United States
Environmental Protection
Agency

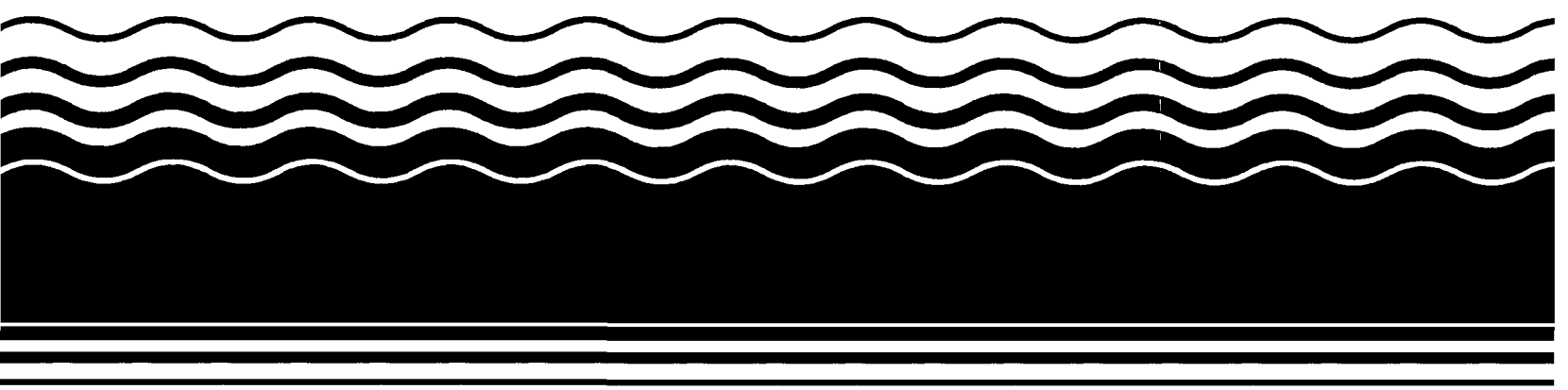
Office of
Emergency and
Remedial Response

EPA/ROD/R02-92/186
September 1992

EPA

Superfund Record of Decision:

Imperial Oil/Champion Chemicals, NJ



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/R02-92/186	2.	3. Recipient's Accession No.
4. Title and Subtitle SUPERFUND RECORD OF DECISION Imperial Oil/Champion Chemicals, NJ Second Remedial Action - Subsequent to follow			5. Report Date 09/30/92 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization 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

PB93-963823

16. Abstract (Limit: 200 words)

The 15-acre Imperial Oil/Champion Chemicals site is an oil blending facility in Marlboro Township, Monmouth County, New Jersey. The site is located within the Matawan watershed of the Atlantic Coastal Drainage Basin. Birch Swamp Brook, an intermittent stream, collects discharge from a fire pond located east of the berm. The site consists of a 4.2-acre oil blending facility, which includes seven production, storage, and maintenance buildings, and several oil storage tanks. Land use in the area is predominantly residential, and a wetland area is located to the north of the site. The estimated 27,000 people who reside within 1 mile of the site use the Englishtown Aquifer, which underlies the site, as their drinking water supply. From 1912 to 1950, the facility and associated land have been used for a variety of business operations under various owners. In 1950, Champion Chemicals Company acquired the property. Since 1969, the Imperial Oil Company has leased the facility to support used oil reclamation and oil blending repackaging operations. Waste products from the reclamation process included wash water, waste oils and sludge, and spent filter clay.

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Imperial Oil/Champion Chemicals, NJ
Second Remedial Action - Subsequent to follow
Contaminated Medium: gw
Key Contaminants: VOCs (benzene, PCE, TCE, toluene, xylenes), other organics (PAHs, PCBs), 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 86
	20. Security Class (This Page) None	22. Price

EPA/ROD/R04-92/186
Imperial Oil/Champion Chemicals, NJ
Second Remedial Action - Subsequent to follow

Abstract (Continued)

In 1981, the state identified onsite contamination by oil and PCBs; metals in the onsite tank farm area and in soil, waste samples, and sediment; and PCBs in the adjacent Swamp Brook, which had resulted from various onsite spills during operations. State inspections of offsite areas identified oily stained soil. In 1982, a site investigation was performed that confirmed the presence of petroleum hydrocarbons, PCBs, arsenic, and VOCs in the ground water and soil, in addition to a floating product layer underneath the former waste pile and catchment area. A subsequent state investigation in 1983 confirmed the continued presence of oily stained soil in the areas that had historically exhibited visible contamination. Results of an EPA Innovative Technology Evaluation indicated that the solidification technology was effective in remediating elevated concentrations of metals in soil, but was ineffective in remediating PCBs and other organics. A 1990 ROD addressed the principal threats posed by offsite areas, including contaminated soil within the wetlands. Subsequently, in 1991, EPA installed extraction wells to remove a petroleum-like product layer from the ground to prevent a major source of ground water contamination and reduce time needed to restore the aquifer to a usable condition. This ROD addresses final remediation of contaminated ground water as OU2. Future RODs will address soil, surface water, sediment, air, and any other outstanding contamination sources. The primary contaminants of concern affecting the ground water are VOCs including benzene, PCE, TCE, toluene, and xylenes; other organics, including PAHs and PCBs; and metals, including arsenic, chromium, and lead.

The selected remedial action for this site includes extracting and treating contaminated ground water onsite using precipitation to remove inorganic contaminants, and carbon adsorption to remove organic contaminants; discharging the treated ground water onsite to Birch Swamp; continuing the previous removal action; conducting a wetlands assessment to determine site impact; regenerating or disposing of the spent carbon; disposing of any sludge generated during the treatment process offsite; and conducting environmental monitoring to ensure the effectiveness of the remedy. The estimated present worth cost for this remedial action is $9,647,000, which includes an annual O&M cost of $515,000 for 30 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific ground water clean-up goals, based on federal MCLs and state levels, include benzene 1 ug/l; xylenes 40 ug/l; toluene 1,000 ug/l; pyrene 200 ug/l; PCBs 5 ug/l; arsenic 8 ug/l; beryllium 20 ug/l; and lead 10 ug/l.

COPY BUT DO NOT DELETE OR ALTER

ROD FACT SHEET

SITE

Name: Imperial Oil/Champion Chemical Superfund Site
Location/State: Marlboro Township, Monmouth County, New Jersey
EPA Region: Region II
HRS Score (date): 42.69 (August 1982)
NPL Rank (date): 585 (September 1, 1983)

ROD

Date Signed: September 30, 1992
Remedy/ies: Extraction and treatment of contaminated ground water via precipitation and carbon adsorption
Capital Cost: $1,526,000
O & M/year: $515,000
Present worth: $9,647,000

LEAD

Remedial/Enforcement: Remedial
EPA/State/PRP: State
Primary contact (phone): Trevor Anderson (212) 264-9212
Secondary contact (phone): Joe Maher (609) 633-0765
Main PRP(s): Imperial Oil Company, Inc. & Champion Chemical Company
PRP Contact (phone)

WASTE

Type (metals, PCB, &c): Metal, PCB, Organics
Medium (soil, g.w., &c): Ground water
Origin: Resulted from past site operations.
Est. quantity cu.yd.: Unknown
gal.
drums
etc.

