and the frequency of detection of each individual contaminant in buried waste/soil can be found in Tables 7-4 through 7-10 of the Baseline Risk Assessment (BlRA).

Ground water

Organic contaminants without PCBs, including chlorinated ethanes, partially water soluble products from gasoline, oil and/or other hydrocarbon products (e.g. benzene, toluene, xylene) were found in the upper aquifer (Table 1). Lower aquifer contamination relative to the upper aquifer is limited, both with respect to the nature of compounds detected and the extent (Table 2). Contaminants were not found to extend off-site to lower aquifer wells. No organic contaminants were detected at any lower aquifer private residential well. Upper aquifer private residential wells were not sampled during the RI.

VI. SUMMARY OF SITE RISKS

A BlRA was developed for the American Chemical Services site by respondents to the Administrative Order on Consent in accordance with USEPA's 1989 Risk Assessment Guidance for Superfund (RAGS). The purpose of a BlRA is to analyze the potential adverse health effects, both current and future, posed by hazardous substance releases from a site if no action were taken to mitigate such a release. The BlRA consists of an identification of chemicals of potential concern, toxicity assessment, exposure assessment, and risk characterization.

Identification of chemicals of potential concern

Ground water, surface water, sediment, and soil data were evaluated and contaminants of concern were selected based on carcinogenicity, detection frequency, comparison with background concentrations, toxicity, physicochemical properties, concentration, and grouping chemicals based on similar chemical structures. Based on this analysis, the chemicals outlined in Table 3 were selected as contaminants of potential concern at the ACS site. The following site contaminants were found to exceed 10-6 excess cancer risk or a hazard quotient of 1:

UPPER AQUIFER GROUND WATER

Volatiles
Chloromethane
Vinyl Chloride
Methylene Chloride
Acetone
1,1-Dichloroethane
1,1-Dichloroethene (cis)
2-Butanone
Trichloroethene

Semivolatiles
*bis(2-Chloroethyl)ether
1,4-Dichlorobenzene
4-Methylphenol
Isophorone
Pentachlorophenol
bis(2-Ethylhexyl)phthalate

Pesticides/PCBs

Table 1

ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Upper Aquifer

CHEMICAL	UNITS	CHEMICAL CONCENTRATION MINIMUM	CHEMICAL CONCENTRATION MAXIMUM	CHEMICAL CONCENTRATION ARITHMETIC MEAN	NUMBER SAMPLES ANALYZED TOTAL	NUMBER SAMPLES ANALYZED DETECTED
Volatiles					24	
Chloromethane	ug/l	68.000	68.000	68.00		1
Vinyl Chloride	ug/l	22.000	720.000	374.00		3
Chloroethane	ug/l	3.000	2000.000	442.71		17
Methylene Chloride	ug/l	1.000	7.000	4.00		2
Acetone	ug/l	84000.000	99000.000	91500.00		2
1,1-Dichloroethane	ug/l	6.000	2400.000	981.25		4
Total 1,2-Dichloroethene	ug/l	1.000	400.000	180.67		6
2-Butanone	ug/l	150000.000	220000.000	185000.00		2
Trichloroethene	ug/l	34.000	45.000	39.50		2
Benzene	ug/l	1.000	100000.000	7265.20		15
4-Methyl-2-Pentanone	ug/l	45000.000	54000.000	49500.00		2
2-Hexanone	ug/l	1200.000	1800.000	1500.00		2
Tetrachloroethene	ug/l	160.000	200.000	180.00		2
Toluene	ug/l	21.000	2300.000	725.25		4
Chlorobenzene	ug/l	2.000	96.000	33.60		5
Ethylbenzene	ug/l	52.000	1100.000	476.00		7
Total Xylenes	ug/l	47.000	3000.000	659.57		7
Semi-Volatiles					24	
Phenol	ug/l	3.000	240.000	34.20		10
bis(2-Chloroethyl)ether	ug/l	4.000	250.000	65.67		9
1,3-Dichlorobenzene	ug/l	3.000	3.000	3.00		1
1,4-Dichlorobenzene	ug/l	3.000	10.000	5.50		4
1,2-Dichlorobenzene	ug/l	4.000	33.000	18.50		6
2-Methylphenol	ug/l	2.000	38.000	14.50		4
bis(2-Chloroisopropyl)ether	ug/l	59.000	300.000	143.20		5
4-Methylphenol	ug/l	5.000	2200.000	468.00		5
Isophorone	ug/l	19.000	35.000	26.33		3
2,4-Dimethylphenol	ug/l	6.000	110.000	41.33		3
Benzoic acid	ug/l	2.000	1900.000	323.00		6
Naphthalene	ug/l	2.000	71.000	32.50		6
4-Chloro-3-methylphenol	ug/l	2.000	2.000	2.00		1
2-Methylnaphthalene	ug/l	9.000	27.000	17.00		3
Diethylphthalate	ug/l	3.000	9.000	6.00		2
Pentachlorophenol	ug/l	2.000	3.000	2.50		2
Di-n-butylphthalate	ug/l	2.000	2.000	2.00		1
bis(2-Ethylhexyl)phthalate	ug/l	2.000	50.000	16.33		6
Pesticides/PCBs					24	
AROCLOR-1248	ug/l	2.600	2.600	2.60		1
AROCLOR-1260	ug/l	27.000	27.000	27.00		1

Table 1
ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Upper Aquifer

CHEMICAL	UNITS	CHEMICAL CONCENTRATION MINIMUM	MAXIMUM	ARITHMETIC MEAN	NUMBER SAMPLES ANALYZED TOTAL	DETECTED
Metals					24	
Aluminum	ug/l	250.000	280.000	265.00		2
Arsenic	ug/l	2.100	43.200	13.59		17
Barium	ug/l	230.000	1840.000	608.75		16
Beryllium	ug/l	0.250	0.250	0.25		1
Cadmium	ug/l	0.240	3.100	0.98		4
Calcium	ug/l	32100.000	1040000.000	176233.33		24
Chromium, Total	ug/l	1.100	3.900	2.43		4
Iron	ug/l	170.000	218000.000	25052.77		22
Lead	ug/l	3.200	4.600	3.90		2
Magnesium	ug/l	7270.000	78800.000	33820.56		18
Manganese	ug/l	281.000	4250.000	2099.00		23
Mercury	ug/l	1.700	1.700	1.70		1
Nickel	ug/l	48.000	53.000	49.67		3
Potassium	ug/l	1480.000	95800.000	13938.75		24
Selenium	ug/l	2.100	6.200	3.47		3
Sodium	ug/l	12700.000	444000.000	145423.81		21
Thallium	ug/l	3.100	4.000	3.55		2
Vanadium	ug/l	2.200	25.900	8.25		8
Zinc	ug/l	10.000	886.000	113.15		20
Cyanide, Total	ug/l	10.000	10.000	10.00		1
Tent. Ident. Compound-SVOC					24	
Unknown	ug/l	6.000	2600.000	249.79		86
Unknown Hydrocarbon	ug/l	36.000	1100.000	418.67		3
Ethylmethylbenzene isomer	ug/l	24.000	130.000	64.00		4
Trimethylbenzene isomer	ug/l	50.000	300.000	172.50		4
Ethyldimethylbenzene isomer	ug/l	32.000	160.000	96.00		2
Undecane, 4,7-dimethyl-	ug/l	120.000	120.000	120.00		1
Benzene, 1,1'-oxybis-	ug/l	24.000	24.000	24.00		1
Benzene, propyl-	ug/l	22.000	22.000	22.00		1
Benzene, 1-ethyl-2-methyl-	ug/l	42.000	88.000	65.00		2
Benzene, 2-ethyl-1,4-dimethyl-	ug/l	6.000	400.000	151.00		4
Unknown Substituted Benzene	ug/l	22.000	110.000	51.00		8
Unknown carboxylic acid	ug/l	22.000	22.000	22.00		1
Tetramethylbenzene isomer	ug/l	120.000	130.000	125.00		2
Benzene, 1,3,5-trimethyl-	ug/l	82.000	280.000	181.00		2
Cyclohexanol, 3,3,5-trimethyl-	ug/l	26.000	2000.000	728.57		7
Hexanoic acid, 2-ethyl-	ug/l	360.000	360.000	360.00		1
Benzene, 1-ethenyl-3-ethyl-	ug/l	18.000	18.000	18.00		1
Hexanoic acid (DOT)	ug/l	740.000	740.000	740.00		1
Dimethylphenol	ug/l	54.000	200.000	127.00		2
Cyclopentanol, 2-methyl-CI...	ug/l	52.000	52.000	52.00		1
Benzene, 1-ethyl-4-methoxy-	ug/l	90.000	90.000	90.00		1
Furan, 2,2'-methylenebis-	ug/l	150.000	150.000	150.00		1
Benzenamine, n,n-diethyl-	ug/l	32.000	32.000	32.00		1

Table 1
ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Upper Aquifer

		CHEMICAL CONCENTRATION			NUMBER SAMPLES ANALYZED	
CHEMICAL	UNITS	MINIMUM	MAXIMUM	ARITHMETIC MEAN	TOTAL	DETECTED
Furan, 2,2'-[oxybis(methylene)]bis,-	ug/l	32.000	54.000	42.67		3
Hexanoic acid, anhydride	ug/l	60.000	60.000	60.00		1
1,4-Methanonaphthalene, 1,4-...	ug/l	160.000	160.000	160.00		1
2-Propanol, 1-[2-(2-methoxy-1-methylethoxy)-1-2-propanol	ug/l	110.000	110.000	110.00		1
Hexanoic acid, 2-methyl-	ug/l	720.000	720.000	720.00		1
2,4-Pentanediol, 2-methyl-	ug/l	72.000	1800.000	936.00		2
2-Propanol, 2-(2-methoxy-1-m...	ug/l	90.000	90.000	90.00		1
Benzeneacetic acid, .alpha.-ethyl-	ug/l	58.000	58.000	58.00		1
Pentanoic acid, 4-methyl-	ug/l	1100.000	1100.000	1100.00		1
Disulfide, diethyl-	ug/l	140.000	720.000	430.00		2
3-Octanone	ug/l	86.000	86.000	86.00		1
Benzene, 1-chloro-3-methyl-	ug/l	120.000	120.000	120.00		1
Cyclohexanemethanol, .alpha.-.alpha.-4-trimethyl-	ug/l	220.000	220.000	220.00		1
Unknown substituted phenol	ug/l	28.000	28.000	28.00		1
Phenol, 3-ethyl-5-methyl-	ug/l	50.000	50.000	50.00		1
Benzoic acid, 3-methyl-	ug/l	38.000	38.000	38.00		1
Ethane, 1,2-bis(2-chloroethoxy)-	ug/l	50.000	78.000	64.00		2
Benzene, ethyl-	ug/l	16.000	16.000	16.00		1
Benzene, 1,3-dimethyl-	ug/l	440.000	440.000	440.00		1
Benzene, 1,2-dimethyl-4-(phenylmethyl)-	ug/l	24.000	24.000	24.00		1
Benzene, (1,1-dimethylpropyl...	ug/l	32.000	32.000	32.00		1
Naphthalene, 1,2,3,4-tetrah...	ug/l	52.000	52.000	52.00		1
1(2H)-Naphthalenone, 3,4-dih...	ug/l	12.000	12.000	12.00		1
2-Cyclohepten-1-one	ug/l	92.000	92.000	92.00		1
Benzene, 1-methyl-4-(methyls...	ug/l	14.000	14.000	14.00		1
Glycine, n-(2-methyl-1-oxo-2...	ug/l	12.000	12.000	12.00		1
Phenol, 3,5-dimethyl-	ug/l	12.000	12.000	12.00		1
1,3-Pentanediol, 2,2,4-trimethyl-	ug/l	40.000	40.000	40.00		1
2,4,6(1H,3H,5H)-Pyrimidinetrione-5-(1-methyl)-	ug/l	10.000	130.000	70.00		2
2-Methylcyclopentanol isomer	ug/l	2000.000	2000.000	2000.00		1
Trimethylphenol isomer	ug/l	62.000	62.000	62.00		1
Methylbenzoic acid isomer	ug/l	44.000	420.000	232.00		2
2-Propanol, 1-(2-methoxy-1-methylethoxy)-2-propanol	ug/l	140.000	2200.000	1170.00		2
Propanoic acid, 2-(3-chlorophenoxy)-propanoic acid	ug/l	98.000	98.000	98.00		1
Unknown substituted sulfonyl	ug/l	44.000	44.000	44.00		1
Trimethyl benzoic acid	ug/l	12.000	12.000	12.00		1
Caprolactam	ug/l	10.000	10.000	10.00		1
Octane, 2,3-dimethyl-	ug/l	320.000	720.000	520.00		2
Decane, 2,6,7-trimethyl-	ug/l	320.000	380.000	350.00		2
Nonane, 3,7-dimethyl-	ug/l	180.000	180.000	180.00		1

Table 1

ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Upper Aquifer

CHEMICAL	UNITS	CHEMICAL CONCENTRATION MINIMUM	MAXIMUM	ARITHMETIC MEAN	NUMBER SAMPLES ANALYZED TOTAL	DETECTED
Dimethyl undecane	ug/l	170.000	170.000	170.00		1
Methylethylphenol	ug/l	54.000	88.000	71.00		2
Unknown diol	ug/l	82.000	82.000	82.00		1
Chloromethylbenzene	ug/l	68.000	68.000	68.00		1
Disilane, hexaethyl-	ug/l	46.000	46.000	46.00		1
Unknown alcohol	ug/l	24.000	24.000	24.00		1
Methylpropenylbenzene	ug/l	6.000	6.000	6.00		1
Tetrahydronaphthalene	ug/l	66.000	66.000	66.00		1
2-Cyclohexen-1-one, 3,5,5-trimethyl-	ug/l	32.000	32.000	32.00		1
Benzoic acid, 2,4-dimethyl-	ug/l	24.000	24.000	24.00		1
Benzoic acid, 2,4,6-trimethyl-	ug/l	36.000	36.000	36.00		1
Benzoic acid, 4-(1,1-dimethylethyl)-	ug/l	34.000	34.000	34.00		1
Phenobarbital (VAN)	ug/l	8.000	22.000	15.00		2
Ethyltrimethylbenzene + unknown	ug/l	54.000	54.000	54.00		1
Methylnaphthalene	ug/l	74.000	74.000	74.00		1
Dimethylnaphthalene	ug/l	38.000	38.000	38.00		1
Tent. Ident. Compound-VOC					24	
Unknown	ug/l	29.000	140.000	73.50		8
Benzene, 1-ethyl-2-methyl-	ug/l	70.000	70.000	70.00		1
Benzene, propyl-	ug/l	60.000	60.000	60.00		1
Benzene, (1-methylethyl)-	ug/l	60.000	60.000	60.00		1
Cyclohexane, methyl-	ug/l	40.000	40.000	40.00		1
Ethylmethylbenzene isomer	ug/l	35.000	100.000	59.60		5
Trimethylbenzene isomer	ug/l	130.000	640.000	437.50		4
Benzene, 1,3,5-trimethyl-	ug/l	170.000	170.000	170.00		1
Unknown alcohol	ug/l	700.000	1100.000	900.00		2
Ethane, 1,1'oxybis-	ug/l	4.000	1500.000	264.29		7
2-Propanol, 2-methyl-	ug/l	8.000	8.000	8.00		1
Unknown oxygenated alkane	ug/l	450.000	450.000	450.00		1
Dimethylcyclohexane	ug/l	76.000	76.000	76.00		1
Ethenylcyclohexene	ug/l	63.000	63.000	63.00		1
Diethylbenzene	ug/l	78.000	78.000	78.00		1
Butanol	ug/l	40.000	40.000	40.00		1
Propane, 1,1'-oxybis-	ug/l	6.000	6.000	6.00		1
Methylpentanol	ug/l	15.000	15.000	15.00		1
Methylhexanone	ug/l	7.000	7.000	7.00		1
Cyclohexane, 1,3-dimethyl-, trans-	ug/l	45.000	45.000	45.00		1
Disopropyl ether (DOT)	ug/l	8.100	8.100	8.10		1

This table includes all compounds identified above detection limits in the Upper Aquifer Source Area (see table 7-1 for samples included in this area), and is provided as the starting point in the development of a Set of Chemical Data for use in the Risk Assessment, as discussed in Section 7.1.2.1. Refer to appropriate appendices to determine the total parameters analyzed and their associated detection limits. Refer to appendix U for values used in risk calulations. The data values presented contain a maximum of three significant digits for the results of metals analyses and two significant digits for organic chemical analyses: additional digits are due to limitations in the computer program used to prepare these tables, and do not infer an increase in accuracy. The number of tentatively identified compounds designated as unknowns may exceed the total number of samples analyzed because more than one unknown compound may be presènt in a given sample.

[ACS]UGW.MAX

Table 2
ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Lower Aquifer

CHEMICAL	UNITS	CHEMICAL CONCENTRATION MINIMUM	MAXIMUM	ARITHMETIC MEAN	NUMBER SAMPLES ANALYZED TOTAL	DETECTED
Volatiles					9	
Chloroethane	ug/l	3.000	440.000	214.33		3
4-Methyl-2-Pentanone	ug/l	3.000	3.000	3.00		1
Semi-Volatiles					9	
bis(2-Chloroethyl)ether	ug/l	11.000	12.000	11.50		2
Metals					9	
Arsenic	ug/l	2.100	8.600	4.06		5
Barium	ug/l	220.000	310.000	255.00		4
Calcium	ug/l	59000.000	151000.000	113266.67		6
Iron	ug/l	152.000	3160.000	1043.33		6
Magnesium	ug/l	19300.000	53100.000	35766.67		6
Manganese	ug/l	123.000	866.000	337.33		6
Mercury	ug/l	0.470	0.470	0.47		1
Potassium	ug/l	960.000	3420.000	1923.33		6
Sodium	ug/l	10000.000	96200.000	40700.00		6
Vanadium	ug/l	2.000	2.000	2.00		1
Zinc	ug/l	10.000	22.000	16.00		2
Tent. Ident. Compound-SVOC					9	
Unknown	ug/l	10.000	3300.000	340.59		17
Cyclohexanol, 3,3,5-trimethyl-	ug/l	2500.000	2500.000	2500.00		1
2-Propanol, 1-[2-(2-methoxy-1-methylethoxy)-1-2 -propanol	ug/l	1000.000	1000.000	1000.00		1
2,4-Pentanediol, 2-methyl-	ug/l	270.000	270.000	270.00		1
2-Propanol, 1-(2-methoxy-1-methylethoxy)-2-prop anol	ug/l	530.000	530.000	530.00		1
Dimethylbenzoic acid	ug/l	400.000	400.000	400.00		1
Dimethylethylbenzoic acid	ug/l	400.000	400.000	400.00		1
Propanoic acid, 2-(3-chlorophenoxy)-propanoic acid	ug/l	170.000	170.000	170.00		1
Tent. Ident. Compound-VOC					9	
Unknown	ug/l	1200.000	1200.000	1200.00		1
Methane, dimethoxy-	ug/l	6.000	6.000	6.00		1

Table 2

ORGANIC AND INORGANIC CHEMICAL CONCENTRATIONS
AMERICAN CHEMICAL SERVICES RI/FS
GRIFFITH, INDIANA

MATRIX: Ground Water
SOURCE AREA: Lower Aquifer

		CHEMICAL CONCENTRATION			NUMBER SAMPLES ANALYZED	
CHEMICAL	UNITS	MINIMUM	MAXIMUM	ARITHMETIC MEAN	TOTAL	DETECTED
Ethane, 1,1'oxybis-	ug/l	36.000	36.000	36.00		1
Propane, 2,2'-oxybis-	ug/l	10.000	10.000	10.00		1
Substituted methylborane	ug/l	11.000	11.000	11.00		1

This table includes all compounds identified above detection limits in the lower Aquifer Source Area (see table 7-1 for samples included in this area), and is provided as the starting point in the development of a Set of Chemical Data for use in the Risk Assessment, as discussed in Section 7.1.2.1. Refer to appropriate appendices to determine the total parameters analyzed and their associated detection limits. Refer to appendix U for values used in risk calulations. The data values presented contain a maximum of three significant digits for the results of metals analyses and two significant digits for organic chemical analyses: additional digits are due to limitations in the computer program used to prepare these tables, and do not infer an increase in accuracy. The number of tentatively identified compounds designated as unknowns may exceed the total number of samples analyzed because more than one unknown compound may be present in a given sample.