From: Peter Moss (PMOSS)
To: TANDERSO
Date: Tuesday, January 12, 1993 3:55 pm
Subject: Imperial ROD

Thanks very much for sending me the ROD Fact Sheet.

Upon reviewing the ROD, I find Table 9 is missing. Everything else is complete.

Please provide a copy of table 9, so I can submit the ROD to the Clearinghouse. Thanks very much.

Peter D. Moss

From: Trevor Anderson (TANDERSO)
To: PMOSS
Date: Tuesday, January 12, 1993 5:26 pm
Subject: Imperial ROD -Reply

there is no table 9 in the rod. the table numbers are as follows: table 1,2,3,4,5,6,7,8,10. if you read the rod carefully, there wouldn't be any mention of a table 9.

DECLARATION STATEMENT

RECORD OF DECISION

IMPERIAL OIL COMPANY/CHAMPION CHEMICALS COMPANY

Site Name and Location

Imperial Oil Company/Champion Chemicals Company
Marlboro Township, Monmouth County, New Jersey

Statement of Basis and Purpose

This decision document presents the selected remedial action for the remediation of contaminated ground water at the Imperial Oil Company/Champion Chemicals Company site. The remedy was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan.

This decision is based on the administrative record file compiled for the site. An index of the contents of the administrative record file is attached.

The New Jersey Department of Environmental Protection and Energy concurs with the selected remedy.

ASSESSMENT OF THE SITE

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

Description of the Selected Remedy

The remedial action described in this document represents the second operable unit for the Imperial Oil Company/Champion Chemicals Company Superfund site. The initial remedy for the site included the remediation of off-site soils. The remedy contained in this Record of Decision includes the remediation of the contaminated ground water in the underlying aquifer. Additional actions are planned to address fully the remaining threats posed by the site.

The major components of the selected remedy include the following:

- Extraction of contaminated ground water above cleanup standards;
- Treatment of the extracted ground water via precipitation for inorganics and carbon adsorption for organics;
- Discharge of the treated ground water to Birch Swamp Brook;
- Continuation of the floating product removal action currently being undertaken by the Environmental Protection Agency; and
- Appropriate environmental monitoring to ensure the effectiveness of the remedy.

Declaration of 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 that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Constantine Sidamon-Eristoff
Regional Administrator

Date

DECISION SUMMARY FOR THE RECORD OF DECISION

IMPERIAL OIL COMPANY/CHAMPION CHEMICALS SITE
MARLBORO TOWNSHIP, MONMOUTH COUNTY
NEW JERSEY

Operable Unit II

TABLE OF CONTENTS

DECISION SUMMARY FOR THE RECORD OF DECISION

IMPERIAL OIL COMPANY/CHAMPION CHEMICALS COMPANY

SITE LOCATION AND DESCRIPTION

The Imperial Oil Company/Champion Chemicals Company (IOC/CCC) site includes a 15-acre facility located in the Morganville section of Marlboro Township, Monmouth County, New Jersey (Figure 1). Champion Chemicals Company is the owner of the real property located on Lot 29, Block 122 (previously Lot 30, Block 10), Orchard Place in Morganville. The premises are leased to the Imperial Oil Company, Inc., which currently operates an oil blending facility that occupies approximately 4.2 acres.

The site consists of seven production, storage and maintenance buildings and numerous above-ground oil storage tanks. Sandy soil extends over those areas not covered by buildings, asphalt or pavement. The process area is enclosed within a six-foot chain-link fence and is protected by security. The western property line abuts the abandoned Central Railroad of New Jersey's Freehold and Atlantic Highlands Branch Main Line (Figure 2).

The site is situated in a predominantly residential area of Monmouth County. The population of Marlboro Township is approximately 27,000 residents. There are approximately 30 residential properties sparsely located along the surrounding roads within a one-mile radius of the site. The nearest residence is within 100 feet of the employee parking lot. A small commercial center (Morganville) is located approximately 1/2 mile southeast of the site at the junction of Routes 3 and 79. Two automobile scrap yards are located just to the northeast of the site. Lake Lefferts, a swimming and recreational area, is located approximately one mile north of the site. Lake Lefferts has been identified as a potential potable water source for the area.

The site is located within the Matawan watershed of the Atlantic Coastal Drainage Basin. The topography of the site ranges from 120 feet above mean sea level (MSL) in the southwest corner of the site to 97 feet above MSL at the northern boundary. Surface water runoff at the site is to the north. During periods of heavy rainfall, water accumulates in an earthen berm which extends along the northeastern fence line of the site. Three oil/water separators and an arsenic treatment unit are used to treat any runoff that collects in the earthen berm. To the east of the berm is a fire pond which discharges to Birch Swamp Brook, an intermittent stream. From this point, the stream flows through a bog northwest of the site, and subsequently drains into Lake Lefferts which, in turn, empties into Raritan Bay.

The Englishtown Aquifer, which underlies the site, is a significant natural resource in the area. The Englishtown Aquifer is classified as GW-2 (current or potential potable water supply) and is an important source of water supply for Monmouth and northern Ocean Counties. The ground water in the shallow and deep zones of the aquifer flows to the north and northeast, respectively.

Twenty-eight residential wells were identified within a one-mile radius of the site. These wells are used for non-potable purposes, such as watering lawns and washing cars. The Imperial Oil employees use the well water to wash drums and other equipment. The Marlboro Township Municipal Utilities Authority (MTMUA) supplies potable water to the residents in the vicinity of the site. The MTMUA water supply wells are located approximately two miles south of the site and obtain their water from the Raritan-Magothy Aquifer.

The site also includes two areas known as Off-site Areas 1 & 2. These two off-site areas are located approximately 220 feet and 700 feet northwest of the facility, respectively. They contain surface soils which are stained with an oily sludge residue, a result of being former dump sites for waste oil. The vegetation in these areas is visibly stressed and the soils are highly stained, as are the soils in the adjacent banks of Birch Swamp Brook.

Wetlands are present north of the site. Based on a preliminary survey, some of the land surrounding the Fire Pond, as well as most of the area encompassing the off-site areas qualifies as wetlands. Soils in these areas are somewhat poorly to very poorly drained. Vegetation observed in these areas is consistent with that normally found in wetland areas. The two types of wetlands identified are forested wetlands and a more traditional freshwater marsh. These areas appear to be hydraulically connected.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Historical Site Use

The IOC/CCC facility and associated land have been used for a variety of business operations since the original buildings were constructed in 1912.

The first company to occupy the site produced tomato ketchup and tomato paste. The plant changed operation around 1917. Also, around that time, the Stratford Chemical Company took over the site and began producing arsenate and arsenic acid. In the 1930s, the Stratford Chemical Company changed its name to the Brocker Chemical Company and continued to manufacture chemicals until bankruptcy forced them to sell out around 1945 to S. B. Penick and Company, which produced flavors and essences at the site until 1949.

The Champion Chemicals Company acquired the property in 1950. The existing facilities were modified to support Champion Chemicals' used oil reclamation operations. Eagle Asphalt Company was also involved in this operation. The process of oil reclamation involved washing the used oil with caustic material in vertical process tanks to remove the sludge and impurities. The washed oil was distilled to remove the heavy oil; the heavy oil was then passed through a clarification process. This process involved mixing the oil with filter clay (diatomaceous earth) in large holding tanks, where the filter clay was allowed to settle to the bottom and the oil was skimmed off the top. The filter clay was used to remove the heavy metals (tetraethyl lead, zinc, iron, etc.) present in the waste oil. The purified oil was then passed through a filter press to remove any filter clay.