Benzene
4-Methyl-2-pentanone
Tetrachloroethene
Ethylbenzene

Inorganics
*Arsenic
Beryllium
Manganese
Thallium

*Also lower aquifer contaminant

total PCBs

TIC Groups
Cyclic Ketones
Dimethyl Ethyl Benzenes
Branched Alkanes
Non-Cyclic Acids

SOILS

Volatiles
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
1,1-Dichloroethene
1,2-Dichloroethene (cis)
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
1,2-Dichloropropane
1,1,2-Trichloroethane
Benzene
4-Methyl-2-Pentanone
Tetracholorethene
1,1,2,2-Tetrachloroethane
Toluene
Chlorobenzene
Ethylbenzene
Styrene
Xylenes (mixed)

Inorganics
Antimony
Barium
Cadmium
Chromium (VI)

Semivolatiles
Hexachlorobutadiene
2,6-Dinitrotoluene
2,4-Dinitrotoluene
N-Nitrosodiphenylamine
Hexachlorobenzene
Pentachlorophenol
Di-n-Butylphthalate
bis(2-Ethylhexyl)phthalate
total CPAHs
bis(2-Cholorethyl)ether
1,4-Dichlorobenzene
Isophorone
1,2,4-Trichlorophenol
Naphthalene

Pesticides/PCBs
Alpha-BHC
Beta-BHC
Gamma-BHC (Lindane)
Aldrin
Heptachlor epoxide
Endosulfan I
4,4'-DDE
4,4'-DDD
4,4'-DDT
total PCBs

TIC Groups
Non-Cyclic Acids
Cyclic Ketones
Methyl Propyl Benzenes
Dimethyl Ethyl Benzenes
Nitrogenated Benzenes
Propenyl Benzenes
Ethyl Methyl Benzenes

Diethyl Benzenes
Oxygenated Benzenes
Methylated Naphthalenes
Halogenated Alkanes
n-Chain Alkanes
Branched Alkanes
PCB

Toxicity Assessment

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects, including carcinogenic and noncarcinogenic effects.

Sixty-four of the one hundred and forty-eight positively identified (nonTIC) contaminants of concern are known, probable or possible human carcinogens. 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 (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 the intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. CPFs are derived from results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied. The weight of evidence classification and CPF for the contaminants of concern is shown in Tables 3 and 4.

Eighty-four of the one hundred and forty-eight positively identified contaminants of concern have noncarcinogenic toxic effects. USEPA has developed chronic reference doses (RfDs) to indicate 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. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse health effects to occur. RFDs for noncarcinogenic effects for the contaminants of concern are shown in Tables 3 and 4.

Table 3

SUMMARY OF TOXICITY INFORMATION FOR CHEMICALS OF POTENTIAL CONCERN

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical of Potential Concern	Chronic Reference Dose: Inhalation: Species/Effect of Concern	Chronic Reference Dose: Inhalation: Uncertainty Factor (1)	Chronic Reference Dose: Oral: Species/Effect of Concern	Chronic Reference Dose: Oral: Uncertainty Factor (1)	Slope Factor: Inhalation: Species/Tumor Site	Slope Factor: Inhalation: Weight of Evidence	Slope Factor: Oral: Species/Tumor Site	Slope Factor: Oral: Weight of Evidence (2)
TARGET COMPOUND LIST								
VOLATILES								
Chloromethane	--/--	--	--	--	mouse/kidney	C	mouse/kidney	C
Bromomethane	rabbit/neurotoxicity	3000	rat/hyperplasia of forestomach epithelium	1000	--/--	--	--	--
Vinyl chloride	--/--	--	--	--	rat/liver	A	rat/lung	A
Chloroethane	--/--	--	--	--	mouse/kidney	C	mouse/kidney	C
Methylene chloride	rat/--	100	rat/liver toxicity	100	mouse/lung, liver	B2	mouse/liver	B2
Acetone	--/--	--	rat/increased liver & kidney weight, nephro-toxicity	1000	--/--	--	--	--
Carbon disulfide	--	--	rabbit/fetal toxicity	100	--/--	--	--	--
1,1-Dichloroethene	--/--	--	rat/liver lesions	1000	mouse/kidney	C	rat/adrenal	C
1,1-Dichloroethane	cat/kidney damage	1000	rat/none	1000	--/--	C	rat/hemangiosarcoma	C

(continued)

Chemical of Potential Concern	Chronic Reference Dose: Inhalation: Species/Effect of Concern	Chronic Reference Dose: Inhalation: Uncertainty Factor (1)	Chronic Reference Dose: Oral: Species/Effect of Concern	Chronic Reference Dose: Oral: Uncertainty Factor (1)	Slope Factor: Inhalation: Species/Tumor Site	Slope Factor: Inhalation: Weight of Evidence	Slope Factor: Oral: Species/Tumor Site	Slope Factor: Oral: Weight of Evidence (
1,2-Dichloroethene (cis)	--/--	--	rat/decreased hemoglobin & hematocrit	3000	--/--	--	--/--	--
1,2-Dichloroethene (trans)	--/--	--	mouse/increased serum alkaline phophatase	100	--/--	--	--/--	--
Chloroform	--/--	--	dog/liver lesions	1000	mouse/liver	B2	rat/kidney	B2
1,2-Dichloroethane	--/--	--	--/--	--	rat/circulatory system	B2	rat/circulatory system	B2
2-Butanone (methyl ethyl ketone)	rat/CNS	1000	rat/fetotoxicity	1000	--/--	--	--/--	D
1,1,1-Trichloroethane	guinea pig/ hepatotoxicity	1000	guinea pig/ hepatotoxicity	1000	--/--	--	--/--	--
Carbon Tetrachloride	--/--	--	rat/liver lesions	100	several/liver	B2	several/liver	B2
Vinyl acetate	--/--	--	--/--	--	--/--	--	--/--	--
Bromodichloromethane	--/--	--	mouse/renal cytomegaly	1000	--/--	B2	mouse/liver	B2
1,2-Dichloropropane	(data inadequate for quantitative risk assessments)				--/--	B2	mouse/liver	B2
cis-1,3-Dichloropropene	rat/degenerative changes in nasal mucosa	100	rat/increased organ weights	10,000	mouse/benign lung tumors	B2	rat/forestomach, liver, adrenal, thyroid	B2
Trichloroethene	--/--	--	--/--	--	mouse/lung	B2	mouse/liver	B2
Dibromochloromethane	--/--	--	rat/liver lesions	1000	--/--	C	mouse/hepatocell- ular adenomas or carcinomas	C
1,1,2-Trichloroethane	--/--	--	mouse/clinical chemistry alter- ations	1000	mouse/liver	C	mouse/liver	C
Benzene	--/--	--	--/--	--	human/leukemia	A	human/leukemia	A
trans-1,3-Dichloropropene	rat/degeneration changes in nasal mucosa	100	rat/increased organ weight	1000	mouse/benign lung tumors	B2	rat/forestomach, liver, adrenal, thyroid	B2

Chemical of Potential Concern	Chronic Reference Dose — Inhalation: Species/Effect of Concern	Chronic Reference Dose — Inhalation: Uncertainty Factor (1)	Chronic Reference Dose — Oral: Species/Effect of Concern	Chronic Reference Dose — Oral: Uncertainty Factor (1)	Slope Factor — Inhalation: Species/Tumor Site	Slope Factor — Inhalation: Weight of Evidence	Slope Factor — Oral: Species/Tumor Site	Slope Factor — Oral: Weight of Evidence (2)
Bromoform	--/--	--/--	rat/liver effects	1000	--/--	B2	rat/adenomatous polyps or adenocarcinomas in the large intestine	B2
4-Methyl-2-pentanone	rat/liver & kidney effects	1000	rat/liver & kidney effects	1000	--/--	--	--/--	--
2-Hexanone	Data inadequate							
Tetrachloroethene	--/--	--	mouse/hepatotoxicity	1000	rat, mouse/ leukemia, liver	B2	mouse/liver	B2
1,1,2,2-Tetrachloroethane	--/--	--	--/--	--	mouse/liver	C	mouse/liver	C
Toluene	human/CNS effects eyes, nose irritation	100	rat/CNS effects	1000	--/--	--	--/--	--
Chlorobenzene	rat/liver & kidney effects	10,000	dog/liver & kidney effects	1000	--/--	--	--/--	--
Ethylbenzene	--/--	--	rat/hepatotoxicity, & nephrotoxicity	1000	--/--	--	--/--	--
Styrene	--/--	--	dog/red blood cell & liver effects	1000	rat/leukemia	B2	mouse/lung & bronchi	B2
Xylenes (mixed)	human/CNS effects, nose & throat irritation	100	rat/hyperactivity, decreased body weight & increased mortality at higher dosage	100	--/--	--	--/--	--
<u>SEMIVOLATILES</u>								
Phenol	--/--	--	rat/reduced fetal body weight	100	--/--	--	--/--	--
bis(2-Chloroethyl) ether	--/--	--	mouse/decrease in hemoglobin & possible erythrocyte destruction	1000	mouse/liver	B2	mouse/liver	B2
2-Chlorophenol	--/--	--	rat/reproductive effects	1000	--/--	--	--/--	--

(continued)

Chemical of Potential Concern	Chronic Reference Dose				Slope Factor			
	Inhalation		Oral		Inhalation		Oral	
	Species/Effect of Concern	Uncertainty Factor (1)	Species/Effect of Concern	Uncertainty Factor (1)	Species/Tumor Site	Weight of Evidence	Species/Tumor Site	Weight of Evidence (2)
1,3-Dichlorobenzene	--/--	--	--/--	--	--/--	--	--/--	--
1,4-Dichlorobenzene	rat/liver & kidney effect	1000-	--/--	--	--/--	B2	mouse/liver	B2
Benzyl Alcohol	--/--	--	rat/hyperplasia of the epithelium of the forestomach	1000	--/--	--	--/--	--
1,2-Dichlorobenzene	rat/decreased body weight gain	1000	rat/liver effects	1000	--/--	--	--/--	--
2-Methylphenol	--/--	--	rat/reduced body weight gain, neurotoxicity	1000	--/--	--	--/--	--
bis(2-Chloroisopropyl)ether	--/--	--	mouse/decrease in hemoglobin & possible erythrocyte destruction	1000	--/--	--	--/--	--
4-Methylphenol	--/--	--	rat/reduced body weight gain, neurotoxicity	1000	--/--	--	--/--	--
N-Nitroso-di-n-dipropylamine	--/--	--	--/--	--	--/--	B2	rat/liver	B2
Hexachloroethane	--/--	--	rat/kidney degeneration	100	mouse/liver	C	mouse/liver	C
Nitrobenzene	mouse/hematological, adrenal, renal & hepatic lesions	3000	mouse/hematological, adrenal, renal & hepatic lesions	10,000	--/--	--	--/--	--
Isophorone	--/--	--	dog/kidney lesions	1000	--/--	C	rat/kidney, preputial gland	C
2-Nitrophenol	data inadequate							
2,4-Dimethylphenol	--/--	--	mouse/neurological signs & hematological changes	3000	--/--	--	--/--	--
Benzoic Acid	--/--	--	human/irritation, malaise	1	--/--	--	--/--	--
bis(2-Chloroethoxy)methane	--/--	--	--/--	--	--/--	--	--/--	--

(continued)

Chemical of Potential Concern	Chronic Reference Dose: Inhalation: Species/Effect of Concern	Chronic Reference Dose: Inhalation: Uncertainty Factor (1)	Chronic Reference Dose: Oral: Species/Effect of Concern	Chronic Reference Dose: Oral: Uncertainty Factor (1)	Slope Factor: Inhalation: Species/Tumor Site	Slope Factor: Inhalation: Weight of Evidence	Slope Factor: Oral: Species/Tumor Site	Slope Factor: Oral: Weight of Evidence (2)
2,4-Dichlorophenol	--/--	--	rat/immune function	100	--/--	--	--/--	--
1,2,4-Trichlorophenol	--/--	--	--/--	--	--/--	--	--/--	--
Naphthalene	--/--	--	rat/ocular & internal lesions	10,000	--/--	--	--/--	--
4-Chloroaniline	--/--	--	rat/proliferative lesions of the spleen	3000	--/--	--	--/--	--
Hexachlorobutadiene	--/--	--	rat/kidney toxicity	100	rat/kidney	C	rat/kidney	C
4-Chloro-3-methylphenol	--/--	--	--/--	--	--/--	--	--/--	--
2-Methylnaphthalene	--/--	--	--/--	--	--/--	--	--/--	--
Hexachlorocyclopentadiene	rat/respiratory tract lesions	1,000	rat/forestomach lesions	1000	--/--	--	--/--	--
2,4,6-Trichlorophenol	--/--	--	--/--	--	mouse/liver	B2	mouse/liver	B2
2,4,5-Trichlorophenol	--/--	--	rat/decreased survival	300	--/--	--	--/--	--
2-Chloronaphthalene	--/--	--	--/--	--	--/--	--	--/--	--
2-Nitroaniline	--/--	--	--/--	--	--/--	--	--/--	--
Dimethylphthalate	--/--	--	--/--	--	--/--	--	--/--	--
Acenaphthylene	--/--	--	--/--	--	--/--	--	--/--	--
2,6-Dinitrotoluene	--/--	--	--/--	--	--/--	B2	--/--	B2
3-Nitroaniline	--/--	--	--/--	--	--/--	--	--/--	--
Acenaphthene	--/--	--	mouse/hepato-toxicity	3000	--/--	--	--/--	--
2,4-Dinitrophenol	--/--	--	human/cataract	1000	--/--	--	--/--	--
4-Nitrophenol	--/--	--	--/--	--	--/--	--	--/--	--
Dibenzofuran	--/--	--	--/--	--	--/--	--	--/--	--
2,4-Dinitrotoluene	--/--	--	--/--	--	--/--	B2	--/--	B2

(continued)

Chemical of Potential Concern	Chronic Reference Dose				Slope Factor			
	Inhalation		Oral		Inhalation		Oral	
	Species/Effect of Concern	Uncertainty Factor (1)	Species/Effect of Concern	Uncertainty Factor (1)	Species/Tumor Site	Weight of Evidence	Species/Tumor Site	Weight of Evidence (2)
Diethylphthalate	--/--	--	rat/reduced terminal body weight	1000	--/--	--	--/--	--
4-Chlorophenyl-phenylether	--/--	--	--/--	--	--/--	--	--/--	--
Fluorene	--/--	--	mouse/hematological changes	3000	--/--	--	--/--	--
4-Nitroaniline	--/--	--	--/--	--	--/--	--	--/--	--
4,6-Dinitro-2-methylphenol	--/--	--	--/--	--	--/--	--	--/--	--
N-nitrosodiphenylamine	--/--	--	--/--	--	--/--	--	rat/urinary bladder	B2
4-Bromophenyl-phenylether	--/--	--	--/--	--	--/--	--	--/--	--
Hexachlorobenzene	--/--	--	rat/liver & hematologic effects	100	hamster/liver	B2	hamster/liver	B2
Pentachlorophenol	--/--	--	rat/liver & kidney pathology	100	--/--	--	--/--	--
Phenanthrene	--/--	--	--/--	--	--/--	--	--/--	--
Anthracene	--/--	--	mouse/no effects	3000	--/--	--	--/--	--
Di-n-butylphthalate	--/--	--	rat/mortality	1000	--/--	--	--/--	--
Fluoranthene	--/--	--	mouse/nephropathy, liver weight changes, hematological changes	3000	--/--	--	--/--	--
Pyrene	--/--	--	mouse/renal effects	3000	--/--	--	--/--	--
Butylbenzylphthalate	--/--	--	rat/effects on body weight gain, testes, liver, kidney	1000	--/--	--	--/--	C
3,3'-Dichlorobenzidine	--/--	--	--/--	--	--/--	--	rat/mammary	B2
Benzo(a)anthracene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2
Chrysene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2

(continued)

Chemical of Potential Concern	Chronic Reference Dose: Inhalation — Species/Effect of Concern	Chronic Reference Dose: Inhalation — Uncertainty Factor (1)	Chronic Reference Dose: Oral — Species/Effect of Concern	Chronic Reference Dose: Oral — Uncertainty Factor (1)	Slope Factor: Inhalation — Species/Tumor Site	Slope Factor: Inhalation — Weight of Evidence	Slope Factor: Oral — Species/Tumor Site	Slope Factor: Oral — Weight of Evidence (2)
bis(2-ethylhexyl)phthalate	--/--	--	guinea pig/increased relative liver weight	1000	--/--	B2	--/--	B2
Di-n-octyl Phthalate	--/--	--	rat/elevated kidney & liver weights	1000	--/--	--	--/--	--
Benzo(b)fluoranthene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2
Benzo(k)fluoranthene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2
Benzo(a)pyrene(c)	--/--	--	--/--	--	hamster/respiratory tract	B2	mouse/stomach	B2
Ideno(1,2,3-cd)pyrene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2
Dibenz(a,h)anthracene(c)	--/--	--	--/--	--	--/--	B2	--/--	B2
Benzo(g,h,i)perylene	--/--	--	--/--	--	--/--	--	--/--	--
Total-Carcinogenic PAHs(3)	--/--	--	--/--	--	hamster/respiratory tract	B2	mouse/stomach	B2
PESTICIDE/PCB								
alpha-BHC	--/--	--	--/--	--	--/--	--	mouse/liver	B2
beta-BHC	--/--	--	--/--	--	--/--	--	mouse/liver	C
delta-BHC	--/--	--	--/--	--	--/--	--	--/--	--
gamma-BHC (Lindane)	--/--	--	rat/liver & kidney toxicity	1000	--/--	--	mouse/liver	B2
Heptachlor	--/--	--	rat/increased liver weight	300	mouse/liver	B2	mouse/liver	B2
Aldrin	--/--	--	rat/liver lesions	1000	mouse/liver	B2	mouse/liver	B2
Heptachlor epoxide	--/--	--	--/--	--	mouse/liver	B2	mouse/liver	B2
Endosulfan I	--/--	--	rat/mild kidney lesions	3000	--/--	--	--/--	--

(continued)

Chemical of Potential Concern	Chronic Reference Dose: Inhalation: Species/Effect of Concern	Chronic Reference Dose: Inhalation: Uncertainty Factor (1)	Chronic Reference Dose: Oral: Species/Effect of Concern	Chronic Reference Dose: Oral: Uncertainty Factor (1)	Slope Factor: Inhalation: Species/Tumor Site	Slope Factor: Inhalation: Weight of Evidence	Slope Factor: Oral: Species/Tumor Site	Slope Factor: Oral: Weight of Evidence (2)
Dieldrin	--/--	--	--/--	--	--/--	B2	mouse/liver	B2
4,4'-DDE	--/--	--	--/--	--	--/--	--	mouse, hamster/ liver	B2
Endrin	--/--	--	dog/convulsions & liver lesions	100	--/--	--	--/--	--
Endosulfan II	--/--	--	rat/mild kidney lesions	3000	--/--	--	--/--	--
4,4'-DDD	--/--	--	--/--	--	--/--	--	mouse/liver	B2
Endosulfan sulfate	--/--	--	--/--	--	--/--	--	--/--	--
4,4'-DDT	--/--	--	rat/liver lesions	100	mouse, rat/ liver	B2	mouse, rat/ liver	B2
Methoxychlor	--/--	--	rat/fetotoxicity	100	--/--	--	--/--	--
Enrin ketone	--/--	--	--/--	--	--/--	--	--/--	--
alpha-Chlordane	--/--	--	rat/liver necrosis	1000	mouse/liver	B2	mouse/liver	B2
gamma-Chlordane	--/--	--	rat/liver necrosis	1000	mouse/liver	B2	mouse/liver	B2
Toxaphene	--/--	--	--/--	--	mouse/liver	B2	mouse/liver	B2
Polychlorinated biphenyls (PCBs)	--/--	--	--/--	--	--/--	--	rat/liver	B2
TARGET ANALYTE LIST								
METALS								
Aluminum	Data Inadequate	--	--/--	--	--/--	--	--/--	--
Antimony	--/cancer	--	rat/reduced life span, altered blood chemistries	1000	--/--	--	--/--	--
Arsenic	--/cancer	--	human/keratosis & hyperpigmentation	1	human/respiratory tract	A	human/skin	A
Barium	--/fetotoxicity	100	rat/increased blood pressure	100	--/--	--	--/--	--

Chemical of Potential Concern	Chronic Reference Dose: Inhalation: Species/Effect of Concern	Chronic Reference Dose: Inhalation: Uncertainty Factor (1)	Chronic Reference Dose: Oral: Species/Effect of Concern	Chronic Reference Dose: Oral: Uncertainty Factor (1)	Slope Factor: Inhalation: Species/Tumor Site	Slope Factor: Inhalation: Weight of Evidence	Slope Factor: Oral: Species/Tumor Site	Slope Factor: Oral: Weight of Evidence (2)
Beryllium	--/--	--	rat/none observed	100	human/lung	B2	rat/total tumors	B2
Cadmium (water) (4)	--/--	--	human/cancer, renal damage	10	human/respiratory tract	B1	--/--	--
Cadmium (food/soil) (4)	--/--	--	human/cancer, renal damage	10	human/respiratory tract	B1	--/--	--
Calcium	--/--	--	--/--	--	--/--	--	--/--	--
Chromium III	--/--	--	rat/hepatotoxicity	1000	--/--	--	--/--	--
Chromium VI	--/cancer	--	rat/not defined	500	human/lung	A	--/--	--
Cobalt	--/--	--	--/--	--	--/--	--	--/--	--
Copper	--/--	--	human/local GI irritation	--	--/--	--	--/--	--
Iron	Data inadequate	--	--/--	--	--/--	--	--/--	--
Lead	--/CNS effects	--	--/CNS effects	--	--/--	B2	--/--	B2
Magnesium	--/--	--	--/--	--	--/--	--	--/--	--
Manganese	human/CNS	100	rat/reproductive	100	--/--	--	--/--	--
Mercury	human/neurotoxicity	30	rat/kidney effects	1000	--/--	--	--/--	--
Nickel	--/cancer	--	rat/reduced body & organ weight	300	human/respiratory tract	A	--/--	--
Potassium	--/--	--	--/--	--	--/--	--	--/--	--
Selenium	--/--	--	--/--	--	--/--	--	--/--	--
Silver	--/--	--	human/argyria	2	--/--	--	--/--	--
Sodium	--/--	--	--/--	--	--/--	--	--/--	--
Thallium	--/--	--	rat/increased SGOT & serum LDH levels, alopecia	3000	--/--	--	--/--	--
Vanadium	--/--	--	rat/none observed	100	--/--	--	--/--	--

(continued)

hemical of 'otential Concern	Chronic Reference Dose				Slope Factor			
	Inhalation		Oral		Inhalation		Oral	
	Species/Effect of Concern	Uncertainty Factor (1)	Species/Effect of Concern	Uncertainty Factor (1)	Species/Tumor Site	Weight of Evidence	Species/Tumor Site	Weight of Evidence (2)
:inc	--/--	--	rat/weight loss, thyroid effects & myelin degeneration	500	--/--	--	--/--	--
:yanide	--/--	--	rat/weight loss, thyroid effects & myelin degeneration	500	--/--	--	--/--	--

(continued)

Chemical Group of Potential Concern	Representative Compound	Chronic Reference Dose			
		Inhalation		Oral	
		Species/Effect of Concern	Uncertainty Factor (1)	Species/Effect of Concern	Uncertainty Factor (1)
TENTATIVELY IDENTIFIED COMPOUNDS (5)					
Propyl Benzenes	Cumene	rat/CNS involvement, nasal irritation	10,000	rat/renal	3,000
Propenyl Benzenes	Methyl Styrene	mouse/nasal lesions	1000	mouse/nasal lesions	1,000
Ethyl Methyl Benzenes	Ethyl toluene	Data inadequate	--	--/--	--
Diethyl Benzenes	Ethyl benzene	--/--	--	rat/hepatotoxicity, nephrotoxicity	--
Methyl Propyl Benzenes	Cumene	rat/CNS involvement, nasal irritation	10,000	rat/renal	3,000
Methyl Ethenyl Benzenes	Methyl Styrene	mouse/nasal lesions	1,000	mouse/nasal lesions	1,000
Methyl Phenyl Benzenes	Naphthalene	--/--	--	rat/decreased body weight gain	10,000
Trimethyl Benzenes	Trimethyl benzene	Data Inadequate	--	--/--	--
Dimethyl ethyl benzenes	Ethyl benzene	--/--	--	rat/hepatotoxicity, nephrotoxicity	1,000
Tetramethyl Benzenes	Trimethyl benzene	Data Inadequate	--	--/--	--
Oxygenated Benzenes	Benzaldehyde	--/--	--	rat/kidney, forestomach	1,000
Halogenated Benzenes	o-chlorotoluene	--/--	--	rat/decreased body weight gain	1,000

(continued)

Chemical Group of Potential Concern	Representative Compound	Chronic Reference Dose: Inhalation — Species/Effect of Concern	Inhalation — Uncertainty Factor (1)	Oral — Species/Effect of Concern	Oral — Uncertainty Factor (1)
Nitrogenated Benzenes	Nitrobenzene	mouse/hematological, adrenal, renal & hepatic lesions	300	mouse/hematological, adrenal, renal & hepatic lesions	1,000
Cyclic alkanes	Methylcyclohexane	--/--	--	--/--	--
Cyclic Alkenes	Vinylcyclohexane	--/--	--	--/--	--
Halogenated Alkanes	1,1,1-Trichloroethane	guinea pig/hepatotoxicity	1,000	guinea pig/ hepatotoxicity	1,000
n-chain Alkanes	n-hexane	human/neurotoxicity	300	rat/neuropathy or testicular atrophy	10,000
Branched Alkanes	n-hexane	human/neurotoxicity	300	rat/neuropathy or testicular atrophy	10,000
Branched Alkenes/Alkynes	Vinyl cyclohexene	Data Inadequate	--	--/--	--
Ethers	Ethylether	--/--	--	rat/liver effects	1,000
Methylated Naphthalenes	Naphthalene	--/--	--	rat/decreased body weight gain	10,000
Phthalates	Phthalic anhydride	--/--	--	mouse/lung & kidney histopathology	1,000
Methylated Phenols	Cresol	--/--	--	rat/reduced body weight gain, neurotoxicity	1,000
Methylated Ketones	Acetone	--/--	--	rat/increased liver & kidney weight, nephrotoxicity	1,000
Simple Ketones	2-butanone	rat/CNS	1,000	rat/fetotoxicity	1,000
Cyclic Ketones	Isophorone	--/--	--	dog/kidney lesions	1,000
Diols	Ethylene glycol	--/--	--	rat/mortality, liver & kidney effects	100
Simple Alcohols	1-butanol	--/--	--	rat/effects on erythrocyte	1,000
Straight chain alkenes/alkynes	Vinyl cyclohexene	Data Inadequate	--	--/--	--

(continued)

Chemical Group of Potential Concern	Representative Compound	Chronic Reference Dose: Inhalation Species/Effect of Concern	Inhalation Uncertainty Factor (1)	Oral Species/Effect of Concern	Oral Uncertainty Factor (1)
Cyclic Alcohols	Benzyl alcohol	--/--	--	rat/hyperplasia of the epithelium of the forestomach	1,000
Oxygenated Alcohols	Ethyl glycol monobutyl ether	rat/altered hemotology	1,000	--/--	--
Cyclic Acids	Benzoic acid	--/--	--	human/irritation, malaise	1
Non-Cyclic Acids	Acrylic acid	mouse/lesions of the nasal mucosa	1,000	rat/reduced body weight, altered organ weights	1,000
Amines	Coprolactam	--/--	--	rat/reduced body weight	100
Polychlorindated Biphenyls (PCBs)	PCBs	--/--	--	--/--	--
Furans	Tetrahydrofuran	--/--	--	mouse/hepatic lesions	1000

NOTES:

1) A reference dose (RFD) is derived from a pertinent toxicity study(s), and is an estimate of the "safe" level of chemical intake over a set length of exposure (e.g., chronic) for humans. Many assumptions must be made when predicting this "safe" chemical intake level (i.e., RFD) from a laboratory study. Uncertainty factors (UFs) are applied when estimating the RFD for the following reasons.

- A UF of 10 is used to account for variation in the general population and is intended to protect sensitive subpopulations (e.g., elderly, children).
- A UF of 10 is used when extrapolating from animal data to humans. This factor is intended to account for the interspecies variability between humans and other mammals.
- A UF of 10 is used when a RFD is derived from a subchronic instead of a chronic toxicity study.
- A UF of 10 is used when a lowest adverse effect level (LOAEL) is used instead of a no adverse effect level (NOAEL) to derive a RFD. This factor is intended to account for the uncertainty associated with extrapolating from toxic levels of chemical exposure (i.e., LOAEL) to nontoxic levels of chemical exposure (i.e., NOAEL).

In certain cases, a modifying factor (MF) is used to account for further uncertainty associated with the toxicity study used to develop the RFD. The MF may vary from >0 to 10.

The uncertainty factors presented in this table represent the product of all the uncertainty factors (and modifying factors) used to derive the RFD (e.g., 10x10x10 = 1000).

(continued)

2) This code represents the U.S. EPA weight-of-evidence classification system for carcinogenicity for chemicals. The following is a description of the classification by group.

Group	Description
A	Known human carcinogen
B1 or B2	Probable human carcinogen
	B1 indicates that limited human data on the carcinogenicity of the chemical are available.
	B2 indicates sufficient evidence of carcinogenicity in animals and inadequate or no evidence of carcinogenicity in humans exists.
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity for humans

3) The slope factor for benzo(a)pyrene was used to represent the carcinogenic potential of the carcinogenic polynuclear aromatic hydrocarbons (PAHs).

4) Toxicity values have been developed separately for ingestion of cadmium in water and cadmium ingestion with solids (i.e., food or soil).

5) Tentatively identified compounds (TICs) were grouped based on similar chemical structure. Compounds of similar chemical structure are assumed to have similar toxicological properties. For each TIC grouping, a representative compound was chosen for which there was a reference dose (RfD). The RFD for the representative compound was used to represent the toxic potential of the particular TIC group.

6) The information in this table was summarized from U.S. EPA's "Health Effects Assessment Summary Tables" (Fiscal Year - Annual, 1991).

LEGEND

-- = information not available

data inadequate = presently, toxicity data is inadequate for reference dose or slope factor derivation.

BCC/JLV/vlr/JH/MWK

Table 4

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical	Chronic Reference Dose (mg/kg-d)			Slope Factor (mg/kg-d)$^{-1}$			Chemical Absorption Estimate (unitless)		Dermal Permeability Constant
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal	Oral	Dermal	(cm/hr)
VOLATILES									
Chloromethane	ND D	ND	ND	6.3e-03 H*	1.3e-02 H	2.6e-02	0.50	0.30	1.0e+00
Bromomethane	6.0e-03 H*	1.4e-03 I	7.0e-04	ND	ND	ND	0.50	0.30	1.0e+00
Vinyl chloride	ND	ND	ND	3.0e-01 6	1.9e+00 H*	1.9e+00	1.00	0.30	1.0e+00
Chloroethane	1.0e+00 I*	ND	ND	ND D	ND	ND	0.50	0.30	8.0e-03
Methylene chloride	3.0e+00 H*	6.0e-02 I	4.8e-02	1.4e-02	7.5e-03 H	9.4e-03	0.80	0.30	1.0e+00
Acetone	ND	1.0e-01 I	9.5e-02	ND	ND	ND	0.95	0.30	1.0e+00
Carbon disulfide	1.0e-02 H*	1.0e-01 H	5.0e-02	ND	ND	ND	0.50	0.30	5.3e-01
1,1-Dichloroethene	ND 2	9.0e-03 I	9.0e-03	1.2e+00 H	6.0e-01 I	6.0e-01	1.00	0.30	1.0e+00
1,1-Dichloroethane	1.0e-01 H	1.0e-01 H	1.0e-01	ND	ND	ND	1.00	0.30	1.0e+00
1,2-Dichloroethene (cis)	ND	1.0e-02 H	9.5e-03	ND	ND	ND	0.95	0.30	1.0e+00
1,2-Dichloroethene (trans)	ND	2.0e-02 H	1.9e-02	ND	ND	ND	0.95	0.30	1.0e+00
Chloroform	ND 2	1.0e-02 I	1.0e-02	8.1e-02 H	6.1e-03 I	6.1e-03	1.00	0.30	1.0e+00
1,2-Dichloroethane	ND	ND	ND	9.1e-02 H	9.1e-02 I	9.1e-02	1.00	0.30	1.0e+00
2-Butanone	9.0e-02 H2	5.0e-02 I	2.5e-02	ND	ND	ND	0.50	0.30	5.0e-03
1,1,1-Trichloroethane	3.0e-01 H2	9.0e-02 I2	9.0e-02	ND	ND	ND	1.00	0.30	1.0e+00
Carbon tetrachloride	ND	7.0e-04 I	6.0e-04	1.3e-01 H	1.3e-01 I	1.5e-01	0.85	0.30	1.0e+00
Vinyl acetate	2.0e-01 I*	1.0e+00 H*	5.0e-01	ND	ND	ND	0.50	0.30	1.0e+00
Bromodichloromethane	ND	2.0e-02 I	1.0e-02	ND	1.3e-01 I	2.6e-01	0.50	0.30	1.0e+00
1,2-Dichloropropane	ND D	ND	ND	ND	6.8e-02 H	1.4e-01	0.50	0.30	1.0e+00
cis-1,3-Dichloropropene	2.0e-02 H*	3.0e-04 H	1.5e-04	1.3e-01 H	1.8e-01 H	3.6e-01	0.50	0.30	1.0e+00
Trichloroethene	ND	ND	ND	1.7e-02 H	1.1e-02 H	1.1e-02	1.00	0.30	1.0e+00
Dibromochloromethane	ND	2.0e-02 I	1.0e-02	ND	8.4e-02 I	1.7e-01	0.50	0.30	1.0e+00
1,1,2-Trichloroethane	ND	4.0e-03 I	2.0e-03	5.7e-02 H	5.7e-02 I	1.1e-01	0.50	0.30	1.0e+00
Benzene	ND	ND	ND	2.9e-02 H	2.9e-02 I	5.8e-02	0.50	0.30	1.1e-01
trans-1,3-Dichloropropene	2.0e-02 H*	3.0e-04 H	1.5e-04	1.3e-01 H	1.8e-01 H	3.6e-01	0.50	0.30	1.0e+00
Bromoform	ND	2.0e-02 I	1.0e-02	3.9e-03 H	7.9e-03 I	1.6e-02	0.50	0.30	1.0e+00
4-Methyl-2-pentanone	2.0e-02 H2	5.0e-02 H1	2.5e-02	ND	ND	ND	0.50	0.30	1.0e+00
2-Hexanone	ND D	ND	ND	ND	ND	ND	0.50	0.30	1.0e+00
Tetrachloroethene	ND	1.0e-02 I	1.0e-02	3.3e-03 6	5.1e-02 H	5.1e-02	1.00	0.30	1.0e+00
1,1,2,2-Tetrachloroethane	ND	ND 2	ND	2.0e-01 H	2.0e-01 I	2.1e-01	0.95	0.30	1.0e+00
Toluene	2.0e+00 H*	2.0e-01 I*	2.0e-01	ND	ND	ND	1.00	0.30	1.0e+00
Chlorobenzene	5.0e-03 H2	2.0e-02 I	6.0e-03	ND	ND	ND	0.30	0.30	1.0e+00
Ethylbenzene	1.0e+00 I*	1.0e-01 I	5.0e-02	ND	ND	ND	0.50	0.30	1.4e+00
Styrene	ND	2.0e-01 I2	1.8e-01	2.0e-03 H	3.0e-02 H	3.3e-02	0.90	0.30	6.7e-01
Xylenes (mixed)	3.0e-01 H2*	2.0e+00 I	1.0e+00	ND	ND	ND	0.50	0.30	1.0e+00
Xylenes (m,o)	2.0e-01 H	2.0e+00 H	1.0e+00	ND	ND	ND	0.50	0.30	1.0e+00
Xylenes (p)	3.0e-01 H*	ND	ND	ND	ND	ND	0.50	0.30	1.0e+00

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES
USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical	Chronic Reference Dose (mg/kg-d)					Slope Factor $(mg/kg-d)^{-1}$					Chemical Absorption Estimate (unitless)		Dermal Permeability Constant
	Inhalation		Oral		Dermal	Inhalation		Oral		Dermal	Oral	Dermal	(cm/hr)
SEMIVOLATILES													
Phenol	ND		6.0e-01	I	5.4e-01	ND		ND		ND	0.90	0.30	8.2e-03
bis(2-Chloroethyl) ether	ND		ND		ND	1.1e+00	I	1.1e+00	I	2.2e+00	0.50	0.30	5.0e-03
2-Chlorophenol	ND		5.0e-03	I	2.5e-03	ND		ND		ND	0.50	0.30	3.3e-02
1,3-Dichlorobenzene	ND	D	ND		ND	ND		ND		ND	0.50	0.30	5.0e-03
1,4-Dichlorobenzene	7.0e-01	H*	ND		ND	ND		2.4e-02	H	2.4e-02	1.00	0.30	5.0e-03
Benzyl Alcohol	ND		3.0e-01	H	1.5e-01	ND		ND		ND	0.50	0.30	5.0e-03
1,2-Dichlorobenzene	4.0e-02	H	9.0e-02	I	4.5e-02	ND		ND		ND	0.50	0.30	5.0e-03
2-Methylphenol	ND		5.1e-02	I	4.1e-02	ND		ND		ND	0.80	0.30	1.6e-02
bis(2-Chloroisopropyl)ether	ND		4.0e-02	H	2.0e-02	ND		ND		ND	0.50	0.30	5.0e-03
4-Methylphenol	ND		5.0e-02	I	4.0e-02	ND		ND		ND	0.80	0.30	1.8e-02
N-Nitroso-di-n-dipropylamine	ND		ND		ND	ND		7.0e+00	I	1.4e+01	0.50	0.30	5.0e-03
Hexachloroethane	ND		1.0e-03	I	5.0e-04	1.4e-02	I	1.4e-02	I	2.8e-02	0.50	0.30	5.0e-03
Nitrobenzene	2.0e-03	H2*	5.0e-04	I	2.5e-04	ND		ND		ND	0.50	0.30	5.0e-03
Isophorone	ND		2.0e-01	I	1.0e-01	ND		4.1e-03	I*	8.2e-03	0.50	0.30	5.0e-03
2-Nitrophenol	ND		ND		ND	ND		ND		ND	0.50	0.30	1.1e-01
2,4-Dimethylphenol	ND		2.0e-02	I	1.0e-02	ND		ND		ND	0.50	0.30	1.1e-01
Benzoic Acid	ND		4.0e+00	I	3.0e+00	ND		ND		ND	0.75	0.30	5.0e-03
bis(2-Chloroethoxy)methane	ND		ND		ND	ND		ND		ND	0.50	0.30	5.0e-03
2,4-Dichlorophenol	ND		3.0e-03	I	1.5e-03	ND		ND		ND	0.50	0.30	6.0e-02
1,2,4-Trichlorobenzene	3.0e-03	H	1.3e-03	H1	6.6e-04	ND		ND		ND	0.50	0.30	5.0e-03
Naphthalene	ND		4.0e-03	H2	3.4e-03	ND		ND		ND	0.84	0.30	5.0e-03
4-Chloroaniline	ND		4.0e-03	I	2.0e-03	ND		ND		ND	0.50	0.30	5.0e-03
Hexachlorobutadiene	ND		2.0e-03	I	1.0e-03	7.8e-02	I	7.8e-02	I	1.6e-01	0.50	0.30	5.0e-03
4-Chloro-3-methylphenol	ND		ND		ND	ND		ND		ND	0.50	0.30	5.5e-02
2-Methylnaphthalene	ND		ND		ND	ND		ND		ND	0.50	0.30	5.0e-03
Hexachlorocyclopentadiene	2.0e-05	H	7.0e-03	I	3.5e-03	ND		ND		ND	0.50	0.30	5.0e-03
2,4,6-Trichlorophenol	ND	2	ND		ND	1.1e-02	I	1.1e-02	I	2.2e-02	0.50	0.30	5.9e-01
2,4,5-Trichlorophenol	ND	2	1.0e-01	I	5.0e-02	ND		ND		ND	0.50	0.30	5.9e-01
2-Chloronaphthalene	ND		8.0e-02	I	4.0e-02	ND		ND		ND	0.50	0.30	5.0e-03
2-Nitroaniline	ND	D	ND		ND	ND		ND		ND	0.50	0.30	5.0e-03
Dimethylphthalate	ND	1	1.0e+00	H	5.0e-01	ND		ND		ND	0.50	0.30	5.0e-03
Acenaphthylene	ND	D	ND	1	ND	ND		ND		ND	0.50	0.30	5.0e-03
2,6-Dinitrotoluene	ND	D	ND		ND	ND		6.8e-01	H	1.4e+00	0.50	0.30	5.0e-03
3-Nitroaniline	ND	D	ND		ND	ND		ND		ND	0.50	0.30	5.0e-03
Acenaphthene	ND		6.0e-02	I	3.0e-02	ND		ND		ND	0.50	0.30	5.0e-03
2,4-Dinitrophenol	ND		2.0e-03	I	1.0e-03	ND		ND		ND	0.50	0.30	3.2e-03
4-Nitrophenol	ND	D	ND		ND	ND		ND		ND	0.50	0.30	5.6e-03
Dibenzofuran	ND	D	ND		ND	ND		ND		ND	0.50	0.30	5.0e-03