The waste products of the reclamation process included wash water, waste oils and sludge, and spent filter clay. Reportedly, the waste filter clay was piled outside near the settling tank for temporary storage. Wash water was discharged into a lagoon located on site for settling. The purpose was to recover excess oil which would float to the surface. It has also been reported that oil-contaminated soil was dumped on the site in the area east of the front gate and the on-site house trailer.

Since 1969, the Imperial Oil Company has leased the facility from Champion Chemicals. Imperial Oil runs an oil blending operation at the site which involves the mixing and repackaging of unused oil for delivery. Currently, raw product (refined clean oil) is delivered by truck and transferred to above-ground tanks on the site. Imperial Oil has reportedly removed sludge material from the oil/water separators and deposited it in the area between the old process building and the filter clay pile. The oil/water separators were installed in 1950, during Champion Chemicals' operations at the site. Later, the oil/water separators were augmented to include a step to remove arsenic from the water. Laboratory wastes and sanitary wastes were disposed in a septic system located north of the office building.

Response Actions to Date

The New Jersey Department of Environmental Protection and Energy (NJDEPE), U.S. Environmental Protection Agency (EPA), Princeton Aqua Science (PAS), Fred C. Hart and Associates, and the Monmouth County Health Department have conducted investigations at the site to date. The site investigations, conducted by PAS for Imperial Oil and Fred C. Hart and Associates for EPA, included the collection of soil, sediment, and ground water samples.

In April 1981, a NJDEPE site inspection found oil-contaminated soils and numerous large puddles at the base of tank farms 1 and 2. The outfall area for the three oil/water separators was also inspected. This area showed oily surface water and oil-stained surface soils. The catchment area for the site surface water runoff, north of the separators, was also stained with oil.

Results of analyses of soil and waste pile samples revealed petroleum hydrocarbons, lead, barium, arsenic, and polychlorinated biphenyls (PCBs). Sediment samples from Birch Swamp Brook also showed significant concentrations of lead, arsenic, PCBs, and petroleum hydrocarbons.

In May 1981, EPA conducted a limited sampling program at the off-site areas and the waste filter clay pile. Results of analyses of the sediment samples from the stream bed of Birch Swamp Brook confirmed the presence of PCBs, petroleum hydrocarbons, lead, and arsenic. The analytical results of the samples from the clay pile indicated that this material contained significant concentrations of PCBs.

In June 1981, a letter from Imperial Oil's consultant (Harold Seldin) to EPA indicated that, in 1976, Imperial Oil had excavated contaminated soil and replaced it with clean sand in the area of the oil/water separators. An earthen berm was constructed and one oil/water separator was cleaned and repaired.

In June and August 1981, NJDEPE conducted two site inspections and identified the following potential sources of contamination:

- Oil/water separators: Overflow from flooding has contaminated surrounding soils; sludge was being removed from the skimmers and dumped on site.
- Waste filter clay pile: Initial estimated volume was approximately 50 to 75 cubic yards.
- Tank farm areas: Tanks appeared to be discharging oils and additives to the surrounding grounds; fill hoses, pipes, and boiler blowdown fluids drained onto the grounds.
- Floor drains: Boiler room and machine shop; unknown composition of liquids being drained, destination of liquids unknown.
- Septic tank and leach field: Receives laboratory wastes generated on site.
- Drum washing area: Oil spillages observed.
- Waste dump: Contaminated soils dumped east of house trailer.
- Two off-site waste dumps: Visible oil sludge and residue on the ground and stressed vegetation.
- Banks of Birch Swamp Brook: Stained with oily residue.

In August 1981, NJDEPE conducted an inspection of the off-site waste oil contamination areas. During the inspection, two distinct areas of contamination were identified. The areas are located north of Imperial Oil along the banks of Birch Swamp Brook. At both areas, the surface soils were visibly stained with oily material. The banks of the stream were also observed by NJDEPE to be stained with oily residue. Vegetation in these areas was noticeably stressed.

In December 1981, Imperial Oil entered into an Administrative Consent Order (ACO) with NJDEPE in which the company agreed to cease discharging hazardous wastes and other pollutants into the waters of the State, unless the effluent met certain specified discharge limits set forth by the New Jersey Pollutant Discharge Elimination System (NJPDES). In addition, the ACO required that Imperial Oil repair the oil/water separators and dispose of oil/water-separator sludge in a manner acceptable to NJDEPE. Further, the ACO required the company to conduct an environmental assessment of the site to determine the nature and extent of contamination and implement a remedial plan for cleaning up the site.

In May 1982, the Imperial Oil Company contracted with Princeton Aqua Science to conduct an evaluation of the site. During this investigation, seven test pits were excavated and sampled. In addition, four monitor wells were installed. The purpose of the investigation was to assess the nature and extent of contamination in the soil and ground water at the site. The results of this investigation were presented in a report issued by PAS in January 1983. The analyses performed on the selected samples confirmed the presence of petroleum hydrocarbons, PCBs, arsenic, and volatile organic compounds in the ground water and soil. A floating product layer was detected in monitoring wells MW-3 and MW-5 during sampling.

The IOC/CCC site was proposed for inclusion on the National Priorities List (NPL) of Superfund sites on December 1, 1982. The site was formally added to the NPL on September 1, 1983.

In May 1983, a NJDEPE inspection of the site, including the off-site waste oil contamination areas, confirmed the continued presence of oily stained soils in the areas that had historically exhibited visible contamination.

In September 1983, a Remedial Action Master Plan was prepared by Fred C. Hart Associates for EPA for the IOC/CCC site. The report summarized the data collected up to that point in time and concluded that soil and ground water on site, and sediment off site, were contaminated with heavy metals and priority organic pollutants, including PCBs.

From 1984 through 1985, NJDEPE conducted three inspections of the site and observed the impounded surface water overflowing the catchment area, erosion of material from the waste filter clay

pile by surface runoff, and flooding into the Fire Pond and Birch Swamp Brook. There was a noticeable oil sheen on the surface of Fire Pond. The inspections also revealed laboratory waste contained in 55-gallon drums stored in a warehouse, overflowing of the oil/water separators, and the oil/water separator effluent not being passed through the arsenic treatment system.

In July 1986, the Monmouth County Prosecutor's Office conducted an investigation of the IOC/CCC site. Samples were obtained and analysis showed that heavy metals, PCBs, and petroleum hydrocarbons were present in soil and ground water.

In October 1986, a site reconnaissance by the NJDEPE's consultant, E.C. Jordan Company, was undertaken. During the reconnaissance, on-site and off-site areas were inspected. Oil-stained surface soils were evident throughout the site. The inspection also revealed mats of oily sludge along the banks of Birch Swamp Brook, in the immediate floodplain, and at the two off-site oil contamination areas.

A remedial investigation (RI) was conducted by E. C. Jordan, NJDEPE's consultant, to determine the nature and extent of the contamination at the IOC/CCC site. The RI was conducted in two phases. Phase I and Phase II were performed in 1987, and 1989 through 1990, respectively. At the completion of the first phase, a draft Phase I Sampling Report (July 1987) was prepared detailing the findings of the field investigations. Also included in the Phase I Sampling Report, were recommendations for a second phase of investigation. The objective of the Phase II investigation was to further delineate the distribution of contaminants identified during Phase I and previous investigations in preparation for a site risk assessment and a feasibility study (FS). In June 1990, a draft RI Report was prepared.