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES
USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical	Chronic Reference Dose (mg/kg-d)			Slope Factor $(mg/kg\text{-}d)^{-1}$			Chemical Absorption Estimate (unitless)		Dermal Permeability Constant (cm/hr)
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal	Oral	Dermal	(cm/hr)
2,4-Dinitrotoluene	ND D1	ND	ND	ND	6.8e-01 H1	1.4e+00	0.50	0.30	5.0e-03
Diethylphthalate	ND	8.0e-01 I	4.0e-01	ND	ND	ND	0.50	0.30	1.1e-05
4-Chlorophenyl-phenylether	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Fluorene	ND	4.0e-02 I	2.0e-02	ND	ND	ND	0.50	0.30	5.0e-03
4-Nitroaniline	ND D	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
4,6-Dinitro-2-methylphenol	ND D	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
N-nitrosodiphenylamine	ND D	ND	ND	ND	4.9e-03 I	5.0e-03	0.98	0.30	5.0e-03
4-Bromophenyl-phenylether	ND D	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Hexachlorobenzene	ND	8.0e-04 I	4.0e-04	1.6e+00 H	1.6e+00 I	3.2e+00	0.50	0.30	6.4e-04
Pentachlorophenol	ND	3.0e-02 I	2.7e-02	ND	1.2e-01 I*	1.3e-01	0.90	0.30	5.0e-03
Phenanthrene	ND D	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Anthracene	ND	3.0e-01 I	1.5e-01	ND	ND	ND	0.50	0.30	5.0e-03
Di-n-butylphthalate	ND 1	1.0e-01 I	9.0e-02	ND	ND	ND	0.90	0.30	2.3e-06
Fluoranthene	ND	4.0e-02 I	2.0e-02	ND	ND	ND	0.50	0.30	5.0e-03
Pyrene	ND	3.0e-02 I	1.5e-02	ND	ND	ND	0.50	0.30	5.0e-03
Butylbenzylphthalate	ND	2.0e-01 I	1.8e-01	ND	ND	ND	0.90	0.30	5.0e-03
3,3'-Dichlorobenzidine	ND	ND	ND	ND	4.5e-01 I	9.0e-01	0.50	0.30	5.0e-03
Benzo(a)anthracene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Chrysene	ND D	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
bis(2-ethylhexyl)phthalate	ND	2.0e-02 I	5.0e-03	ND	1.4e-02 I	5.6e-02	0.25	0.30	5.7e-06
Di-n-octyl Phthalate	ND	2.0e-02 H	1.0e-02	ND	ND	ND	0.50	0.30	5.0e-03
Benzo(b)fluoranthene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Benzo(k)fluoranthene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Benzo(a)pyrene	ND	ND	ND	ND H	ND H	ND	0.50	0.30	5.0e-03
Ideno(1,2,3-cd)pyrene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Total Carcinogenic PAHs	ND	ND	ND	6.1e+00 H7	1.2e+01 H7	2.3e+01	0.50	0.30	5.0e-03
PESTICIDE/PCB									
alpha-BHC	ND	ND	ND	6.3e+00 H	6.3e+00 I	1.3e+01	0.50	0.30	1.4e-02
beta-BHC	ND	ND	ND	1.8e+00 H	1.8e+00 I	3.6e+00	0.50	0.30	1.4e-02
delta-BHC	ND D	ND	ND	ND	ND	ND	0.50	0.30	ND
gamma-BHC (Lindane)	ND	3.0e-04 I	3.0e-04	ND	1.3e+00 H	1.3e+00	1.00	0.30	1.3e-02
Heptachlor	ND	5.0e-04 I	3.5e-04	4.5e+00 H	4.5e+00 I	6.4e+00	0.70	0.30	ND
Aldrin	ND	3.0e-05 I	1.5e-05	1.7e+01 H	1.7e+01 I	3.4e+01	0.50	0.30	1.5e-03
Heptachlor epoxide	ND	1.3e-05 I*	6.5e-06	9.1e+00 H	9.1e+00 I	1.8e+01	0.50	0.30	1.5e-03
Endosulfan I	ND	5.0e-05 H	2.5e-05	ND	ND	ND	0.50	0.30	ND
Dieldrin	ND	5.0e-05 I	2.5e-05	1.6e+01 H	1.6e+01 I	3.2e+01	0.50	0.30	ND

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES
USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical	Chronic Reference Dose (mg/kg-d)			Slope Factor $(mg/kg\text{-}d)^{-1}$			Chemical Absorption Estimate (unitless)		Dermal Permeability Constant
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal	Oral	Dermal	(cm/hr)
4,4'-DDE	ND	ND	ND	ND	3.4e-01 I	3.8e-01	0.90	0.30	1.8e-01
Endrin	ND	3.0e-04 I	1.5e-04	ND	ND	ND	0.50	0.30	ND
Endosulfan II	ND	5.0e-05 H	2.5e-05	ND	ND	ND	0.50	0.30	ND
4,4'-DDD	ND	ND	ND	ND	2.4e-01 H	4.8e-01	0.50	0.30	3.0e-01
Endosulfan sulfate	ND	5.0e-05 H8	2.5e-05	ND	ND	ND	0.50	0.30	ND
4,4'-DDT	ND	5.0e-04 I	2.5e-04	3.4e-01 H	3.4e-01 I	6.8e-01	0.50	0.30	3.0e-01
Methoxychlor	ND	5.0e-03 I*	2.5e-03	ND	ND	ND	0.50	0.30	ND
Endrin ketone	ND	ND	ND	ND	ND	ND	0.50	0.30	ND
alpha-Chlordane	ND	6.0e-05 H	3.0e-05	1.3e+00 H	1.3e+00 H	2.6e+00	0.50	0.30	ND
gamma-Chlordane	ND	6.0e-05 H	3.0e-05	1.3e+00 H	1.3e+00 H	2.6e+00	0.50	0.30	ND
Toxaphene	ND	ND	ND	1.1e+00 H	1.1e+00 I	2.2e+00	0.50	0.30	ND
PCB	ND	ND	ND	ND	7.7e+00 H	2.6e+01	0.30	0.08	5.3e-01
METALS									
Aluminum	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Antimony	ND	4.0e-04 I	2.0e-05	ND	ND	ND	0.05	0.01	1.5e-03
Arsenic	ND	1.0e-03 H2	9.5e-04	5.0e+01 H	1.8e+00 6	1.9e+00	0.95	0.01	1.5e-03
Barium	1.0e-04 H	7.0e-02 I*	3.5e-03	ND	ND	ND	0.05	0.01	1.5e-03
Beryllium	ND	5.0e-03 I	5.0e-04	ND 11*	4.3e+00 I	4.3e+01	0.10	0.01	1.5e-03
Cadmium (water)	ND 2	5.0e-04 I	3.5e-05	ND 11*	ND	ND	0.07	0.01	1.5e-03
Cadmium (food/soil)	ND 2	1.0e-03 I	7.0e-05	ND 11*	ND	ND	0.07	0.01	1.5e-03
Calcium	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Chromium III	2.0e-06 H	1.0e+00 H	5.0e-01	ND	ND	ND	0.50	0.01	2.1e-03
Chromium VI	2.0e-06 H2*	5.0e-03 I	2.5e-03	ND 11*	ND	ND	0.50	0.01	2.1e-03
Cobalt	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Copper	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Iron	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Lead	ND	ND 1	ND	ND	ND	ND	0.50	0.01	1.5e-03
Magnesium	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Manganese	4.0e-04 I*	1.0e-01 I*	4.0e-03	ND	ND	ND	0.04	0.01	1.5e-03
Mercury	3.0e-04 H2*	3.0e-04 H2	4.5e-05	ND	ND	ND	0.15	0.01	1.5e-03
Nickel	ND	2.0e-02 I2	2.0e-03	8.4e-01 4	ND	ND	0.10	0.01	1.5e-03
Potassium	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Selenium	ND	ND 2	ND	ND	ND	ND	1.00	0.01	1.5e-03
Silver	ND	3.0e-03 I	3.0e-04	ND	ND	ND	0.10	0.01	1.5e-03
Sodium	ND	ND	ND	ND	ND	ND	0.05	0.01	1.5e-03
Thallium	ND	7.0e-05 H	3.5e-06	ND	ND	ND	0.05	0.01	1.5e-03
Vanadium	ND	7.0e-03 H	3.5e-04	ND	ND	ND	0.05	0.01	1.5e-03
Zinc	ND	2.0e-01 H2	6.0e-02	ND	ND	ND	0.30	0.01	1.5e-03

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Chemical	Chronic Reference Dose (mg/kg-d)			Slope Factor $(mg/kg\text{-}d)^{-1}$			Chemical Absorption Estimate (unitless)		Dermal Permeability Constant (cm/hr)
	Inhalation	Oral	Dermal	Inhalation	Oral	Dermal	Oral	Dermal	
Cyanide	ND	2.0e-02 I	1.4e-02	ND	ND	ND	0.70	0.01	1.5e-03
TIC Groupings									
Propyl Benzenes	9.0e-03 H*	4.0e-02 H	2.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Propenyl Benzenes	1.0e-02 H	6.0e-03 H	3.0e-03	ND	ND	ND	0.50	0.30	1.0e+00
Ethyl Methyl Benzenes	2.0e+00 H*	2.0e-01 I*	2.0e-01	ND	ND	ND	1.00	0.30	1.0e+00
Diethyl Benzenes	1.0e+00 I*	1.0e-01 I	5.0e-02	ND	ND	ND	0.50	0.30	1.4e+00
Methyl Propyl Benzenes	9.0e-03 H*	4.0e-02 H	2.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Methyl Ethenyl Benzenes	1.0e-02 H	6.0e-03 H	3.0e-03	ND	ND	ND	0.50	0.30	5.0e-03
Methyl Phenyl Benzenes	ND	4.0e-03 H2	3.4e-03	ND	ND	ND	0.84	0.30	5.0e-03
Trimethyl Benzenes	5.7e-01	4.0e-01	4.0e-01	ND	ND	ND	1.00	0.30	1.0e+00
Dimethyl ethyl benzenes	1.0e+00 I*	1.0e-01 I	5.0e-02	ND	ND	ND	0.50	0.30	1.4e+00
Tetramethyl Benzenes	5.7e-01	4.0e-01	4.0e-01	ND	ND	ND	1.00	0.30	1.0e+00
Oxygenated Benzenes	ND	1.0e-01 H	5.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Halogenated Benzenes	ND	2.0e-02 H	1.0e-02	ND	ND	ND	0.50	0.30	5.0e-03
Nitrogenated Benzenes	2.0e-03 H2*	5.0e-04 I	2.5e-04	ND	ND	ND	0.50	0.30	1.0e+00
Cyclic alkanes	ND D	ND	ND	ND	ND	ND	0.50	0.00	1.0e+00
Cyclic Alkenes	ND D	ND	ND	ND	ND	ND	0.50	0.00	1.0e+00
Halogenated Alkanes	3.0e-01 H2	9.0e-02 I2	9.0e-02	ND	ND	ND	1.00	0.30	1.0e+00
n-chain Alkanes	2.0e-01 H*	6.0e-02 H*	3.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Branched Alkanes	2.0e-01 H*	6.0e-02 H*	3.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Branched Alkenes/Alkynes	ND D	ND	ND	ND	ND	ND	0.50	0.00	1.0e+00
Ethers	ND	5.0e-01 H	2.5e-01	ND	ND	ND	0.50	0.30	1.7e-02
Methylated Naphthalenes	ND	4.0e-03 H2	3.4e-03	ND	ND	ND	0.84	0.30	5.0e-03
Phthalates	ND	2.0e+00 H	1.0e+00	ND	ND	ND	0.50	0.30	5.0e-03
Methylated Phenols	ND	5.1e-02 I	4.1e-02	ND	ND	ND	0.80	0.30	1.8e-02
Methylated Ketones	ND	1.0e-01 I	9.5e-02	ND	ND	ND	0.95	0.30	1.0e+00
Simple Ketones	9.0e-02 H2	5.0e-02 I	2.5e-02	ND	ND	ND	0.50	0.30	1.0e+00
Cyclic Ketones	ND	2.0e-01 I	1.0e-01	ND	4.1e-03 I*	8.2e-03	0.50	0.30	1.0e+00
Diols	ND	2.0e+00 H	1.0e+00	ND	ND	ND	0.50	0.30	5.0e-03
Simple Alcohols	ND	1.0e-01 H	5.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Cyclic Alcohols	ND	3.0e-01 H	1.5e-01	ND	ND	ND	0.50	0.30	5.0e-03
Oxygenated Alcohols	2.0e-02 H	ND	ND	ND	ND	ND	0.50	0.30	5.0e-03
Cyclic Acids	ND	4.0e+00 I	3.0e+00	ND	ND	ND	0.75	0.30	5.0e-03
Non-Cyclic Acids	3.0e-04 H	8.0e-02 H	4.0e-02	ND	ND	ND	0.50	0.30	1.0e+00
Amines	ND	5.0e-01 H	2.5e-01	ND	ND	ND	0.50	0.30	1.0e+00
PCBs	ND	ND	ND	ND	7.7e+00 H	2.6e+01	0.30	0.00	5.0e-03
Furans	ND	2.0e-03	1.0e-03	ND	ND	ND	0.50	0.30	1.0e+00

CHEMICAL TOXICITY VALUES AND ABSORPTION ESTIMATES
USED FOR RISK QUANTIFICATION

American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Notes:

Toxicity values were obtained from the U.S. EPA's Integrated Risk Information System (IRIS), U.S. EPA's "Health Effects Assessment Summary Tables" (HEAST, Annual FY-1991), and information provided by U.S.EPA Environmental Criteria Assessment Office (ECAO). Toxicity values for the TIC groupings are values for the representative compounds.

Chemical specific information pertaining to the oral and dermal absorption of compounds was provided by ECAO. In the absence of chemical specific values, it was assumed that the oral absorption efficiency for organic compounds and metals was 50 % and 5 %, respectively. The dermal absorption estimates were assumed to be 30% for organic compounds and 1.0 % for metals. The oral and dermal absorption estimates are presented as unitless values where 1.0 represents 100 % (complete) absorption. Chemical-specific dermal permeability constants were obtained from the U.S. EPA "Superfund Exposure Assessment Manual" (SEAM) 1988, or the ECAO. As required by the U.S.EPA, when chemical-specific information is not available, default values were assigned to represent chemical permeability, as footnoted.

Reference Doses and Slope Factors designated for the dermal route of exposure are not provided in the U.S. EPA information sources, but were calculated from corresponding values for the oral route of exposure. These values are used to calculate risks associated with chemical dose estimates based on an absorbed (in contrast to an administered) level of chemical. All chemical dose estimates for the dermal route of exposure are based on absorbed chemical levels. The following relationships were used to derive dermal toxicity values:

Oral Reference Dose (administered) x Oral Absorption Estimate = Dermal Reference Dose (absorbed)
Oral Slope Factor (administered) / Oral Absorption Estimate = Dermal Slope Factor (absorbed)

FOOTNOTES - (listed to the right of the value)

I = Verified in IRIS 5/15/91
H = Values from HEAST FY-1991
D = 'Data inadequate for quantitative risk assessment' (HEAST); applies to all RfDs for this compound.
ND = Value not determined for this compound.
C = Values from Interim Guidance for Dermal Exposure Assessment. (OHEA-E-367, 3/91, Review Draft)
S = Values from the Superfund Environmental Assessment Manual (EPA/540/1-88/001) Table A-4.
* = Value updated 5/91 (Revised from draft risk assessment)
1 = Value withdrawn by IRIS pending further review.
2 = Compound under IRIS review.
3 = Total carcinogenic PAHs; RfDs and SF values from Benzo[a]pyrene used.
4 = Nickel slope factor for nickel refinery dust.
5 = IRIS not queried for this compound
6 = Values from ECAO Technical Support Center.
7 = Baranowska-Dutkiewic, B. 1981. Absorption of Hexavalent Chromium in Man. Arch. Toxicol., 47: 47-50.
8 = Value for endosulfan used for endosulfan sulfate.

Dermal Permeability Constant Default Values:
- Volatiles - Toluene (1.01e+00) as required by U.S.EPA.
- Semivolatiles - 2-Butanone (5.0e-03) as required by U.S.EPA.
- Pesticides - Values from ECAO. Total PCBs use Aroclor 1248.
- Inorganics - water (1.5e-03)

JAH/jah/EAG/KJD
[acs.2020]tox-table.w20
9/3/91

It is important to note that risks due to exposure to lead in soils and waste areas were not evaluated because USEPA has not developed a CPF or RfD for lead. Until a CPF or RfD is developed, USEPA is using the Agency for Toxic Substances and Disease Registry's finding that lead levels of 500 to 1,000 mg/kg in soils can cause increased blood lead levels in children as a basis for assessing risks due to lead. Lead concentrations in waste areas and in some other site soils exceed 500 mg/kg and thus may result in adverse health effects under the scenarios discussed below. U.S. EPA now believes that the best approach in evaluating lead contamination involves using the Uptake Biokinetic Model as a risk assessment tool to predict blood lead levels and develop appropriate clean-up standards. Specific clean-up standards may be modified during design based upon the results of this model.

Exposure Assessment

The exposure assessment identified potential pathways for contaminants of concern to reach the receptors and the estimated contaminant concentration at the point of exposure. Estimated exposures to contaminated media were calculated based on a reasonable maximum exposure (RME) scenario, in accordance with the National Contingency Plan (NCP, 40 CFR Part 300), under both current and projected future land use conditions. The exposure pathways evaluated in the BlRA are summarized in Table 5.

The current land use scenario takes into account that there are residents who have access now and will have access in the future to contaminated areas of the site. It is therefore plausible that off-site residents, including trespassers, may be exposed to contaminants at the site. ACS continues to operate and thus, site employees represent a population potentially exposed to site contamination.