In June 1987, the Imperial Oil Company and Champion Chemicals Company entered into a Plea Agreement with Monmouth County. The companies agreed to remove the clay pile to grade at a cost not to exceed $400,000. In addition, the companies agreed to contribute $400,000 to Phase I of the remedial investigation and feasibility study (RI/FS) and a sum not to exceed $7,000 to defray State costs for laboratory fees. The companies also agreed to abide by the 1981 ACO with NJDEPE. Currently, EPA is seeking to recover the $400,000 set aside in the escrow account with Monmouth County.

In September 1987, in order to evaluate an innovative technology for potential consideration for the cleanup of the site, EPA initiated a Superfund Innovative Technology Evaluation (SITE) demonstration program at the IOC/CCC site. The technology demonstrated was the solidification/stabilization process developed by Soiltech, Inc. of Houston, Texas. The results indicated that the solidification technology was effective in remediating elevated concentrations of metals in soil, but was

not very effective in remediating PCBs and other organic compounds. A Technology Evaluation Report for the project was released in February 1990. This information will be used in the evaluation of soil cleanup alternatives.

Waste Filter Clay Pile

In September 1989, EPA issued a Unilateral Administrative Order (UAO) to Imperial Oil and Champion Chemicals for the delineation, characterization, removal and/or treatment and disposal of the on-site waste filter clay pile. In November 1989, the two potentially responsible parties (PRPs) submitted to EPA a draft Work Plan for the removal and disposal of the waste filter clay pile. After comments and revisions, the draft Work Plan still did not conform to the terms of the UAO. EPA then modified the document to bring it into compliance with the UAO. The modified Work Plan was sent to Imperial Oil and Champion Chemicals on March 21, 1991. On July 18, 1991, EPA notified the two PRPs that they were in violation of the UAO for not removing and disposing of the waste filter clay.

In November 1991, EPA excavated the waste filter clay pile down to ground level. The filter clay pile was contaminated with PCBs, arsenic, lead, and total petroleum hydrocarbons. The excavated clay pile material (approximately 660 cubic yards) was disposed of in an approved landfill under the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act (TSCA), located in Model City, New York. The contaminated area beneath the waste pile was covered with an impermeable sheet to prevent the infiltration of rainwater.

Off-site Areas 1 & 2

In July 1990, a focused feasibility study (FFS) was prepared by NJDEPE to address the soil contamination at the two off-site areas. This study was based on surface and subsurface soil samples collected during the Phase I and II field investigations of the RI. The soils in these areas were found to contain petroleum hydrocarbons, heavy metals and PCBs. The alternatives evaluated in the FFS included no action; excavation with on-site storage; excavation with off-site land disposal; excavation with on-site thermal treatment; and excavation with off-site thermal treatment.

In August 1990, EPA sent General Notice letters to four potentially responsible parties pursuant to Sections 106(a) and 107(a) of the Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA), notifying them that they may be ordered to perform response actions deemed necessary by EPA to protect public health, welfare or the environment.

In September 1990, EPA signed a Record of Decision to address the contaminated soil at Off-site Areas 1 & 2. The selected remedy included the installation of a fence around the contaminated areas; the excavation and off-site disposal of the contaminated soil; and the restoration of the affected wetlands.

In September 1991, EPA installed the fence around Off-site Areas 1 & 2 to control access to the contaminated soil.

In September 1991, EPA issued UAOs to the above four PRPs (Imperial Oil, Champion Chemicals, Jersey Central Power & Light, and J and M Land Company) to conduct the remedial design and remedial action for the off-site areas. The PRPs declined to do the work required by the UAO. Utilizing CERCLA funds, NJDEPE is currently in the process of procuring a remedial contractor to perform the remedial design for the off-site areas. A selection of a design contractor is expected in the near future. This work is being performed under a cooperative agreement with EPA. EPA is continuing to evaluate its enforcement options.

Petroleum Product Layer (Floating Product)

EPA has installed extraction wells to remove a petroleum-like product layer from the ground water. The removal of the petroleum-like product, which began in the fall of 1991, was undertaken to try to eliminate a major source of ground water contamination and, consequently, reduce the time needed to restore the aquifer to a usable condition. Currently, the extracted petroleum product is being stored on the site in storage tanks for ultimate treatment and disposal.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

In preparation for the September 1990 Record of Decision (ROD), the focused feasibility study and the Proposed Plan for Operable Unit 1 (the cleanup of Off-site Areas 1 & 2) were released to the public for comment on July 26, 1990. The notice of availability for these two documents was published in the Asbury Park Press on August 1, 1990. A public comment period was held from July 26, 1990 through August 25, 1990. On August 14, 1990, a public meeting was held at the Marlboro Township Municipal Building, where NJDEPE presented the results of the FFS and the Proposed Plan for Operable Unit 1. A Record of Decision for the off-site areas was signed on September 26, 1990. Responses to the comments received during the public meeting were included in the Responsiveness Summary section of the September 1990 ROD.

For this decision document, the Ground Water Control Feasibility Study (GWCFS) and the Proposed Plan for the remediation of the ground water at the IOC/CCC site were released to the public for comment on July 31, 1992. Notice of the availability of the documentwv.t516Xahde public meeting were published in the Asbury Park Press on July 31, 1992. These documents were made available to the public at two information repository locations. Also,

flyers were sent to residents and other members of the community announcing the upcoming public meeting and the start of the public comment period. The public comment period was held from July 31, 1992 to August 30, 1992. The public meeting was held on Thursday, August 20, 1992 in the Marlboro Township Municipal Building. At this meeting, representatives from NJDEPE and its contractor presented the findings of the GWCFS and the Proposed Plan, and also answered questions concerning the site and the remedial alternatives developed to address the cleanup of ground water. A response to the comments received during the public comment period is included in the Responsiveness Summary, which is a part of this Record of Decision. Comments received at the public meeting were generally supportive of the selected remedial alternative identified in the Proposed Plan.

This decision document presents the selected remedial action for the contaminated ground water at the IOC/CCC site, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. The decision for this site is based on the administrative record.

SCOPE AND ROLE OF REMEDIAL ACTION

As with many Superfund sites, the problems at the IOC/CCC site are complex. As a result, NJDEPE has organized the remedial work into phases or operable units noted below:

- Operable Unit 1: Addressed the principle threats posed by the off-site areas. These areas included contaminated soil within the wetlands adjacent to the IOC/CCC facility. A Record of Decision was signed in September 1990.

- Operable Unit 2: Addresses the remediation of the contaminated ground water (the subject of this document).

- Operable Unit 3: Will address soil, surface water, sediments, air, and any other remaining contamination sources.

As stated above, EPA has already selected the remedy for Operable Unit 1 (soil contamination at Off-site Areas 1 & 2). The contaminated soil is a principal threat at this site because the off-site areas were frequented by children (prior to the installation of the fence) for dirt biking. In addition, soil contaminants are migrating toward Lake Lefferts via Birch Swamp Brook. Soil associated with the off-site areas contains contaminants above health-based levels, including lead, arsenic, PCBs, and semi-volatile and volatile organic compounds.