The future land use scenario takes into account that the site is zoned general industrial. However, there is residential zoning adjacent to the site and some residences exist within the industrial zoned areas. It may therefore be possible that the site, or areas near the site, could be developed for residential use.

<u>Current-Use Conditions - Off-Site Residents</u>

Zoning in the immediate vicinity of ACS is industrial, light industrial, or residential. The current use exposure assessment evaluated the following pathways for Off-Site Residents: incidental ingestion and dermal contact of upper aquifer ground water; ingestion, dermal contact, and inhalation of lower aquifer ground water; inhalation of volatile emissions released from subsurface contaminants; and inhalation of fugitive dusts from surface contaminants.

Table 5

Exposure Pathway Analysis
American Chemical Services RI/FS
Griffith, Indiana

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
CURRENT LAND USE CONDITIONS			
Off-Site residents adjacent to Site.	Ingestion of groundwater from the upper aquifer.	No	Surveys performed at homes adjacent to the Site indicate those with wells in the shallow aquifer do not use them for drinking water; the municipal system is used.
Off-Site residents adjacent to Site.	Dermal contact and incidental ingestion of groundwater from the upper aquifer.	Yes	Some homes adjacent to the Site maintain wells in the upper aquifer and use the water for lawn care and gardening. If contaminated groundwater were to migrate to the off-Site wells, exposure may be possible for garden produce and subsequent human consumption. In addition, children may play in the water (e.g., in swimming pools) and become exposed dermally or through incidental ingestion. However, no testing was performed for these wells because they are not used for drinking water and because if contamination were found, it would be difficult to determine the source, in a region where there exists many industries. Also, the flow of groundwater in the upper aquifer is diverted towards the excavation near the active landfill and by the wetlands which surround the Site, both serving to control off-Site migration of contaminants. Nonetheless, if contaminants in the shallow aquifer migrate to off-Site locations, residents adjacent to the Site may occasionally be exposed, therefore, this pathway was included in the risk assessment.

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Off-Site residents adjacent to Site.	Ingestion and/or other potential exposures to groundwater from the lower aquifer.	Yes	Eight private wells located in the deep aquifer were analyzed during the RI and had no detectable levels of contamination. The ACS and landfill facilities both maintain wells in the lower aquifer; the landfill facility uses their well for drinking water, the use of the well at ACS is for industrial purposes as well as drinking water. There is retardation of contaminant migration vertically due to the confining layer. The potential for exposure to the groundwater in the lower aquifer is considered to be low. Nonetheless, contaminants detected in the lower aquifer were assumed to migrate to off-Site locations where exposure may occur.
Off-Site residents adjacent to Site.	Inhalation of volatiles emissions released from subsurface contaminants.	Yes	The amount of VOCs eminating from the contaminated soils is expected to be low compared to that from the ACS facility and from the air in this region of heavy industry. No samples were taken in the field because of the difficulty in distinguishing air pollutant sources and anthropogenic background. It should be recognized that volatiles released from the Site may pose an exposure to off-Site residents. Predicting the amount of exposure quantitatively would be difficult given the current conditions. Nonetheless, an emission and dispersion model was used to estimate potential releases to air from subsurface contamination.
Off-Site residents adjacent to Site.	Inhalation of fugitive dusts emanating from surface contamination at Kapica/Pazmey.	Yes	There exist unvegetated areas of surface soil contamination at Kapica/Pazmey. These soils may be disturbed via wind erosion and disperse contaminated particulates to off-Site locations. The greatest impact is likely to be on-Site. A particulate erosion and dispersion model has been used to estimate exposure from this pathway.
Off-Site residents adjacent to Site.	Ingestion of garden vegetables and fruits.	No	This pathway was not considered to present substantial risk.
Off-Site residents adjacent to Site.	Fishing, hunting and trapping; terrestrial and aquatic species for consumption.	No	The wetlands do not support fish populations. Hunting and trapping are considered low potential exposure pathways because of small user groups.
Adolescents playing (trespassing) on-Site.	Inhalation of volatiles released from the Site.	Yes	Similar to off-Site residents, estimating exposure via this pathway under current conditions utilized an emissions and dispersion model.

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Adolescents playing (trespassing) on-Site.	Inhalation of fugitive dusts at Kapica/Pazmey.	Yes	Wind erosion may contribute to the total exposure for a trespasser coming on-Site at Kapica/Pazmey.
Adolescents playing (trespassing) on-Site.	Incidental ingestion of, and dermal contact with, contaminated soils on-Site.	Yes	Surface contamination is evident at Kapica/Pazmey. Children playing (trespassing) on-Site at this location may be exposed occasionally via the pathways indicated. Other areas of the RI/FS Site where contaminated soils exist are covered with clean material and/or have extreme access limitations (i.e., ACS).
Adolescents playing (trespassing) on-Site.	Incidental ingestion of, and dermal contact with, contaminants detected in wetland surface water and sediments and in drainage ditches.	Yes	This pathway is evaluated to assess the risks associated with surface water and sediment. Contamination has been detected in these media.
On-Site workers at the ACS facility.	Direct contact with soils, sediments and lagoon waters.	No	Contaminated soils and sediments have been covered by clean cover material and/or building construction. The surface water in the lagoon has been analyzed and indicates low contamination. The lagoon is the only surface water feature on the Site. In addition, workers on-Site wear health and safety protection, and must comply with OSHA safety requirements.
On-Site workers at the ACS facility.	Inhalation of airborne contaminants emanating from the Site.	Fugitive Dusts - Yes Volatiles - Yes	Contaminated soils are covered by clean cover material effectively minimizing the potential for generation of contaminated fugitive dust. Volatiles released from subsurface soils to the ambient air may occur, however, exposure to volatiles released from operating processes is likely more substantial. Analysis of volatiles released from subsurface soils has not been performed because of the difficulty in obtaining meaningful estimates of exposure point concentrations given the contributions of pollutants to the air from the ACS facility and anthropogenic background. Nonetheless, emissions and dispersion models have been used to estimate release of volatile contaminants from subsurface materials to the air.
On-Site workers at the ACS facility.	Ingestion and/or other potential exposures to groundwater from the lower aquifer.	No	ACS maintains 4 wells in the deep aquifer, more than 300 ft below the ground surface, in bedrock.

(continued)

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
POTENTIAL FUTURE LAND USE CONDITIONS			
Hypothetical resident living on-Site.	Ingestion of and dermal contact with groundwater from the upper aquifer. Inhalation of volatiles released while showering.	Yes	Hypothetical.
	Ingestion of and dermal contact with groundwater from the lower aquifer. Inhalation of volatiles released while showering.	Yes	Hypothetical.
	Dermal contact with and incidental ingestion of unearthed subsurface soils.	Yes	Hypothetical - to address risks associated with subsurface soils, it was assumed that contaminated subsurface soils are unearthed and present direct exposure potential to residents living on-Site.
	Direct contact with and incidental ingestion of sediments.	Yes	Similar exposure as current use scenario.
	Direct contact (dermal and incidental ingestion) with surface water.	Yes	Similar exposure as current use scenario.
	Inhalation of volatiles released to air on-Site.	Yes	24-hour/day exposure to volatiles.
	Inhalation of particulate released from unearthed subsurface soils.	No	Assume vegetative cover in residential setting minimizes this pathway; addressed under current use scenario.

KJD/vlr/BJC
[ccf-400-91]
60251.17-MD

Current-Use Conditions - Trespassers

The current-use exposure assessment evaluated the following pathways for Trespassers: inhalation of volatiles and fugitive dusts released from the site; incidental ingestion and dermal contact with contaminated soils on-site; incidental ingestion of and dermal contact with contaminants detected in wetlands, surface water and sediments in drainage ditches.

Current-Use Conditions - On-site Workers at ACS Facility

The current-use exposure assessment evaluated the following pathways for on-site workers: inhalation of volatiles and fugitive dusts released from the site.

Future-Use Conditions

The future-use exposure assessment evaluated the following pathways for a resident living on-site: ingestion and dermal contact of contaminated ground water from the lower or upper aquifer; inhalation of volatiles released from contaminated lower or upper aquifer; dermal contact and incidental ingestion of contaminated soils, sediments and surface water; inhalation of volatiles released to ambient air.

Risk Characterization

The risk characterization combines the chronic daily intakes developed in the exposure assessment with the toxicity information collected in the toxicity assessment to assess potential human health risks from contaminants at the site. For carcinogens, results of the risk assessment are presented as an excess lifetime cancer risk, or the probability that an individual will develop cancer as a result of a 70-year lifetime exposure to site contaminants. These risks are probabilities that are generally expressed in scientific notation (e.g. 1 x 10-6 or 1E-06). An excess lifetime cancer risk of 1 x 10-6 indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of exposure to conditions at a site.

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 contaminant'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 exposures within a single medium or across media.

Results of the risk characterization are detailed in Table 6 and discussed below.

Current-Use Conditions

The greatest calculated potential risk under current-use conditions was to children exposed to contaminated upper aquifer ground water. Dermal absorption exposure to contaminated ground water results in an excess cancer risk of 1.7 x 10-2. Benzene contributes 80 percent of this risk, with vinyl chloride contributing almost 17 percent. Non-cancer health effects were at a level of concern primarily from dermal contact to 4-methyl-2-pentanone.

For trespassing children, the total excess cancer risk is 6.3 x 10-3, mainly from dermal absorption exposure to PCB-contaminated soils. Noncancer health effects are also unacceptable due to the inhalation and dermal absorption pathways for a number of contaminants.

For on-site ACS workers, the total excess cancer is 1.6 x 10-3, mainly due to volatiles emanating from buried wastes (based on modeling). Most of this risk comes from 1,1 dichloroethene, chloroform, and carbon tetrachloride. Noncancer health effects are also unacceptable for the inhalation pathway due to non-cyclic acids and vinyl chloride.

For adult off-site residents, the total lifetime excess cancer risk for all pathways was 4.5 x 10-4. Most of this risk comes from ingestion of arsenic and bis(2-chloroethyl)ether in lower aquifer ground water and inhalation of several volatile compounds. Noncancer health effects are also unacceptable for the inhalation pathway due to a number of contaminants.

Future-Use Conditions

If a home with a private well were built on the following locations at the site, residents would be exposed to the following lifetime excess cancer risk: 9.7 x 10-2 for the On-site Containment Area; 1.3 x 10-1 for the Still Bottoms/Treatment Lagoon Area; 2.4 x 10-1 for the Off-site Containment Area; and 1.1 x 10-1 for the Kapica/Pazmey Area. Future site residents would also be exposed to unacceptable noncancer health effects at all locations.

Table 6

SUMMARY OF HAZARD INDICES AND CANCER RISKS FOR POTENTIALLY EXPOSED POPULATIONS
American Chemical Services NPL Site
Remedial Investigation
Griffith, Indiana

Population/Exposure Pathway	Table Number	Hazard Indices: Ingestion	Hazard Indices: Dermal Absorption	Hazard Indices: Inhalation	Cancer Risks: Ingestion	Cancer Risks: Dermal Absorption	Cancer Risks: Inhalation
CURRENT LAND USE CONDITIONS							
Off-Site Resident-Adult							
Groundwater, Lower Aquifer	7-19	8.1e-01	2.7e-02	3.5e-01	2.6e-04	1.6e-06	2.7e-05
Ambient Air, VOC	7-20	-	-	9.3e-01	-	-	1.6e-04
Ambient Air, Dust	7-21	-	-	3.4e-04	-	-	5.2e-09
Population Total		2.1e+00			4.5e-04		
Off-Site Resident-Child							
Groundwater, Upper Aquifer	7-22	3.2e+00	1.5e+02	-	2.8e-04	1.7e-02	-
Population Total		1.5e+02			1.7e-02		
Trespasser-Child							
Surface Soils, Kapica-Pazmey	7-23	3.7e-01	1.2e+01	-	9.3e-05	5.5e-03	-
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	
Ambient Air, VOC	7-26	-	-	5.3e+00	-	-	2.9e-04
Ambient Air, Dust	7-27	-	-	3.9e-04	-	-	2.0e-09
Population Total		1.9e+01			6.3e-03		
ACS Worker							
Ambient Air, VOC	7-28	-	-	9.9e+00	-	-	1.6e-03
Ambient Air, Dust	7-29	-	-	7.4e-04	-	-	1.1e-08
Population Total		9.9e+00			1.6e-03		

(Continued)

Population/Exposure Pathway	Table Number	Hazard Indices: Ingestion	Hazard Indices: Dermal Absorption	Hazard Indices: Inhalation	Cancer Risks: Ingestion	Cancer Risks: Dermal Absorption	Cancer Risks: Inhalation
FUTURE LAND USE CONDITIONS							
On-Site Resident - On-Site Containment Area							
Groundwater, Lower Aquifer	7-30	9.3e-01	3.1e-02	3.5e-01	3.5e-04	2.1e-06	3.9e-05
Groundwater, Upper Aquifer	7-31	2.0e+02	2.0e+01	1.1e+02	6.0e-02	9.7e-03	1.7e-02
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	-
Ambient Air, VOC	7-32	-	-	1.6e+01	-	-	2.7e-03
Soils	7-33	1.2e+00	4.9e+01	-	1.9e-04	6.6e-03	-
Population Total*			4.0e+02			9.7e-02	
On-Site Resident - Still Bottoms and Treatment Lagoons							
Groundwater, Lower Aquifer	7-30	9.3e-01	3.1e-02	3.5e-01	3.5e-04	2.1e-06	3.9e-05
Groundwater, Upper Aquifer	7-31	2.0e+02	2.0e+01	1.1e+02	6.0e-02	9.7e-03	1.7e-02
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	-
Ambient Air, VOC	7-32	-	-	1.6e+01	-	-	2.7e-03
Soils	7-34	8.3e+00	4.1e+02	-	8.8e-04	3.8e-02	-
Population Total*			7.7e+02			1.3e-01	
On-Site Resident - Off-Site Containment Area							
Groundwater, Lower Aquifer	7-30	9.3e-01	3.1e-02	3.5e-01	3.5e-04	2.1e-06	3.9e-05
Groundwater, Upper Aquifer	7-31	2.0e+02	2.0e+01	1.1e+02	6.0e-02	9.7e-03	1.7e-02
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	-
Ambient Air, VOC	7-32	-	-	1.6e+01	-	-	2.7e-03
Soils	7-35	1.8e+01	1.0e+03	-	3.3e-03	1.5e-01	-
Population Total*			1.4e+03			2.4e-01	

(Continued)

Population/Exposure Pathway	Table Number	Hazard Indices: Ingestion	Hazard Indices: Dermal Absorption	Hazard Indices: Inhalation	Cancer Risks: Ingestion	Cancer Risks: Dermal Absorption	Cancer Risks: Inhalation
On-Site Resident - Surface Soils, Kapica-Pazmey							
Groundwater, Lower Aquifer	7-30	9.3e-01	3.1e-02	3.5e-01	3.5e-04	2.1e-06	3.9e-05
Groundwater, Upper Aquifer	7-31	2.0e+02	2.0e+01	1.1e+02	6.0e-02	9.7e-03	1.7e-02
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	
Ambient Air, VOC	7-32	-	-	1.6e+01	-	-	2.7e-03
Soils	7-36	1.6e+00	3.3e+01	-	1.2e-03	4.4e-02	-
Population Total*			3.8e+02			1.4e-01	
On-Site Resident- Soils All depths Kapica-Pazmey							
Groundwater, Lower Aquifer	7-30	9.3e-01	3.1e-02	3.5e-01	3.5e-04	2.1e-06	3.9e-05
Groundwater, Upper Aquifer	7-31	2.0e+02	2.0e+01	1.1e+02	6.0e-02	9.7e-03	1.7e-02
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.2e-04	
Ambient Air, VOC	7-32	-	-	1.6e+01	-	-	2.7e-03
Soils	7-37	1.6e+00	3.4e+01	-	4.1e-04	1.8e-02	-
Population Total*			3.8e+02			1.1e-01	

(Continued)

Population/Exposure Pathway	Table Number	Hazard Indices: Ingestion	Hazard Indices: Dermal Absorption	Hazard Indices: Inhalation	Cancer Risks: Ingestion	Cancer Risks: Dermal Absorption	Cancer Risks: Inhalation
Multi-Population Assessment (1)							
Off-Site Resident - Adult & Off-Site Resident - Child							
Off-Site Resident Adult							
Groundwater, Lower Aquifer	7-19	8.1e-01	2.7e-02	3.5e-01	2.6e-04	1.6e-06	2.7e-05
Ambient Air, VOC	7-20	-	-	9.3e-01	-	-	1.6e-04
Ambient Air, Dust	7-21	-	-	3.4e-04	-	-	5.2e-09
Off-Site Resident-Child							
Groundwater, Upper Aquifer	7-22	3.2e+00	1.5e+02	-	2.8e-04	1.7e-02	
Population Total			1.6e+02			1.7e-02	
Off-Site Resident - Adult & Trespasser - Child (2)							
Off-Site Resident-Adult							
Groundwater, Lower Aquifer	7-19	8.1e-01	2.7e-02	3.5e-01	2.6e-04	1.6e-06	2.7e-05
Ambient Air, VOC	7-20	-	-	9.3e-01	-	-	1.6e-04
Ambient Air, Dust	7-21	-	-	3.4e-04	-	-	5.2e-09
Trespasser-Child							
Surface Soils, Kapica - Pazmey	7-23	3.7e-01	1.2e+01	-	9.3e-05	5.5e-03	-
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	
Ambient Air, VOC	7-26	-	-	5.3e+00	-	-	2.9e-04
Ambient Air, Dust	7-27	-	-	3.9e-04	-	-	2.0e-09
Population Total			2.1e+01			6.7e-03	

(Continued)

Population/Exposure Pathway	Table Number	Hazard Indices: Ingestion	Hazard Indices: Dermal Absorption	Hazard Indices: Inhalation	Cancer Risks: Ingestion	Cancer Risks: Dermal Absorption	Cancer Risks: Inhalation
Off-Site Resident - Adult & Off-Site Resident - Child & Trespasser - Child (2)							
Off-Site Resident Adult							
Groundwater, Lower Aquifer	7-19	8.1e-01	2.7e-02	3.5e-01	2.6e-04	1.6e-06	2.7e-05
Ambient Air, VOC	7-20	-	-	9.3e-01	-	-	1.6e-04
Ambient Air, Dust	7-21	-	-	3.4e-04	-	-	5.2e-09
Off-Site Resident-Child							
Groundwater, Upper Aquifer	7-22	3.2e+00	1.5e+02	-	2.8e-04	1.7e-02	-
Trespasser-Child							
Surface Soils, Kapica - Pazmey	7-23	3.7e-01	1.2e+01	-	9.3e-05	5.5e-03	-
Surface Water	7-24	6.4e-03	1.2e+00	-	1.9e-06	1.6e-04	-
Sediment	7-25	6.7e-04	8.7e-02	-	3.5e-06	2.1e-04	
Ambient Air, VOC	7-26	-	-	5.3e+00	-	-	2.9e-04
Ambient Air, Dust	7-27	-	-	3.9e-04	-	-	2.0e-09
Population Total			1.7e+02			2.4e-02	
Off-Site Resident - Adult & ACS Worker (3)							
Off-Site Resident-Adult							
Groundwater, Lower Aquifer	7-19	8.1e-01	2.7e-02	3.5e-01	2.6e-04	1.6e-06	2.7e-05
Ambient Air, VOC	7-20	-	-	9.3e-01	-	-	1.6e-04
Ambient Air, Dust	7-21	-	-	3.4e-04	-	-	5.2e-09
ACS Worker							
Ambient Air, VOC	7-28	-	-	9.9e+00	-	-	1.6e-03
Ambient Air, Dust	7-29	-	-	7.4e-04	-		1.1e-08
Population Total			1.2e+01			2.1e-03	

(Continued)

(*) Total population hazard indices and cancer risks for future Site residents were calculated by incorporating values for groundwater in the upper aquifer.