Operable Unit 2 authorized by this ROD addresses the remediation of the contaminated ground water underlying the site. The ground water at the site poses a principal threat to human health and the environment because it is a potential potable water supply which is currently being used by residents in the area and by Imperial Oil employees for non-potable purposes. In addition, the contaminated ground water is migrating toward Lake Lefferts, which is used for recreational purposes and is also a potential source of drinking water. The purpose of this response is to prevent current and future migration of the contaminated ground water to Lake Lefferts and reduce the contaminant concentrations to Federal and State Maximum Contaminant Levels (MCLs) in the underlying aquifer. Operable Unit 3 will address the on-site soils and sediment contamination.

SUMMARY OF SITE CHARACTERISTICS

The scope of the RI for the IOC/CCC site included studies for all media that may be contaminated. Soil, ground water, and sediments at the site were investigated and found to be contaminated. As stated previously, this decision document addresses only the contaminated ground water underlying the site, including the removal of the floating product layer beneath the former waste pile and catchment area. The cleanup of the soil and sediments will be addressed in a subsequent Record of Decision.

Data collected during the RI indicates that the ground water under the site is contaminated with volatile organics compounds (VOCs) and semi-volatile organics compounds (SVOCs), pesticides, PCBs, metals, and total petroleum hydrocarbons (TPHs). The RI data also indicates that the ground water contamination is present throughout the thickness of the Englishtown Aquifer. The plume emanating from beneath the site is approximately 1,200 feet long, 200 to 300 feet wide, and 40 to 50 feet deep. Figure 3 shows the horizontal extent of the plume.

The contaminated soil on the Champion Chemicals Company property (on-site) and on nearby properties (off-site), an on-site waste filter clay pile, and a layer of contaminated petroleum material floating above the ground water have been identified as sources of the ground water contamination. Figure 4 shows the various sources of ground water contamination.

The presence of the floating product beneath the former waste filter clay pile is a continuing source of VOCs and SVOCs ground water contamination. Contaminants found in the floating product and the ground water include methylene chloride, toluene, ethlybenzene, xylene, 4-methyl-2-pentanone, 2,4-dimethylphenol, 2-methylnaphthalene, pyrene, naphthalene, fluorene, fluoranthene, PCBs, and TPHs. The VOCs and SVOCs detected in the ground water

and floating product exceeded the State and Federal promulgated MCLs for drinking water. MCLs are enforceable standards based on health risks associated with an individual's consumption of two liters of water per day over a 70-year period.

Contaminants found in the ground water, their maximum concentrations measured, and the Federal and State promulgated MCLs are shown in Table 1.

SUMMARY OF SITE RISKS

Human Health Risks

A Baseline Risk Assessment was conducted to evaluate the potential risks to human health and the environment associated with the IOC/CCC site in its current state. The risk assessment looked at the contaminants in the ground water which are likely to pose a significant threat to human health and the environment. Summaries of the contaminants of concern (COCs) in the ground water are listed in Table 2.

The Risk Assessment identified potential exposure pathways by which the public may be exposed to contaminant releases at the site under present and potential future land use scenarios. The ground water is currently not used as a drinking water source. Presently, the residents use their domestic wells only for non-potable purposes, such as irrigating lawns and washing cars. Risks associated with potential future ground water ingestion were quantified for residents. Exposure assumptions were based on the most probable (average) and realistic worst (approximately the reasonable maximum) case exposures.

Under current EPA guidelines, the likelihood of carcinogenic (cancer causing) and non-carcinogenic effects due to exposure to site chemicals are considered separately. It was assumed that the toxic effects of the site-related chemicals would be additive. Thus, carcinogenic and non-carcinogenic risks associated with exposures to individual COCs were separately summed to indicate the potential risks associated with mixtures of potential carcinogens and non-carcinogens, respectively.

Summary of Non-carcinogenic Risks

Non-carcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and safe levels of intake (reference doses). Reference doses (RfDs) have been developed by the EPA for indicating the potential for adverse health effects. RfDs, which are expressed in units of milligrams per kilogram per day (mg/kg-day), are estimates of daily exposure levels for humans which are thought to be safe over a lifetime (including sensitive individuals).

Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared with the RfD to derive the hazard quotient for the contaminant in the particular media. The HI is obtained by adding the hazard quotients for all compounds across all media. An HI greater than 1.0 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. The reference dose for the chemicals of concern at the IOC/CCC site are presented in Table 3.

The NJDEPE, as part of the remedial investigation, performed a risk assessment for the site. Since that time, EPA guidance on the performance of risk assessments has been updated. As a result, EPA has recalculated the risks associated with the site to reflect some of these changes. The values identified in the RI report utilized the previous risk assessment guidance. Both the earlier and updated risk assessment values are identified in Table 4, which shows that the assessments provide similar results in terms of identifying unacceptable risks.

For the IOC/CCC site, EPA has recalculated the estimated HI values associated with the ingestion of the contaminated ground water, which exceeded 1.0 for both the most probable and realistic worst cases. EPA recalculated the HI by subtracting all lead non-carcinogenic effects based on NJDEPE's RfD, which is not an EPA verified toxicity value. For the off-site ground water, the most probable and realistic worst case HIs are 4.0 and 18.2, respectively. The most probable and realistic worst case HIs for the on-site ground water are 8.8 and 19.4, respectively. The HI values are listed in Table 4. The risk is primarily due to the high concentration of antimony found in both the on-site and off-site ground water. Under the realistic worst case exposure scenario, the concentration of lead at both the on-site and off-site wells exceeded the 15 ppb action level for lead.

For the off-site ground water, the estimated HI values associated with the site, utilizing the previous risk assessment guidance, are 5.2 and 25.1 for the most probable and the realistic worst case exposure scenarios, respectively. For the on-site ground water, the most probable and realistic worst case HI are 16.8 and 51.8, respectively.

Summary of Carcinogenic Risks

Potential carcinogenic risks were evaluated using the cancer slope factors developed by EPA for the COCs. Cancer slope factors (SFs) have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$,

are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes the underestimation of the risk highly unlikely. The SF for the chemicals of concern are presented in Table 5.

For known or suspected carcinogens, EPA considers excess upper bound individual lifetime cancer risks of between 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual has approximately a one in ten thousand to one in a million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year period under specific exposure conditions at the site. The calculated cancer risks associated with ground water ingestion are listed in Table 4.

Utilizing the updated guidance for calculating risk assessment, the carcinogenic risk associated with the ingestion of the on-site contaminated ground water is 8×10^{-4} (eight in ten thousand) for the most probable case. The realistic worst case was 2×10^{-3} (two in a thousand). For the off-site ground water, the risk is 1×10^{-3} (one in a thousand) and 4×10^{-2} (four in a hundred) for the most probable and realistic worst exposure cases, respectively. The off-site risk is primarily attributed to the presence of PCBs, while the on-site risk is primarily associated with beryllium.

The arsenic concentrations under a realistic worst case exposure scenario for on-site and off-site wells were 69,500 parts per billion (ppb) and 60.9 ppb, respectively. The ground water ingestion risks calculated for arsenic using these values exceeded the limitations of the linear low dose cancer risk equation. Hence, the cancer risk for arsenic is not included in the revised risk calculation in Table 4. The arsenic concentrations, however, greatly exceed the MCL of 50 ppb and exposure to these levels could result in a highly increased cancer incidence.