(1) In addition to the current use exposures that exist for each population as described above, it is possible that a trespasser may also be an off-Site resident, and on-Site workers may be an off-Site resident. Thus, while pathways have been combined for each individual population, populations have also been combined, as appropriate (e.g., off-Site resident and trespasser) to evaluate the maximum exposure of a population through current land use conditions that is reasonably expected to occur at the Site.

(2) The amount of exposure time to contaminants in air as a trespasser (3 hours/day, 52 days/year, 10 years) is 1.2% of the off-Site resident (24 hours/day, 182 days/year, 30 years). Because making this adjustment does not significantly alter the total multi-population risk, individual population risks were directly added in order to evaluate maximally exposed population risks.

(3) Similarly, ACS exposure to contaminants in air while working on-Site (8 hours/day, 130 days/year, 30 years) is 23.8% of the exposure conditions assumed for the off-Site resident (24 hours/day, 182 days/year, 30 years). This difference does not have a substantial impact on the total multi-population risk. Individual population risks were directly added in order to evaluate maximally exposed population risks.

JAH/vlr/EAG/KJD
[mad-401-89g]
60251.17

Environmental Risks

The ecological assessment for the ACS site identified two types of ecological habitat; upland and wetland. Based on the semi-quantitative, screening-level analysis of ecological risks, upland, wetland and aquatic receptors may be adversely affected by contaminants present in the environmental media within the ACS watershed. The contaminants posing the greatest potential risk are PCBs and lead. Further study will be necessary to assess the need for remedial action in the wetlands.

The U.S. Fish and Wildlife Service report suggested that the area around Griffith, Indiana, may provide habitat for several Federal or State endangered or threatened species. The King Rail, a state threatened species, was observed by the U.S. F&W during a site visit. Other endangered or threatened species are suspected on the site based on observations of available habitat made by the U.S F&W.

The results of the BlRA show that 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.

VII. DESCRIPTION OF ALTERNATIVES

Based on the findings of the Remedial Investigation, the following remedial action goals were developed for the ACS site:

* To ensure that public health and the environment are not exposed to cancer and non-cancer risks greater than the acceptable risk range from drinking water, soils, buried drums/liquid wastes/sludges, or other substances from the ACS site;

* to restore ground water to applicable state and federal standards;

* to reduce the migration of contaminants off site through water, soils or other media; and

* to reduce the potential for erosion and possible migration of contaminants via site surface water and sediments, including areas surrounding Turkey Creek.

Remedial action alternatives to meet these goals were developed in the Feasibility Study and are summarized below:

Alternative 1: No Action

CERCLA requires that a "No Action" alternative be considered, against which all other alternatives are compared. Under this alternative, no remedial action would take place and the site would remain in its present condition. All contamination would remain in the source areas, ground water and soils, with continued potential for entering water supplies. The Griffith Municipal Landfill would continue to operate and would eventually close under State law. Every five years a review would be performed to evaluate the site's threat to public health and the environment.

Total cost of Alternative 1: $ 0
Time to complete: 0
Quantity of waste treated: 0
Quantity of soil treated: 0

Alternative 2: Containment with slurry wall; on-site ground-water gradient control; ground-water pumping and treatment outside slurry wall; and covering contaminated surface soils.

Alternative 2 provides for the construction of a slurry wall around the entire site to minimize off-site contaminant migration and impede ground water flow into the site. The soil/bentonite slurry wall would be keyed into a clay confining layer (approximately 25 feet below the surface). Inward ground water gradients would be maintained by pumping from within the slurry wall. Ground water pumping and treatment would be performed outside the slurry wall to prevent off-site migration. Treated ground water would be discharged or reinjected to the wetlands to prevent dewatering. Contaminant source areas would be covered with a RCRA cap. Operational areas of the ACS facility could be covered with asphalt or concrete.

Total cost of Alternative 2: $ 12,000,000

Total time to complete construction: 1 year
Operation and maintenance period: 30 years
Quantity of waste treated: 0
Quantity of contaminated soil treated: 0

Alternative 3: Site dewatering; Excavation and (a) on-site incineration of buried waste or (b) on-site low temperature thermal treatment of buried waste.

Alternative 3 provides for site dewatering using a series of ground water pumping wells to allow excavation of buried waste. Excavated waste would be treated on-site by incineration (3a) or with a low temperature thermal treatment unit (3b). Treatment residuals would be placed back into the excavation. An infiltration basin would be constructed over each source area in order to use treated ground water to flush contaminants.

Total cost of Alternative 3a: $ 54,800,000
Total cost of Alternative 3b: $ 45,100,000
Total time to complete source treatment: 3 years
Quantity of waste treated: 35,000 - 65,000 cubic yards
Quantity of contaminated soil treated: 0

Alternative 4: In-situ steam stripping of buried waste, soils, and ground water.

Alternative 4 would simultaneously treat buried wastes, soil and on-site ground water in place. In-situ steam stripping consists of injecting steam at approximately 400 degrees fahrenheit through specially designed hollow stem augers which are moved vertically through the unsaturated and saturated zones. PCB-contaminated surficial soils would either be treated in-situ or excavated for off-site landfilling.

Cost of Alternative 4: $ 50,900,000
Total time to complete treatment: 10-20 years
Quantity of waste and soil treated: 135,000 cubic yards

Alternative 5: Site dewatering; Offsite incineration of intact buried drums in the On-site Containment Area; Off-site disposal of miscellaneous debris; In-situ vapor extraction of buried waste and soils.

Alternative 5 provides for site dewatering using a series of ground water pumping wells to allow for excavation of intact drums and miscellaneous debris. Intact buried drums in the On-site Containment Area would be incinerated off-site while miscellaneous debris would be landfilled off-site. PCB-contaminated surficial soils would either be treated in-situ or excavated for off-site landfilling. An in-situ vapor extraction (ISVE) system (possibly four separate systems) would then be installed to treat both soils and buried wastes. A cover would be placed over unpaved surfaces in the areas that require ISVE to prevent short-circuiting of air from the surface and to reduce rainwater infiltration. A pilot scale test would need to be conducted to demonstrate the overall effectiveness of ISVE on materials with such high contaminant levels.

Cost of Alternative 5: $33,000,000
Total time to complete treatment: 5 - 20 years
Quantity of waste and soil treated: 135,000 cubic yards

Alternative 6: Site dewatering; (a) on-site or (b) off-site Incineration of buried drums; offsite disposal of miscellaneous debris; (a) on-site incineration of waste or (b) on-site low temperature thermal treatment of waste; in-situ vapor extraction of soils.

Alternative 6 provides for site dewatering using a series of ground water pumping wells to allow for excavation of intact drums and miscellaneous debris. Intact drums would be incinerated on-site (6a) or off-site (6b) while miscellaneous debris would be landfilled off-site. Areas designated as buried waste or PCB-contaminated soils would either be incinerated on-site (6a) or treated with low temperature thermal treatment (6b). Treatment residuals would be deposited back into the excavations. An in-situ vapor extraction (ISVE) system (possibly four separate systems) would then be installed to treat contaminated soils. Partial installation of a ISVE system could begin following the completion of site dewatering in areas which are not impacted by buried waste excavation activities. A cover would be placed over unpaved surfaces in the areas that require ISVE to prevent short-circuiting of air from the surface and to reduce rainwater infiltration. A pilot scale test would need to be conducted to demonstrate the overall effectiveness of ISVE on materials with such high contaminant levels.

Cost of Alternative 6a: $ 43,100,000 - $ 56,600,000
Cost of Alternative 6b: $ 37,800,000 - $ 46,800,000
Time to complete treatment: 6 - 8 years
Quantity of waste treated: 35,000 - 65,000 cubic yards
Quantity of soil treated: 70,000 - 100,000 cubic yards

Alternative 7: Site dewatering; (a) on-site or (b) off-site Incineration of buried drums; off-site disposal of miscellaneous debris; (a) onsite incineration of buried wastes and soils or (b) onsite low

temperature thermal treatment of buried wastes and soils.

Alternative 7 provides for site dewatering using a series of ground water pumping wells to allow for excavation of intact drums and miscellaneous debris. Intact drums will either be incinerated on-site (7a) or off-site (7b). Miscellaneous debris will be taken off-site for landfilling. Buried waste and contaminated soils will be incinerated on-site (7a) or treated on-site through low temperature thermal treatment (7b). Treatment residuals would be deposited back into the excavations.

Cost of Alternative 7a: $84,600,000
Cost of Alternative 7b: $64,400,000
Time to complete treatment: 2 - 6 years
Quantity of waste and soils treated: 135,000 cubic yards

Alternative 8: Site dewatering; Off-site incineration of buried drums; off-site disposal of miscellaneous debris; (a) landfarming of buried waste and soils or (b) slurry-phase bioreactor treatment of buried waste and soils.

Alternative 8 provides for site dewatering using a series of ground water pumping wells to allow for excavation of buried wastes, contaminated soils, intact drums and miscellaneous debris. Intact drums will be incinerated off-site. Miscellaneous debris will be taken off-site for landfilling. Buried waste and contaminated soils will be treated on-site through biological treatment. Biological treatment would be accomplished by land-farming (8a) or by slurry-phase bioreactors (8b). Treated soils would be deposited back into excavations. Because it is not known if biological treatment would attain appropriate treatment levels, a pilot study would be necessary to evaluate the technology on this contaminant matrix.

Cost of Alternative 8a: $ 34,200,000
Cost of Alternative 8b: $ 43,200,000
Time to Complete treatment: 8 - 15 years (8a)
5 years (8b)
Quantity of waste and soils treated: 135,000 cubic yards

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The NCP requires that alternatives be evaluated on the basis of nine criteria: overall protection of human health and the environment; compliance with applicable, or relevant and appropriate, requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, and volume (TMV) through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. This section compares alternatives with respect to these criteria.

COMPARATIVE ANALYSIS OF ALTERNATIVES ACCORDING TO THE NINE EVALUATION CRITERIA

The remedial action alternatives considered for the ACS site were evaluated in accordance with the nine evaluation criteria. An analysis summary of the alternatives compared to the criteria is provided below.

THRESHOLD CRITERIA

Overall Protection

Alternative 1 does not provide any protection against contaminant exposure through buried waste, soil or ground water contact or possible exposure of emissions from buried wastes and would not prevent future site users from being exposed to unearthed soils or buried wastes resulting from future development of the site. It is therefore eliminated from further analysis.

Buried waste materials are addressed in Alternatives 2 through 8. Alternatives 3, 6, 7 and 8 provide the most protection from buried wastes because the wastes would be excavated and treated. Residual contamination would be left in the ground after treatment under Alternatives 2, 4 and 5. If buried wastes were disturbed under a future use scenario, the risks would be greater for Alternative 2, than Alternatives 4 and 5.

Contaminated soils are addressed in Alternatives 2 through 8. Alternative 7 would provide the most protection from contaminated soils through thermal treatment. Alternative 8 treats contaminated soils biologically and affords a slightly lower degree of protection due to the uncertainty of the technology to adequately handle ACS's contaminant matrix. Residual contaminants would remain in soils in Alternatives 2 through 6. Alternatives 2 and 3 are the least protective, providing natural flushing as the only soil treatment.

Alternatives 4 through 8 provide the most protection for contaminated ground water by applying pumping and treatment of the upper and lower aquifers. Alternatives 2 and 3 provide reduced protection through containment and natural flushing of on-site ground water.

Compliance with ARARs

All alternatives should comply with ARARs. However, the RCRA cap ARAR outlined in alternative 2 also applies to alternatives 3, 6, 7, and 8 if treatment residuals do not meet health-based levels. U.S. EPA has determined that LDR treatability variance levels are not protective because of the high contaminant levels known to exist. Because U.S. EPA has determined that LDR treatability variance levels are not protective for this site, and treatment to health-based levels is necessary, a RCRA cap will not be required for treatment residuals. Alternatives that include excavation and treatment (3, 6, 7, and 8) will require treatability testing to ensure that all RCRA standards are met. Another criterion to be considered is the TSCA cleanup policy for PCB spills. This policy requires that spills resulting in PCB contamination of greater than 50 ppm be cleaned up to a level of 10 ppm and covered with at least 10 inches of clean soil.

PRIMARY BALANCING CRITERIA

Implementability

Alternative 2, requiring containment only, would be easiest to implement. Alternatives 3, 6, and 7 involve proven technologies and have been effective for a wide range of contaminated matrices. Alternatives 5 and 8 have yet to be demonstrated effective on a contaminant matrix or scale analogous to the ACS site. Alternative 4 technology has not been demonstrated on full scale soil and waste cleanups and no known vendor is available.

Short-term Effectiveness

Alternatives 2 through 8 require ground water pumping and treatment and would be equally effective in addressing off-site short-term risk from ground water. Alternatives 2 and 3 would be less effective in addressing on-site ground water contamination. Alternatives which require excavation of wastes and soils (7 and 8) produce potential short-term exposure of contaminants to site workers and nearby residents. Personal protective equipment for remedial workers and VOC emission control addresses this concern for remedial workers, ACS workers and nearby residents. Alternatives which involve excavation of buried waste only and in-situ treatment of contaminated soils (3 and 6) would produce much shorter exposure to site workers and nearby residents and would also remove the majority of site contamination in a relatively short timeframe. Alternatives 4 and 5 attempt to treat buried wastes and contaminated soils in-situ. This would involve a minimum of short-term exposure but unknown effectiveness due to possible buried drums and relatively long timeframes to complete.

Long-term Effectiveness

Alternatives 2 through 8 require ground water pumping and treatment and would be equally effective in truncating continued migration of contaminants in ground water and potential exposure to offsite ground water users. Alternatives 2 and 3 would be less effective in addressing on-site ground water contamination. The buried waste at the site currently does pose an unacceptable risk to public health. There is more uncertainty with Alternative 2 than others in alleviating this risk because its effectiveness is dependent upon the cover material and the slurry wall performing adequately over the long-term. Alternatives which require removal and treatment of wastes (3, 6, 7, and 8) will result in much lower residual contamination and fewer long term maintenance problems. The effectiveness in significantly removing contaminants from wastes through Alternatives 4 and 5 is suspect. Residual contaminants in waste would definitely remain in the ground after treatment in Alternatives 2, 4, and 5.

Alternative 2 provides the same relative level of protection for contaminated soils as is discussed above for buried wastes. Alternative 3 provides only for natural flushing of contaminants from soils. Alternatives 4, 5, 6, 7, and 8 provide for treatment of contaminated soils. Alternatives 5 and 6 use the same technology and would therefore be equally effective. The relative effectiveness of Alternatives 4 and 8 is unknown. Alternative 7 would be the most effective in removing risk from contaminated soils.

Reduction of Toxicity, Mobility and Volume

Both the toxicity, mobility and volume of off-site ground water contaminants would be equally reduced in Alternatives 2 through 8. Alternatives 2 and 3 would be less effective than Alternatives 4 through 8 in reducing on-site ground water contaminant toxicity.

Alternative 2 provides only for containment and flushing of buried waste so this alternative would not significantly reduce the toxicity or volume but is designed to reduce contaminant mobility. The toxicity and volume of contaminants in wastes are reduced in Alternatives 3 through 8. The greatest probable reduction in volume and toxicity would occur with Alternatives 3, 6, and 7. The degree of volume and toxicity reduction in Alternatives 4, 5, and 8 would have to be determined with bench and pilot scale testing. It should be noted that none of the alternatives reduce the volume or toxicity of heavy metals in the waste.

Alternatives 2 and 3 provide only for flushing of contaminated soils and therefore would probably retain the highest residual soil contamination. The effectiveness of Alternative 4 through 8 in reducing contaminant volume, toxicity and mobility on contaminated soils would have to be determined through bench and pilot scale testing. Alternatives 5 and 6 are identical in treatment technology for contaminated soils. Alternative 7 would probably afford the greatest effectiveness.

Cost

Alternatives are evaluated for the costs of capital (construction), operation and maintenance, and present-worth. Cost estimates are presented at the end of each alternative discussed in Section VII.

MODIFYING CRITERIA

State Acceptance

IDEM has been involved throughout the remedial process for ACS and has concurred with the selected remedy (as discussed below).

Community Acceptance

Community acceptance of the selected remedy is discussed in the Responsiveness Summary, which is attached as Appendix B.

IX. THE SELECTED REMEDY

Based on the information collected and developed in the RI/FS and using the comparative analysis of alternatives described above, USEPA has selected Alternative 6b as the most appropriate remedial action at the ACS site. This section contains a detailed description of the selected alternative. A flow chart outlining the basic elements is shown in Figs. 5 and 6.

A note of explanation is necessary to avoid confusion regarding the terminology of site features. The ACS site boundary is defined in Section 1. Within the site boundary individual areas referred to as the On-site Area, the On-site Containment Area, the Off-site Area, and the Off-site Containment Area exist. References made to sending material "off-site" actually mean physically transporting material off-site of the ACS Superfund Site. Likewise, treating "on-site" means physically on the ACS Superfund site and has nothing to do with the above identified site areas.