For the off-site ground water, the carcinogenic risks using the previous risk assessment guidance are 8×10^{-1} (eight in ten) for the most probable case and the carcinogenic risk exceed one for the realistic worst case scenario. For the on-site ground water carcinogenic risk, the most probable and realistic worst case exposure scenario are 2×10^{-3} (one in a thousand) and 5×10^{-2} (five in a hundred), respectively.

A more detailed evaluation of the risks associated with ground water is described in Chapter 13 of the Remedial Investigation Report.

Uncertainties

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subjected to a wide variety of uncertainties. In general, the main sources of uncertainty include:

- Environmental Chemistry Sampling and Analysis
- Environmental Parameter Measurement
- Fate and Transport Modeling
- Exposure Parameter Estimation
- Toxicological Data

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is significant uncertainly as to the actual levels present. Environmental chemistry analysis error can stem from several sources including the errors inherent in analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentration of the chemical of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the Risk Assessment provides upper bound estimates of the risks to populations near the site, and is highly unlikely to underestimate actual risks related to the site.

Environmental Risks

The environmental evaluation provides a qualitative assessment of the actual or potential impacts associated with the ground water at the site on plants and animals. The primary objectives of this assessment are to identify the ecosystems, habitats, and populations likely to be found at the site and to characterize the contaminants, exposure routes and potential impacts on the identified receptors. There are wetlands on the site which have been impacted, primarily as a result of contaminated surface runoff. They will be addressed by the first operable unit remedial action. It is believed that the ground water contamination has not adversely impacted these wetlands to any significant degree, nor are there any other direct routes of

exposure to aquatic or terrestrial biota. Consequently, any potential additional ground water related impacts are considered negligible.

Conclusion

Based on the above, actual or threatened release of hazardous substances from the Imperial Oil/Champion Chemicals site, if not addressed by implementing the response action selected in this Record Of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Remedial Action Objectives

Remedial action objectives are specific goals to protect human health and the environment. The baseline risk assessment for this site indicates that the potential human health risks associated with ingestion of contaminated ground water underlying the site are unacceptable. Based on the site conditions, nature of contaminants, migration pathways, and conclusions of the risk assessment, the following specific remedial response objectives have been established for this site:

- prevent further off-site migration of contaminated ground water

- return the aquifer to its designated use as a source of drinking water by reducing contaminant concentrations in the ground water to drinking water quality.

DESCRIPTION OF ALTERNATIVES

CERCLA requires that each selected site remedy be protective of human health and the environment, be cost-effective, complies with other statutory laws, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. In addition, the statute includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances.

The estimated capital and annual operation and maintenance (O&M) costs are used to calculate an estimated total present worth cost for each alternative. In addition, for each of the described alternatives, the implementation timeframe refers to the time required to implement the alternative from the start of construction, through operation of the treatment system to remedy completion. This timeframe does not include the time required to perform remedial design activities or negotiate with PRPs.

The FS considered the following general response actions for addressing the contaminated ground water at the site: no action; containment; and collection, treatment, and discharge of the ground water. Several remedial technologies that could meet the

ground water cleanup objectives were identified and evaluated initially for effectiveness, implementability, and cost. Those alternatives which passed the initial screening are highlighted in this section. A detailed description of all the remedial alternatives evaluated for the ground water at the IOC/CCC site are provided in the Ground Water Control Feasibility Study, which is available at the Marlboro Township Municipal Building.

Three options were considered for the discharge of the treated ground water. These options included discharging to: a publicly owned treatment works (POTW); the aquifer; and Birch Swamp Brook. Discharging to a POTW or the aquifer were eliminated in the feasibility study. The closest POTW is operating under an administrative consent order issued by NJDEPE because of the POTW's failure to implement pretreatment standards for industrial dischargers and formulate local limits. Therefore, this option was eliminated from further consideration. The disadvantages of reinjection to the aquifer include potential interference with the future on-site soil remediation, potential widening of the plume width, and potential mounding due to the shallow depth of the ground water table at the site. Mounding could potentially raise the water table above the ground surface, which could result in flooding and the further migration of the contaminants. Chapter 8 of the Feasibility Study Report contains a detailed analysis of the different discharge options. Discharge to Birch Swamp Brook was found to be feasible.

The five alternatives which received detailed analysis (as numbered in the GWCFS) are:

Alternative 1: NO ACTION

Alternative 2: CONTAINMENT

Alternative 3: GROUND WATER EXTRACTION, PRECIPITATION, ULTRAVIOLET (UV) OXIDATION, DISCHARGE TO BIRCH SWAMP BROOK

Alternative 5: GROUND WATER EXTRACTION, PRECIPITATION, CARBON ADSORPTION, DISCHARGE TO BIRCH SWAMP BROOK

Alternative 7: GROUND WATER EXTRACTION, ION EXCHANGE, CARBON ADSORPTION, DISCHARGE TO BIRCH SWAMP BROOK

A detailed discussion of the remedial alternatives to address the ground water contamination is provided below.

Alternative 1: NO ACTION

Estimated Capital Cost: $ 0
Estimated Annual O&M Cost: $ 56,000
Estimated Present Worth Cost: $ 975,000
Estimated Implementation Timeframe: None

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and CERCLA require the evaluation of a No Action alternative as a basis for comparison with other remedial action alternatives. Under this alternative, EPA and NJDEPE would not take any action to prevent or control extraction of, or exposure to, contaminated ground water emanating from the IOC/CCC site. Because this alternative would result in contaminants remaining on site, CERCLA requires that a review of site conditions be conducted every five years. The above cost estimate includes the cost to perform a 30-year monitoring program with evaluation of the program every five years.

Alternative 2: CONTAINMENT

Estimated Capital Cost: $4,148,000
Estimated Annual O&M Cost: $59,000
Estimated Present Worth Cost: $5,140,000
Estimated Implementation Timeframe: 30 years

This alternative consists of constructing a low permeability cap over the entire site (including filling and capping the fire pond and the portion of Birch Swamp Brook that flows through the site), a slurry wall upgradient and along the sides of the cap, and a ditch to divert the surface water flow of Birch Swamp Brook around that portion of the brook that would be capped. The cap would cover approximately seven to eight acres. The slurry wall would be anchored approximately three to five feet into the Woodbury Formation beneath the aquifer to prevent ground water flow beneath the wall. The approximate dimensions of the slurry wall would be 1,850 feet in length around the cap and 55 feet deep into the aquifer. A 30-year long-term monitoring program to monitor the effectiveness of the slurry wall and cap is included in the above cost estimate. This alternative would reduce the migration of contaminants from the source areas on site (soils, below grade waste pile, and the floating product layer) by reducing the amount of water flowing through the contaminated media. The slurry wall will prevent the further migration of the ground water towards Lake Lefferts. This alternative addresses contaminated soil as well as ground water. Accordingly, it will also be evaluated as part of Operable Unit 3.

The 30-year timeframe for remediating the ground water is based on the removal of all sources of the ground water contamination (soil, waste filter clay pile, and eventually, the floating product layer) and the reduction of the concentrations of the contaminants via biological degradation and natural attenuation.

Treatment Alternatives 3, 5, 7

Alternatives 3, 5, and 7 have similar components for ground water extraction, on-site treatment, discharge to Birch Swamp Brook, and long-term ground water monitoring. A discussion of these components is given below and is followed by a discussion of each alternative.