Fig. 5: SOURCE AREAS/CONTAMINATED SOILS

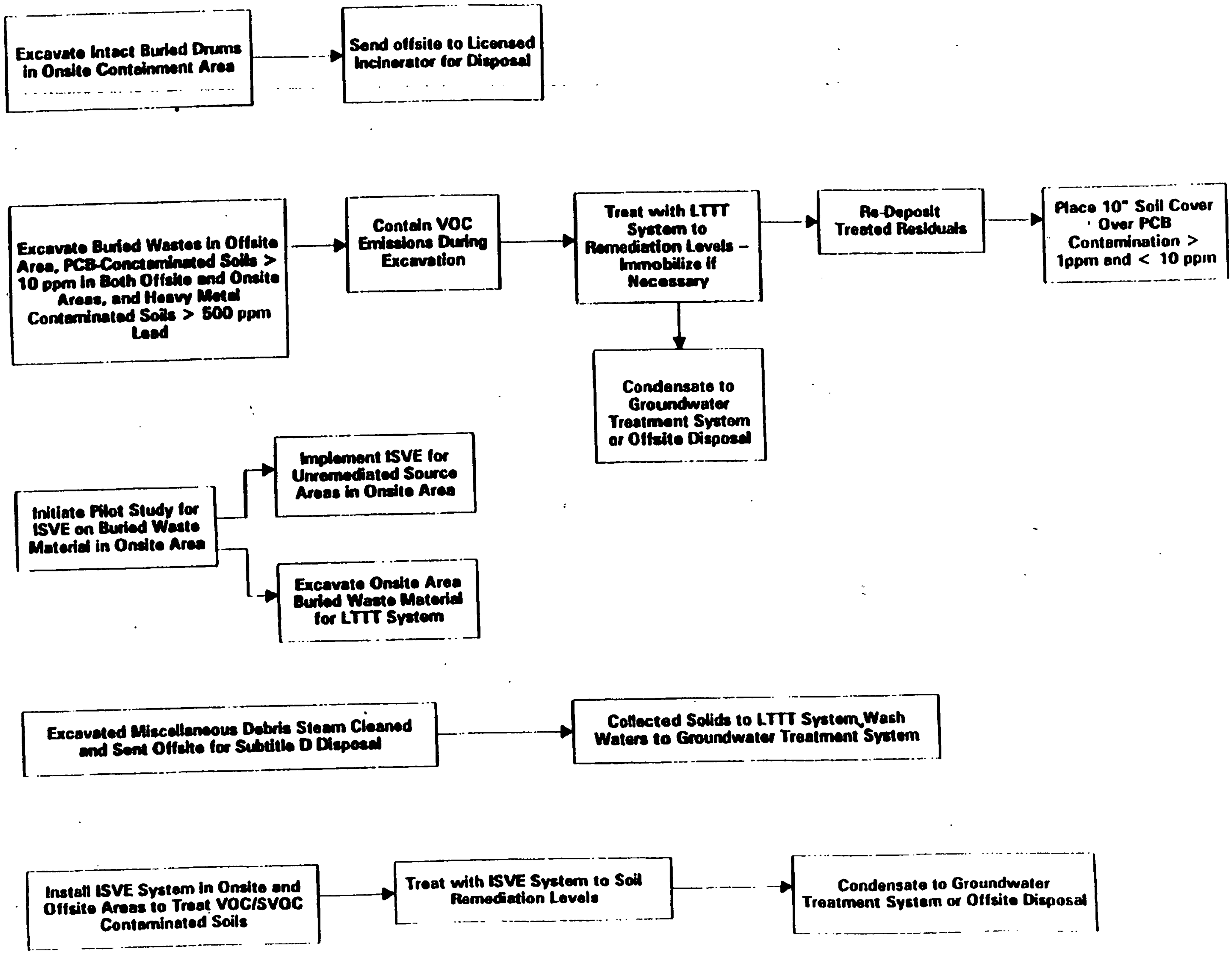
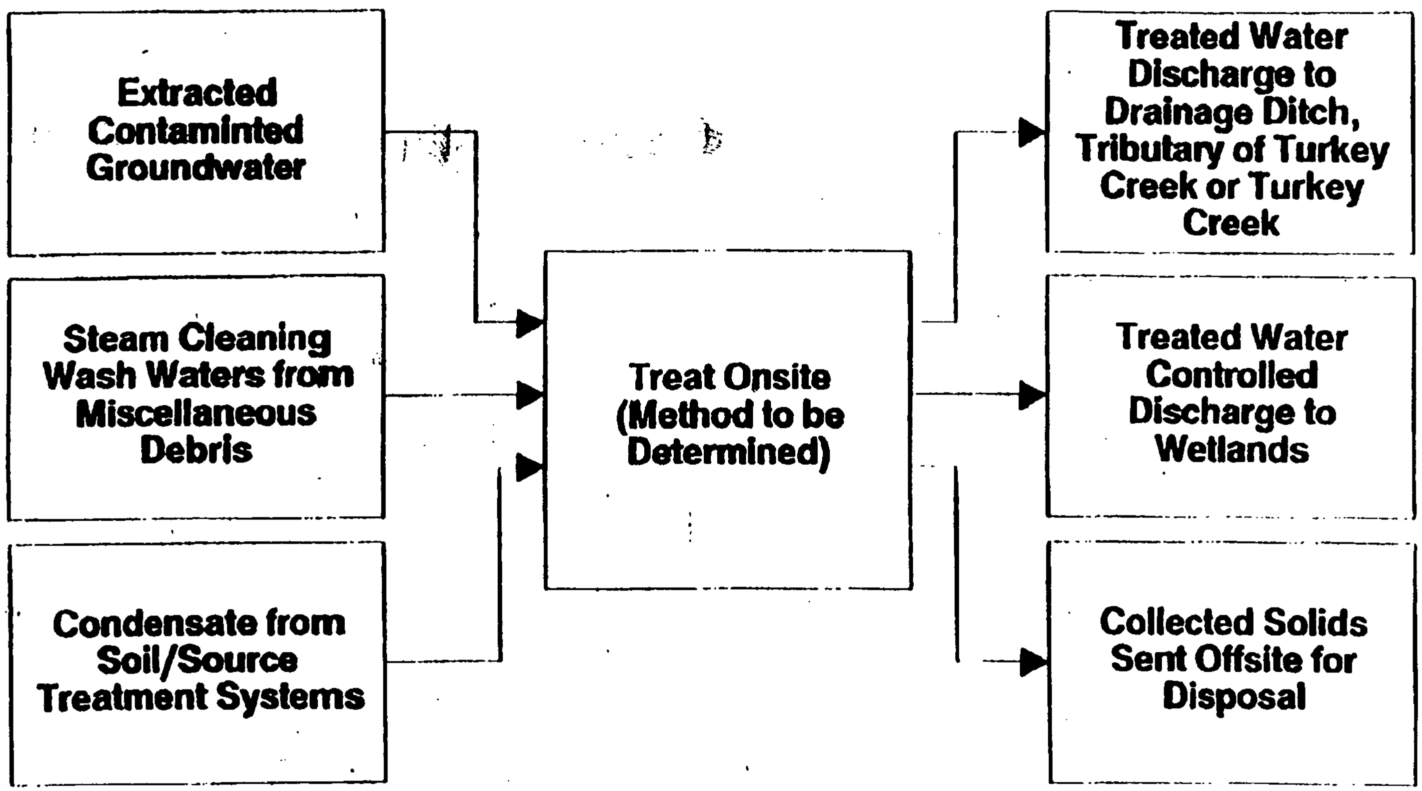


Fig. 6: **GROUNDWATER**



ALTERNATIVE 6B PREFERRED REMEDY:

<u>SITE WIDE:</u> off-site incineration of intact buried drums; off-site disposal of miscellaneous debris; in-situ vapor extraction pilot study for contaminated soils.

<u>ON-SITE AREA:</u> in-situ vapor extraction of contaminated soils; in-situ vapor extraction pilot project for selected buried wastes.

<u>OFF-SITE AREA:</u> in-situ vapor extraction of contaminated soils; on-site low temperature thermal treatment of buried wastes (with vapor emission control during excavation and possible immobilization after treatment); treatment residuals required to meet health-based levels prior to redepositing back into excavations;

<u>GROUND WATER:</u> ground water pumping and treatment; treated water controlled discharge to wetlands; continued evaluation and monitoring of wetlands and, if necessary, remediation, which may require replacement of wetlands.

<u>Ground water</u>

Under the Selected Alternative 6b, a ground water pump and treat system will be installed in the upper and lower ground water aquifers to dewater the site, to contain contaminated ground water within the point of compliance and to ensure that MCLs, a cumulative cancer risk of 1.3 x 10-5 and a cumulative noncancer risk of HI < 1 are attained outside and downgradient of the point of compliance.

The method of ground water treatment to be used will be determined during the design of the system. It is expected that ground water treatment will include technologies involving air stripping, UV/Oxidation, chemical precipitation, and carbon absorption. Permitting the choice to be made during design will provide for the selection of the most appropriate system for the task to be performed by allowing for additional information to be used in the decision. The selection will be made using good engineering practice. The ground water treatment extraction system will meet NPDES substantive requirements and will utilize the best available control technology for treatment and discharge of the treated ground water to surface water or wetlands. U.S. EPA's OSWER Directive 9355.0-28, relating to the control of air emissions at Superfund ground water sites will also be considered in the ground water treatment process selection.

The following discharge options exist for the remaining quantity of treated ground water: discharge to the drainage ditch running through the western wetlands; discharge directly to Turkey Creek or a tributary; and reinjection. The discharge option to the

Hammond POTW, as identified in the proposed plan, has been eliminated because of Hammond's poor compliance history. This option could be reconsidered if Hammond came into compliance. Reinjection of treated ground water after buried waste excavation and ISVE are complete may be considered because nutrient addition to treated ground water could promote bioremediation of any residual SVOC contaminants remaining in the subsurface. Ground water will be discharged in accordance with appropriate NPDES discharge limits, or in the case of controlled discharge to wetlands, Ambient Water Quality Criteria. A portion of the treated ground water will be discharged to the western wetlands in a controlled fashion to prevent wetland dewatering and degradation. Continued wetland evaluation is required based on the conclusions of the USEPA-produced ecological assessment. Wetland remediation will be implemented as part of this remedy, if necessary, to avoid the long and short term adverse impacts associated with the destruction or modification of wetlands.

Ground water remediation levels are provided in Table 7. The point of compliance for ground water remediation levels is the down-gradient site boundary. The site boundary was selected as the point of compliance because site contamination was not found to be limited to discrete, well-defined units. Remediation levels must also be attained outside the site boundary, to the extent of ground water contamination. The intent of the remediation levels outlined in Table 7 is to present a guide to manage risk within the cumulative 10-4 - 10-6 carcinogenic risk range and cumulative noncancer hazard index (HI) of < 1.0.

The ground water will be treated to meet MCLs, to achieve a cumulative cancer risk of 1.3 x 10-5 for carcinogenic contaminants and to achieve a cumulative noncancer risk of HI < 1. Due to the existence of multiple contaminants, clean up of the ground water to MCLs alone would exceed a cancer risk of 1 x 10-4 and thus would not be protective of human health and the environment. Thus the ground water remediation levels for carcinogenic contaminants represent levels that have a carcinogenic risk of 1 x 10-6 or MCLs less than 10-6 risk.

For noncancer contaminants, these remediation levels represent a noncancer risk of HQ =1 for individual contaminants (or MCLs less than 10-6 risk). Based on the number of carcinogenic contaminants, the cumulative risk that must be attained is therefore 1.3 x 10-5 for carcinogenic contaminants.

The actual remediation level will depend on how many noncancer contaminants are detected in compliance monitoring wells and must represent a cumulative HI < 1.0.

Technology limitations and detection limits may affect the attainment of these levels for individual contaminants, however,

TABLE 7: GROUND WATER

Final Remediation Levels			Corresponding Risk	
Chemical	Remediation Level ug/L	Basis	Cancer	NonCancer
Benzene	5.0	MCL	6.5E-07	NA
Vinyl Chloride	0.25	Risk	1.0E-06	NA
PCBs	0.06	Risk	1.0E-06	NA
bis(2-Chloro-ethyl)ether	21.0	Risk	1.0E-06	NA
Arsenic	8.8	Risk	1.0E-06	<.01
PCE	5.0	MCL	6.2E-07	NA
Methylene Chloride	5.0	MCL	5.4E-07	NA
Chloromethane	8.4	Risk	1.0E-06	NA
Beryllium	0.02	Risk	1.0E-06	NA
Trichloroethene	5.0	MCL	2.1E-07	NA
bis(2-Ethylhexyl) phthalate	5.8	Risk	1.0E-06	NA
Cyclic Ketones	5.8	Risk	1.0E-06	NA
Pentachlorophenol	1.0	MCL	1.5E-06	NA
1,4-Dichlorobenzene	3.3	Risk	1.0E-06	NA
Isophorone	19	Risk	1.0E-06	NA
2-Butanone	24,000 - 2,000	HI	NA	1.0-0.08
4-Methyl-2-pentanone	640 - 53	HI	NA	1.0-0.08
Non-Cyclic Acids	280 - 23	HI	NA	1.0-0.08
Acetone	2,300 - 192	HI	NA	1.0-0.08
Branched Alkanes	210 - 18	HI	NA	1.0-0.08

Ethylbenzene	390 - 33	HI	NA	1.0-0.08
Thallium	2.4 - 0.2	HI	NA	1.0-0.08
Dimethyl Ethyl Benzenes	250 - 21	HI	NA	1.0-0.08
1,2-Dichloroethene (cis)	330 - 28	HI	NA	1.0-0.08
Manganese	3,300 - 275	HI	NA	1.0-0.08
4-Methylphenol	1,700 - 142	HI	NA	1.0-0.08
1,1-Dichloroethane	2,200 - 183	HI	NA	1.0-0.08

the cumulative risk must meet 1.3 x 10-5 cumulative cancer risk and a cumulative HI < 1.0 total noncancer risk.

During the 30 or more years of aquifer remediation, the ground water pump and treat system will be monitored and adjusted, as necessary, by the performance data collected during operation. Adjustments to the system may include a more aggressive pump and treat approach including; nutrient introduction to promote bioremediation, alternating pumping at wells to eliminate stagnation points, and pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into ground water.

Source Areas and Contaminated Soils - Cleanup Levels

Under the selected alternative, all buried waste and soil will be treated to a cumulative carcinogenic risk of 3.3 x 10-5, and a cumulative noncancer risk of HI < 1. For carcinogenic contaminants, these remediation levels represent carcinogenic risk of 1 x 10-6 for individual contaminants. Based on the number of carcinogenic contaminants, the cumulative risk that must be attained is therefore 3.3 x 10-5 for carcinogenic contaminants.

For noncancer contaminants, these remediation levels represent a noncancer risk of HQ = 1 for individual contaminants. The range given for individual noncancer contaminants is based on the number of noncancer contaminants detected in site soils. The actual remediation level will depend on how many noncancer contaminants are detected in the particular remediation area and must represent a cumulative HI < 1.0.

Technology limitations and detection limits may affect the attainment of these levels for individual contaminants, however, the cumulative risk must meet 3.3 x 10-5 cumulative cancer risk and a cumulative HI < 1.0 total noncancer risk.

The cleanup level of 500 ppm lead for contaminated soils is based on the Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive 9355.4-02). This guidance sets a clean-up range of 500-1000ppm lead. The most conservative value was chosen due to the large number and high levels of other site contaminants. This clean-up level for lead may need further evaluation and refinement through the use of the U.S. EPA Uptake Biokinetic (UBK) Model.

The cleanup level of 10 ppm PCBs with 10" soil cover is based on TSCA policy for unrestricted access. U.S. EPA guidance suggests a concentration of 1 ppm for PCB cleanup based on the standard exposure assumptions under the residential use scenario. A ten inch soil cover has been estimated to give an additional order of magnitude protection. Therefore, a cleanup level of 10 ppm with

10" of clean soil cover would provide protection at the 10-5 level. Soil and waste exceeding 10 ppm will be treated to 2 ppm PCBs in order to achieve a clean up level equivalent to incineration. If treatment of soil and waste cannot achieve 2 ppm, the soil and waste will be sent offsite in compliance with TSCA.

Compliance with the Land Disposal Restrictions may be achieved through a Soil and Treatability Variance pursuant to 40 CFR 268.44. Such a variance will result in the establishment of treatment levels/ranges for the contaminated soil at the site. However, because of the high site contaminant levels U.S. EPA has determined that the treatment level ranges established through a treatibility variance are not protective of human health and the environment. Residuals from the LTTT process must meet remediation levels identified for contaminated soils set in Table 8 in order to be redeposited onsite. Because clean-up levels are presented as ranges for noncarcinogenic contaminants and flexibility exists with respect to clean-up levels for individual carcinogenic contaminants, LDR treatability variance levels cannot be exceeded for any individual contaminant. Residuals will also be immobilized, if necessary, to attain these standards and RCRA hazardous waste characteristic levels.

Source Areas

Under the selected alternative, intact buried drums in the On-Site Area will be excavated for off-site incineration. The following soils and waste will be excavated and treated by low temperature thermal treatment (LTTT) to meet clean up levels: 1) buried wastes in the Off-site Area; 2) soils contaminated with PCBs at a level greater than 10 ppm in both the On-site and Off-site Areas; and 3) isolated VOC-contaminated soil not within the areas to be addressed by In-situ Soil Vapor Extraction (ISVE). All LTTT residuals will be deposited back into the excavations after meeting appropriate health-based remediation levels identified in Table 8. LTTT treatment residuals can contain up to 2 ppm PCBs, however, in order to be used as cover material treatment residuals must not contain more than 1 ppm total PCBs. PCB treatment criteria cannot be met through dilution of material to be treated. Treatability studies will need to be conducted to determine if LTTT can treat to 2 ppm total PCBs. If the technology fails to meet this cleanup objective then PCB contaminated soils greater than 10 ppm must be sent offsite to a licensed TSCA landfill or incinerator.

Isolated pockets of heavy metal-contaminated soils greater than 500 ppm lead in both the On-Site and Off-Site Areas will also be excavated, treated by LTTT to remove VOCs and SVOCs, possibly immobilized to remove the hazardous waste characteristic for metals, and sent off-site for disposal. Vapor emissions will be contained during excavation and ambient air monitoring will be

TABLE 8: SOIL

Final Remediation Levels			Corresponding Risk	
Chemical	Remediation Level mg/kg	Basis	Cancer	NonCancer
CPAHs	0.0026	Risk	1.0E-06	NA
Tetrachloroethene	1.1	Risk	1.0E-06	NA
bis(2-Ethylhexyl) phthalate	1.1	Risk	1.0E-06	NA
Aldrin	0.002	Risk	1.0E-06	NA
Tricholorethene	5.3	Risk	1.0E-06	NA
Isophorone	7.2	Risk	1.0E-06	NA
Styrene	1.7	Risk	1.0E-06	NA
Pentachlorophenol	0.43	Risk	1.0E-06	NA
Benzene	1.0	Risk	1.0E-06	NA
4,4'-DDD	0.12	Risk	1.0E-06	NA
2,4-Dinitrotoluene	0.044	Risk	1.0E-06	NA
1,1-Dichloroethene	0.098	Risk	1.0E-06	NA
Carbon Tetra-Chloride	0.38	Risk	1.0E-06	NA
bis(2-Chloroethyl) ether	0.027	Risk	1.0E-06	NA
4,4'DDT	0.088	Risk	1.0E-06	NA
Chloroform	9.5	Risk	1.0E-06	NA
Hexachlorobuta-diene	0.36	Risk	1.0E-06	NA
1,2-Dichloroethane	0.64	Risk	1.0E-06	NA
Methylene Chloride	6.2	Risk	1.0E-06	NA
1,2-Dichloropropane	0.42	Risk	1.0E-06	NA
Hexachlorobenzene	0.018	Risk	1.0E-06	NA
gamma-BHC (Lindane)	0.046	Risk	1.0E-06	NA

Cyclic Ketones	7.3	Risk	1.0E-06	NA
1,1,2-Trichloro-ethane	0.51	Risk	1.0E-06	NA
n-Nitrosodiphenyl-amine	12.0	Risk	1.0E-06	NA
1,1,2,2-Tetra-chloroethane	0.28	Risk	1.0E-06	NA
Vinyl Chloride	0.031	Risk	1.0E-06	NA
alpha-BHC	0.0047	Risk	1.0E-06	NA
beta-BHC	0.016	Risk	1.0E-06	NA
2,6-Dinitrotoluene	0.044	Risk	1.0E-06	NA
4,4'-DDE	0.16	Risk	1.0E-06	NA
1,4-Dichlorobenzene	2.4	Risk	1.0E-06	NA
Heptachlor Epoxide	0.0033	Risk	1.0E-06	NA
Antimony	15 - 0.5	HI	NA	1.0-0.03
Tolune	5,000 - 167	HI	NA	1.0-0.03
Cadmium	51 - 2	HI	NA	1.0-0.03
Ethylbenzene	1,300 - 43	HI	NA	1.0-0.03
Barium	2,600 - 87	HI	NA	1.0-0.03
Chromium (VI)	1,400 - 47	HI	NA	1.0-0.03
Naphthalene	82 - 3	HI	NA	1.0-0.03
Nitrogenated Benzenes	6.2 - 0.2	HI	NA	1.0-0.03
n-Chain Alkanes	760 - 25	HI	NA	1.0-0.03

1,1,1-Trichloro-ethane	2,300 - 77	HI	NA	1.0-0.03
Branched Alkanes	770 - 26	HI	NA	1.0-0.03
4-Methyl-2-pentanone	630 - 21	HI	NA	1.0-0.03
Methyl Proply Benzenes	490 - 16	HI	NA	1.0-0.03
Halogentaed Alkanes	2,300 - 77	HI	NA	1.0-0.03
Endosulfan I	0.63 - 0.02	HI	NA	1.0-0.03
Dimethyl Ethyl Benzenes	1,300 - 43	HI	NA	1.0-0.03
1,2-Dichloroethene (cis)	250 - 8.3	HI	NA	1.0-0.03
2-Butanone	620 - 21	HI	NA	1.0-0.03
Non-Cyclic Acids	1,000 - 33	HI	NA	1.0-0.03
Methylated Naphthalenes	85 - 3	HI	NA	1.0-0.03
Acetone	2,400 - 80	HI	NA	1.0-0.03
Chlorobenzene	150 - 5	HI	NA	1.0-0.03
Xylenes (mixed)	26,000 - 867	HI	NA	1.0-0.03
Oxygenated Benzenes	1,200 - 40	HI	NA	1.0-0.03
Diethyl Benzenes	1,300 - 43	HI	NA	1.0-0.03

Propenyl Benzenes	320 - 11	HI	NA	1.0-0.03
Di-n-butylphthalate	2,300 - 77	HI	NA	1.0-0.03
Ethyl Methyl Benzenes	4,900 - 163	HI	NA	1.0-0.03
1,2,4-Trichloro benzene	16 - 0.5	HI	NA	1.0-0.03
Chloroethane	2700 - 90	HI	NA	1.0-0.03

required. Condensate from LTTT or ISVE processes will be properly disposed offsite.