It has been estimated that two extraction wells would be installed into the aquifer at a depth of approximately 50 feet. One well would be placed downgradient of the plume and the other within the plume. Both wells together would be capable of extracting ground water at rates between 10 to 15 gallons per minute (GPM). Over a 30-year period, it is estimated that the two wells would extract between 150 to 250 million gallons of ground water. The wells would be connected to a pipe leading to the on-site treatment plant. Effluent from the treatment plant would be discharged into the fire pond and, subsequently, to Birch Swamp Brook via a buried pipe.

A ground water monitoring program would be implemented to monitor the performance of the remedial action. Existing monitoring wells would be used to collect samples and to monitor the migration of the plume. While the actual location of the wells would be determined during design, anticipated points include locations upgradient and downgradient from, and within the ground water plume.

Alternative 3: GROUND WATER EXTRACTION, PRECIPITATION, ULTRAVIOLET (UV) OXIDATION, DISCHARGE TO BIRCH SWAMP BROOK

Estimated Capital Cost:	$ 1,586,000
Estimated Annual O&M Cost:	$ 553,000
Estimated Present Worth Cost:	$10,291,000
Estimated Implementation Timeframe:	More than 30 years

Under this alternative, extraction wells to collect the contaminated ground water and an on-site treatment system to treat the inorganic and organic contaminants to required treatment levels would be installed. The precipitation treatment scheme for inorganic contaminants would consist of coprecipitation, flocculation, clarification, and filtration. Organics treatment via the UV/Oxidation process would consist of chemical oxidation utilizing ozone or hydrogen peroxide enhanced by exposure to ultraviolet light. In the oxidation process, organic contaminants are broken down into simpler non-hazardous substances. As previously mentioned, the treated ground water would be discharged to Birch Swamp Brook and ground water monitoring would be performed during and following active remediation.

Alternative 5: GROUND WATER EXTRACTION, PRECIPITATION, CARBON ADSORPTION, DISCHARGE TO BIRCH SWAMP BROOK

Estimated Capital Cost:	$ 1,526,000
Estimated Annual O&M Cost:	$ 515,000
Estimated Present Worth Cost:	$ 9,647,000
Estimated Implementation Timeframe:	More than 30 years

Alternative 5 is the same as Alternative 3 except for the treatment technology used to treat organic contaminants in ground water. In this alternative, activated carbon adsorption is

utilized for the treatment of organics. Activated carbon adsorption is a physical separation process in which organic substances are removed from contaminated ground water by sorption (i.e., the attraction and accumulation of one substance on the surface of another). The treated water would be discharged to Birch Swamp Brook. As in Alternative 3, ground water monitoring would be performed during and following active remediation.

Alternative 7: GROUND WATER EXTRACTION, ION EXCHANGE, CARBON ADSORPTION, DISCHARGE TO BIRCH SWAMP BROOK

Estimated Capital Cost: $ 1,750,000
Estimated Annual O&M Cost: $ 467,000
Estimated Present Worth Cost: $ 9,133,000
Estimated Implementation Timeframe: More than 30 years

Alternative 7 is the same as Alternative 5 except for the treatment technology chosen to treat inorganic contaminants in ground water. The inorganic treatment technology would involve ion exchange rather than precipitation. Ion exchange would be used to remove the inorganic compounds (metals) from the ground water. The treated water would be discharged to Birch Swamp Brook. As in Alternatives 3 and 5, ground water monitoring would be performed during and following active remediation.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In accordance with the NCP, a detailed analysis of each remedial alternative was conducted with respect to each of nine criteria for selecting a site remedy. This section discusses and compares the performance of the remedial alternatives under consideration against these criteria. The resulting strengths and weakness of the alternatives were then weighed to identify the ground water alternative which provides the best balance among the nine criteria.

The criteria are categorized into three groups -- threshold, primary balancing, and modifying criteria. Briefly, threshold criteria are the most important and must be satisfied by any alternative to be eligible for selection. Primary balancing criteria are used to make comparisons and identify the major tradeoffs among the various alternatives. Finally, modifying criteria are generally taken into account after the formal public comment period on the RI/FS Reports and the Proposed Plan is completed. The nine criteria are described below.

THRESHOLD CRITERIA

Overall Protection of Human Health and the Environment

addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Alternative 1 (No Action) is not protective of human health and the environment. Under this alternative, contaminated ground water will continue to migrate further downgradient of the site, presenting the threat of exposure to human receptors. The Englishtown Aquifer is classified as GW-2: Current or Potential Potable Water Supply. While there are presently no known users of the aquifer as a potable water source, there could be in the future and there are current users of the aquifer for non-potable purposes. It is unlikely that contaminant concentrations would be reduced to safe drinking water levels by natural phenomena such as chemical and biological degradation within any reasonable timeframe. Because Alternative 1 does not meet the threshold criteria of being protective of human health and the environment, it is eliminated from consideration and will not be discussed any further.

Alternative 2 is marginally more protective of human health and the environment than Alternative 1 because the slurry wall and cap would reduce further migration of contamination downgradient. However, without some type of active treatment, there is little likelihood that contaminant concentrations would be reduced to safe levels by natural phenomena such as chemical and biological degradation.

Alternatives 3, 5, and 7 all would be protective of human health and the environment if implemented. Each of these three alternatives would prevent the further migration of contaminated ground water, limiting the threat of exposure to potential receptors, and would reduce the concentrations of contaminants found in the ground water emanating from the site to safe levels.

Compliance with Applicable Relevant and Appropriate Requirements (ARARs)

addresses whether or not a remedy will meet all Federal and State environmental laws, and/or provide the basis for a waiver from any of these laws. These ARARs are divided into the following three groups: chemical-specific, action-specific, and location-specific.

Chemical-Specific ARARs

Chemical-specific ARARs are usually numerical values which establish the amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

Alternatives 3, 5, and 7 would all meet chemical-specific ARARs. The chemical-specific ARARs for ground water remediation at the IOC/CC site are the promulgated Federal and State drinking water standards.

Alternative 2 is unlikely to attain the chemical-specific ARARs for ground water because reducing contaminant concentrations is solely dependent upon natural chemical and biological degradation

phenomena. Even if the cleanup levels could be achieved, the time period would be significantly longer than would be achieved under active remediation.

Action-Specific ARARs

Action-specific ARARs are technology or activity-specific regulations, requirements, or limitations related to any remedial measures determined necessary for the site.

All of the alternatives can be designed and implemented to achieve their action-specific ARARs including applicable Resource Conservation and Recovery Act (RCRA) and Toxic Substances Control Act (TSCA) requirements.

Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because they occur in a special location.

All of the alternatives would comply with current wetlands and floodplain regulations. A wetlands delineation/assessment will be conducted to identify any potential impacts of the remedial activities to the wetlands and to identify procedures to reduce the impacts. Also, an assessment will be conducted to delineate the floodplain and to identify an appropriate mitigation for any adverse floodplain impacts. The floodplain assessment will be conducted using the 500-year contour as defined by the Federal Emergency Management Agency. The wetlands and floodplain assessments will be conducted early in the remedial design. In addition, a Stage IA cultural resource survey will be conducted in accordance with the National Historic Preservation Act.