Under the selected alternative, in order to assess whether ISVE technology will work on buried wastes with such high contaminant levels and because buried drums may interfere with the ISVE effectiveness, a pilot study may be conducted on a portion of the buried wastes in the On-site Area. The On-site Area was chosen because it was determined through the RI that buried drums were more accurately defined than in the Off-site Area. This pilot study, if conducted, will be in conjunction with the ISVE system to be developed for all contaminated site soils and will have a defined proof of performance period.

At the end of the performance period, it will be determined by USEPA if in-situ soil vapor extraction is effective on the buried waste in the On-site Area. Confirmation sampling will be required to determine if ISVE can meet health-based levels. If the U.S. EPA determines that the technology is capable of meeting remediation levels then it may be expanded to unremediated portions of the On-site Area.

The potential benefit derived from successful demonstration of ISVE's effectiveness on On-site Area buried waste would be a decrease in the overall cost of remediation and a reduction of the amount of material that would have to be handled for LTTT. If the technology doesn't provide a potential to meet remediation levels or if pilot studies are not conducted then LTTT will be implemented for all buried wastes and contaminated soils.

Even if the pilot study fails to demonstrate that ISVE can meet remediation levels for both buried wastes and contaminated soils, the potential decrease in VOCs might negate the need for elaborate VOC emission control during buried waste excavation, contaminated soil excavation, drum removal, and transportation of waste material and contaminated soil to the Off-site Area LTTT System. With U.S. EPA's approval, studies accessing ISVE's effectiveness on site contamination may be abandoned in favor of implementing LTTT for all buried wastes and contaminated soils.

Regardless of the pilot study results, LTTT will be implemented and completed for buried wastes in the Off-site Area. USEPA has determined that an in-situ technology (i.e. ISVE) is not appropriate for the Off-site Area due to the large number and random distribution of buried drums. However, additional pilot scale testing on other innovative technologies may be conducted providing such testing does not delay the current remediation schedule involving LTTT.

Miscellaneous debris uncovered during excavation activities will be steam-cleaned and sent off-site for disposal. Any intact buried drums excavated will be sent off-site for incineration.

Miscellaneous debris wash waters will be treated in the ground water treatment system or sent offsite.

<u>Contaminated Soils</u>

Both On-site Area and Off-site Area Soils contaminated with VOCs and SVOCs will be treated with ISVE. Remediation levels for contaminated soils are also set in Table 8.

If it is determined by USEPA that final remediation levels cannot be met by ISVE then VOC/SVOC contaminated soil will be excavated, treated by LTTT to health-based standards, and redeposited.

Implementation of an unproven technology through pilot testing on a contaminant matrix and scale found at the ACS site contaminated soils may provide valuable data for remediation of future sites. Additional pilot scale testing on other innovative technologies may be conducted providing any additional testing does not delay the current remediation schedule. Because LTTT will be implemented in the Off-site Area, no time will be lost in the overall remediation of this site.

This alternative has been supplemented by USEPA because alternative 6b, as proposed in the FS, did not address VOC emissions resulting from excavation, heavy metal-contaminated soils outside of defined source areas, and continued evaluation of the wetlands.

<u>Air Emissions, Monitoring, and Institutional Controls</u>

Air emissions from excavation and treatment processes will be controlled and monitored. The need for air emission controls will be triggered by exceedences in Federal or State air quality standards. These processes include excavation of intact drums and miscellaneous debris; soil excavation, consolidation, and treatment associated with the LTTT system; and ISVE treatment. Offgas treatment or other corrective actions will be utilized if excess cancer risk from off-gas chemicals is outside the 10-4 to 10-6 risk range for nearby residences or site workers.

The remedy will also include (1) long-term ground water monitoring to ensure that action levels are being met, (2) site fencing and, to the extent possible, deed restrictions to prevent use of the ground water in contaminated aquifers under the site, and (3) to the extent possible, deed notices or advisories will be provided for protection from contaminants and to inform off-site users of ground water use recommendations until cleanup levels are met.

A cost estimate for the selected remedy is provided in Table 9. This cost estimate represents the scenario where ISVE attains

Table 9

PROPOSED PLAN (THERMAL OFF SITE/ ISVE ON SITE) COST ESTIMATE

DIRECT CAPITAL COSTS

ITEM	UNIT	QUANTITY	UNIT COST	COST
Surface Water Diversion	lump sum	1		$200,000
Site Preparation	lump sum	1		$525,000
Groundwater Extraction System	wells	24		$500,000
Groundwater Treatment System	gpm	200		$1,200,000
Remove ACS Tank Farms	lump sum	1		$150,000
Excavation of Drums	drums	500		$80,000
Repackaging and Off-site Incineration of Drums	drums	500		$360,000
Off-site Disposal of Drum and Miscellaneous Debris	lump sum	1		$1,000,000
Off-site Disposal of PCB Soil Residue at RCRA/TSCA Landfill	cu yds	1,000		$700,000
Treatability/Pilot Study	lump sum	1		$200,000
Portable Building	lump sum	1		$168,000
On-site Low Temp	cu yds	18,000	300	$5,400,000
Surface Restoration or Capping	lump sum	1		$525,000
Offsite Disposal of Metals	cu yds	2,500	250	$625,000
Vapor Extraction Pilot Study	lump sum	2	200,000	$400,000
Vapor Extraction	systems	4		$800,000
Wetland Assessment	lump sum	1		

DIRECT CAPITAL SUBTOTAL, EXCLUDING LTTT	$7,383,000
DIRECT CAPITAL SUBTOTAL FOR LTTT	
OVERALL DIRECT CAPITAL SUBTOTAL	$12,783,000

(CONTINUED)

INDIRECT CAPITAL COSTS

Expressed as a fraction of the direct capital subtotal (excluding LTTT):

ITEM	PERCENTAGE	COST
Health & Safety	20%	$1,479,000
Design Level Investigation	20%	$1,479,000
Engineering Design	10%	$739,000
Startup Costs	10%	$739,000
License/Permit Fees/Oversight	10%	$739,000
Scope Contingency	20%	$1,479,000
	25%	$1,848,000
	TOTAL INDIRECT CAPITAL COSTS	$8,500,000

(CONTINUED)

OPERATION & MAINTENANCE COSTS

	ANNUAL O&M	DISCOUNT RATE	NUMBER OF YEARS	PRESENT WORTH
Groundwater Monitoring	$200,000	5%	30	$3,074,000
Groundwater Extraction Wells	$65,000	5%	30	$999,000
Initial Groundwater Treatment	$250,000	5%	6	$1,269,000
Intermediate Groundwater Treatment	$250,000	5%	11	$2,077,000
Final Groundwater Treatment	$250,000	5%	30	$3,843,000
Excavation Vapor Treatment	$400,000	5%	2.5	$919,000
Vapor Extraction	$400,000	5%	7	$2,315,000
Insurance	$10,000	5%	6	$51,000
Reserve Fund	$10,000	5%	6	$51,000
Administration	$200,000	5%	30	$3,074,000

TOTAL PRESENT WORTH OF O&M $17,670,000

DIRECT CAPITAL COST $12,790,000

INDIRECT CAPTITAL COST $8,600,000

TOTAL NET PRESENT WORTH $39,000,000

remediation levels for On-site Area buried waste. If ISVE is proven ineffective on all site contaminants then costs for LTTT would increase dramatically and the overall remedial action may require costs similar to those outlined for alternative 7b (see Section VII).

Griffith Municipal Landfill

The Griffith Municipal Landfill was included in the ACS remedial investigation after the ACS site was added to the NPL. The BlRA did not identify any completed exposure pathways from the landfill. Additionally, the RI did not indicate that the landfill was causing any downgradient ground water contamination. This could be due in part to the dewatering activities at the landfill. As part of the RI, it was determined through modeling, that if the current dewatering system was discontinued the ground water flow patterns would not change significantly. Given these facts, this ROD does not require remedial action at the Griffith Municipal Landfill.

RCRA Closure

A total site closure plan was approved by IDEM on August 4, 1992, for container, tank storage, and solvent distillation units at the site. As defined in the approval letter, the closure process must be completed within 180 days and must include a certification by both the Site's Owner/Operator and an independent registered professional engineer that the facility's regulated units have been closed in accordance with the approved closure plan. Because this closure process is expected to be completed before remedial design begins, the results of this closure will be evaluated by U.S. EPA on the need to incorporate any additional contaminated areas into this final remedy.

X. DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan, which described USEPA's preferred alternative for remediation of the ACS site was released for public comment on June 30, 1992. The public comment period ended August 28, 1992. The Agency has reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as described in the Proposed Plan, were necessary. However, a few minor changes were made to the proposed remedy, as discussed below:

- The treated ground water discharge option to the Hammond POTW has been eliminated based on Hammond's poor compliance history.

- Innovative technologies may be evaluated as part of a treatability testing program for effectiveness on buried waste and contaminated soils. However, this evaluation will not delay the overall remediation plan outlined in this ROD.

- Treatability testing on the effectiveness of ISVE on buried waste and contaminated soils may be abandoned with U.S. EPA's approval if it is determined through further engineering analysis that ISVE will be ineffective at meeting final remediation levels.

XI. STATUTORY DETERMINATIONS

Protection of Human Health and the Environment

The Baseline Risk Assessment developed for the American Chemical Services site showed that exposure to upper aquifer ground water, buried wastes and contaminated soils pose the greatest risks associated with the site. Extraction and treatment of contaminated ground water, and imposition of use restrictions for contaminated ground water until aquifer remediation is attained will address risks from ground water.

Implementation of the remedy will protect against risks from direct contact with wastes and soils. All risks resulting from exposure to individual contaminants will be reduced to MCLs, a 1 x 10-6 carcinogenic risk level or a HI of less than one. Cumulative carcinogenic risk will be managed within the 10-4 to 10-6 risk range.

Use of emissions controls, if determined to be necessary, will protect against short term exposure to contaminants during the remedial action. The discharge of treated water to the on-site wetlands and Turkey Creek (or one of its tributaries) will be regulated by NPDES and ambient water quality criteria to ensure that the remedial action does not affect aquatic life.

Attainment of Applicable, or Relevant and Appropriate, Requirements

The selected remedial action will meet all identified applicable, or relevant and appropriate, federal and more stringent state requirements unless waived pursuant to Section 121(d)(4)(B). The ARARs for the selected remedy are described and/or listed below.

Chemical Specific

Safe Drinking Water Act

The Safe Drinking Water Act is relevant and appropriate to the Site because the aquifers underlying the Site are class II aquifers which are presently being used as a drinking water source in the area surrounding the Site. The NCP calls for use of MCLs or MCLGs when setting standards for aquifer restoration, except in cases where the MCLG is zero, or where the attainment of MCLs would result in a cumulative carcinogenic risk outside of the 10-4 to 10-6 risk range. The selected remedy includes cleanup standards for all contaminants in the aquifers which achieve risk based standards. The standard for each contaminant equals or exceeds the MCL for that contaminant.

Clean Water Act

Surface water quality standards for the protection of human health and aquatic life were developed under section 304 of the Clean Water Act. The federal Ambient Water Quality Criteria (AWQC) are nonenforceable guidelines that set pollutant concentration limits to protect surface waters that are applicable to point source discharges, such as from industrial or municipal wastewater streams. At a Superfund site, the federal AWQC would not be applicable except for pretreatment requirements for discharge of treated water to a Publicly Owned Treatment Works (POTW). AWQCs would be relevant and appropriate to the point source discharges if the treated ground water is discharged to the drainage ditch running through wetlands, to Turkey Creek, or directly to wetlands. The substantive NPDES permitting requirements would need to be met if discharge is allowed to the Hammond POTW.

Toxic Substances Control Act

The 10 ppm clean up level for PCBs is based on the requirements for PCB spills outlined in 40 CFR 761.125(c)(4)(v) which states that soil contaminated by PCBs at 10 ppm will be excavated to a minimum depth of 10 inches. Although the PCB Spill Policy is not an ARAR, it is an important TBC. Excavated soils will be replaced with clean soils containing PCBs less than 1 ppm. U.S. EPA guidance on Remedial Actions for Superfund Sites with PCB contamination also suggests 1 ppm PCB cleanup level, providing a 10-5 excess cancer risk, under the residential use scenario. Adding a 10" soil cover provides an additional order of magnitude protection. Therefore, a 10 ppm cleanup level with a 10" soil cover will provide protection under the future residential use scenario at the 10-5 excess cancer risk level.

TSCA regulations are generally considered applicable or relevant and appropriate when PCB concentrations are greater than 50 ppm and disposal occurred after February 17, 1978. Although PCBs were originally disposed of at ACS prior to 1978, excavation and re-disposal of PCB material will occur on site as part of the planned remedial action. Thus, TSCA regulations governing disposal are considered applicable for those portions of the remedy which involve on site disposal of material contaminated above 50 ppm.

TSCA disposal regulations at 40 CFR 761.60 allow PCB disposal of non-liquid PCBs at concentrations greater than 50 ppm through the use of treatment that provides treatment equivalent to incineration, ie. treatment to a level less than 2 ppm. This remedy requires treatment of PCB soils containing greater than 10 ppm PCBs to a level of 2 ppm. Low temperature thermal treatment is anticipated to provide treatment equivalent to incineration. If LTTT is unable to treat PCBs to 2 ppm, they will be sent to an off-site incinerator.

Clean Air Act

Clean Air Act, 42 U.S.C. 7401 et seq. provides air emission requirements for actions which may release contaminants into the air. The selected remedy involves excavation and treatment activities which may release contaminants or particulates into the air. Emission and technology requirements promulgated under this act are relevant and appropriate, including provisions of the State of Indiana Implementation Plan. Also ARARs are the Clean Air Act's National Emission Standards for Hazardous Air Pollutants (NESHAPs, 40 CFR 61).

-Indiana VOC Emission Standards (Title 326 IAC Articles 2-1 and 8-1)

-Indiana fugitive dust control (Title 326 IAC Articles 6-4 and 6 -5)

-Indiana regulations on treatment of hazardous waste or PCBs in a unit (Title 329 IAC Articles 3-50-2, 3-51-2, 3-52-4, 3-54-4 through 546, 3-30-2, and 4)

Action Specific

RCRA Land Disposal Restrictions

Land disposal restrictions (LDRs) are applicable to this site since the remedy involves excavation, treatment, and placement of residuals from the treatment of RCRA listed waste. The LDRs provide for the use of LDR treatability variance levels for soil or debris contaminated with a RCRA listed waste. The selected remedy will comply with the LDRs through a treatability variance under 40 CFR 268.44. Because of the high concentrations of contaminants at the Site, LDR treatability variance levels are not protective of human health at this site. This remedy requires that standards for each contaminant at the site must equal risk based levels and equal or exceed LDR treatability variance requirements.

-Air Emissions from On-site treatment operations (40 CFR 50.1-50.12, 61.01-61.252; 40 CFR 264 Subpart AA and BB; Title 326 IAC Articles 1-3-4, 2-1, 8;)

-RCRA Definition and Identification of Hazardous Waste (40 CFR 261)

-Indiana Hazardous Waste Rule (Title 329 IAC Article 3.1)

-Indiana Special Waste Rule (Title 329 IAC Article 2-21)

-Indiana PCB Rule (Title 329 IAC Article 4)

-RCRA Standards for Generators of Hazardous Waste (40 CFR 262 and Article 329 IAC 3.1)

-RCRA Standards for Transport of Hazardous Waste (40 CFR 263)

-RCRA Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (40 CFR 264)

-Occupational Safety and Health Act (OSHA) Regulations for Workers Involved in Hazardous Waste Operations (29 CFR 1910)

-Indiana Final Rules Concerning the Regulation of Water Well Drilling/Well Abandonment Specifications (Title 310 IAC Article 16)

Location Specific

Flood Plains

The requirements of 40 CFR 264.18(b) and Executive Order 11988, Protection of Flood Plains are relevant and appropriate to actions on the Site. To meet these ARARs, the treatment systems will be located above the 100-year flood plain and be protected from erosion damage.

Wetlands

Executive Order 11990 (Protection of Wetlands) is an applicable requirement. Wetlands will be monitored and evaluated. The selected remedy may include significant excavation affecting wetlands adjacent to the ACS facility.

ARARs regarding these wetlands include Executive Order 11990, which requires that actions at the Site be conducted in a manner minimizing the destruction, loss, or degradation of wetlands. These ARARs will be met through the continued evaluation of the wetlands, and if necessary, implementation of a plan to limit adverse impacts to the wetlands, or restore or mitigate the wetlands. Water will also be discharged into the wetlands to prevent their dewatering from ground water treatment at the site.

-Indiana regulations on activities affecting the quality of water (Title 327 IAC Articles 2-1-7, 2-1-6(f), 2-1-6(g))

-Indiana DNR (IC-13-2-6.1) registration of extraction wells

-Indiana regulations on water quality standards for direct discharge of pollutants (Title 327 IAC Articles 2-1, 2-1-6(b), 3 (construction standards), and 5)

-Fish and Wildlife Protection Act (40 CFR 6.302)

-Endangered Species Act (16 USC 1351 as amended by Public Law 98 -237)

-Wetland Protection through the State of Indiana Water Quality Surveillance Standards Branch and the Indiana DNR Division of Water Requirements

To Be Considered Criteria

-Guidance on Remedial Actions for Superfund Sites with PCB Contamination (OSWER Directive 9355.4-01)

-Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive 9355.4-02)

-Guidance on Control of Air Emissions From Superfund Air Strippers at Superfund Ground Water Sites (OSWER Directive 9355.0-28)

-RCRA health-based "action levels" for individual Appendix VIII hazardous constituents. (7/27/90 FR; proposed RCRA corrective action rule)

-TSCA PCB Spill Cleanup Policy and provisions (40 CFR 761)

Cost-Effectiveness

Alternative 6b will achieve significant risk reduction at a total PNW cost of $37,800,000 to $46,800,0000. Costs could be in the range of Alternative 7b PNW estimates of $64,400,000 if all contaminated soils are required to undergo LTTT. Alternatives involving incineration (6a and 7a) offer a somewhat higher degree of permanence but at a significantly higher cost.

The selected alternative is approximately three to four times more expensive than the least expensive action, Alternative 2, which only provides for ground water treatment and containment of site contaminants.

Other alternatives not involving incineration, are less costly than the preferred alternative but provide less treatment. Alternative 3b is less costly than the preferred alternative but does not treat contaminated soils. Alternatives 5 and potentially 4 are less costly than the preferred alternative but employ in-situ technologies on wastes that contain buried drums. U.S. EPA does not believe it is possible to verify the effectiveness of in-situ treatment on some portions of the ACS site. Alternatives 8a and 8b are less costly than the preferred alternative but have not been demonstrated to be potentially effective on a contaminant matrix or scale similar to ACS's.

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

USEPA believes that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner at the American Chemical Services site. Of those alternatives that are protective of human health and the environment and that comply with ARARs, USEPA has determined that the selected remedy provides the best balance of long-term effectiveness and permanence, reduction of TMV through treatment, short term effectiveness, implementability, and cost, taking into consideration the statutory preference for treatment as a principal element and State and community acceptance.

Several innovative treatment alternatives were considered for this site. USEPA has selected LTTT followed by solidification for buried waste material because it affords a higher degree of certainty of achieving the remedial action goals for all contaminants than some of the less established technologies considered, such as ISVE, in-situ steam stripping or biological treatment of the buried waste material.

Preference for Treatment as a Principal Element

The selected remedy provides for treatment of the principal threats at the site. The remedy calls for removal and offsite incineration of intact buried drums. The remedy treats the highest concentrations of VOCs, SVOCs, PCBs, and metals in the buried waste areas by LTTT, followed by solidification, if necessary. Contaminated soils will be treated in place by soil vapor extraction. If soil vapor extraction fails to meet final remediation levels then LTTT will be implemented for contaminated soils. Ground water will be treated onsite. The selected alternative thus satisfies the statutory preference for treatment as a principal element.