PRIMARY BALANCING CRITERIA

Long-term Effectiveness and Permanence

refers to the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Alternatives 3, 5, and 7 all provide the greatest long-term effectiveness and permanence because their intent is to treat ground water to health-based standards which are developed to minimize risk to safe levels. In order to effectively achieve the ground water cleanup goals, it will also be necessary to remediate the various sources of ground water contamination (soil, waste filter clay, and the petroleum product). If these sources are not remediated, they will continue to contaminate the ground water and have a detrimental impact on the ground water cleanup. However, the effectiveness of Alternative 3 or 7 is less certain than Alternative 5 owing to implementability

concerns as discussed later in the Implementability Section of this document.

Alternative 2 provides much less long-term effectiveness and permanence than any of the three treatment alternatives since contaminant reduction to safe levels is dependent upon natural phenomena and the contaminants would remain on the site.

Reduction of Toxicity, Mobility, or Volume Through Treatment

refers to the preference for a remedy that uses treatment to reduce health hazards, contaminant migration, or the quantity of contaminations at the site.

The active treatment alternatives (Alternatives 3, 5, and 7) would provide the greatest reduction of toxicity, mobility, and volume of contaminated ground water. The extraction of the ground water would reduce the volume of the contaminated ground water and would reduce the mobility of the contaminants. The treatment of the extracted ground water would reduce its toxicity prior to discharging to Birch Swamp Brook.

Under Alternative 2, the mobility of contaminated ground water would be reduced, due to partial containment of the aquifer, although, not as much as by the three treatment alternatives. Alternative 2 relies upon natural phenomena to reduce the volume and toxicity level of contaminated ground water.

Short-term Effectiveness

refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during construction and implementation of the remedy.

For Alternative 2, short-term adverse environmental impacts would result from diverting Birch Swamp Brook. Fugitive dust emissions from the construction of the slurry wall and cap could pose risks to the community beyond those which would be experienced under the general construction activities associated with Alternatives 3, 5, and 7. However, for Alternatives 2, 3, 5, and 7, dust suppression measures would be implemented to prevent off-site migration of dust and minimize risks to nearby residents and on-site workers.

The installation and operation of extraction wells under Alternatives 3, 5, and 7 will involve risks similar to those encountered during the RI, primarily exposure to volatile organic contaminants existing at the site. A Health and Safety Plan would be implemented to address and minimize those risks.

Discharging the treated water to Birch Swamp Brook would not have any adverse impact on the stream. The treated water would be discharged in accordance with the effluent criteria developed by NJDEPE.

Implementability

refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution. It also includes coordination of Federal, State, and local governments to clean up the site.

Alternative 2 would utilize demonstrated reliable technologies with readily available construction equipment and material but would pose certain coordination and administrative hurdles. These hurdles include those associated with filling wetlands and diverting Birch Swamp Brook.

Alternatives 3, 5 and 7 pose administrative hurdles with regard to the need to purchase at least two adjacent off-site properties to install the treatment plant. Because of the wide spread soil contamination and the relatively small land size of the Champion Chemicals Company property, the treatment plant will be located on the two adjacent properties.

Alternative 3 includes UV/Oxidation technology, which can destroy organic contaminants, but is questionable for the treatment to required levels for ground water contaminated with PCBs. Treatability studies would be required for this technology with uncertain results.

Alternative 5 technologies have been proven effective in full scale operations and are widely used for water treatment. Precipitation effectively removes metals including arsenic, while carbon adsorption effectively removes organic contaminants. Treatability studies would be limited to those needed to determine types and amounts of precipitating agents and the amounts of carbon required. Sludge from the precipitation step would be disposed of in accordance with appropriate Federal and State requirements. Spent carbon would be regenerated for reuse, if feasible, or disposed of in accordance with appropriate Federal and State requirements.

Alternative 7 includes ion exchange technology, which can remove metals (inorganics), but is questionable for the removal of arsenic. Treatability studies would be required for this technology with uncertain results as to the technology's effectiveness.

Alternatives 3, 5, and 7 pose a potential future implementability concern regarding the availability of adequate disposal and treatment facilities for the spent carbon and the sludge generated by the treatment system. Currently, there are licensed chemical waste landfills and incinerators available for the disposal of PCB-contaminated activated carbon regulated under the Toxic Substances Control Act. Future availability via landfill disposal or incineration is uncertain.

Cost

refers to the estimated costs for each remedial alternative. These include estimated capital and annual operation and maintenance (O&M) costs, also expressed as estimated total present worth cost.

Cost estimation for the ground water remedial alternatives are based on a 30-year period using a discount rate of 5 percent. All alternatives and their associated costs are as follows:

Alt.	Capital Cost	O&M	Total Present Worth Cost
1	$ 0	$ 56,000	$ 975,000
2	$4,148,000	$ 59,000	$ 5,140,000
3	$1,586,000	$553,000	$10,291,000
5	$1,526,000	$515,000	$ 9,647,000
7	$1,750,000	$467,000	$ 9,133,000

MODIFYING CRITERIA

State Acceptance

refers to the aspects of the preferred alternatives and other alternatives that the supporting agency favors, objects to, and any specific comments regarding State ARARs or the proposed use of waivers.

As the lead agency for the investigation, the State of New Jersey participated in the selection of the remedy for this site. The State, therefore, concurs with the selected remedy of Alternative 5.

Community Acceptance

This summarizes the public's general response to the alternative described in the Proposed Plan and in the RI/FS, based on public comments.

The objective of the community relations activities was to inform the public about the work being performed at the site and to receive input from the public on the remedy. The community expressed support for the preferred alternative. Questions and answers raised during the public meeting are presented in the Responsiveness Summary (Appendix C). The community did not identify any issues that necessitated changes to the Proposed Plan or the preferred alternative.

SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, the EPA and NJDEPE have selected Alternative 5 as the remedy for the IOC/CCC site.

Alternative 5: Ground water Extraction, Precipitation, Carbon Adsorption, Discharge to Birch Swamp Brook is comprised of the following components:

- Extraction of the contaminated ground water that is above cleanup standards;

- Treatment of the extracted ground water via precipitation of inorganic contaminants and carbon adsorption of organic contaminants;

- Discharge of the treated ground water to Birch Swamp Brook;

- Continuation of the floating product removal action currently being undertaken by the Environmental Protection Agency; and

- Appropriate environmental monitoring to ensure the effectiveness of the remedy.

The selection of Alternative 5 is based upon the comparative analysis of the ground water alternatives above, and provides the best balance of tradeoffs with respect to the nine evaluation criteria. ARARs for the selected remedy are provided in the discussion Attainment of Applicable or Relevant and Appropriate Requirements of Environmental Laws in the following section. The selected alternative for the cleanup of the contaminated ground water employs an effective, readily-implementable technology for treatment of inorganic and organic compounds. The only residuals of the treatment are the spent carbon and sludge from the precipitation process. As stated previously, the spent carbon would be regenerated for reuse, if possible, and the sludge generated from the treatment facility would be disposed of in accordance with appropriate Federal and State requirements.

As stated previously, EPA is in the process of removing the petroleum product layer from the ground water. Since this product is contributing to the ground water contamination, EPA and NJDEPE consider the removal of this source of contamination an integral part of the remediation of the ground water. It is anticipated EPA will not complete the product removal under its removal authority. As a result, NJDEPE as the lead agency for the site, will complete the remaining work associated with the removal of the floating product as a component of this Operable Unit 2 ground water remedy.

One goal of the ground water remedy is to restore the contaminated aquifer to Federal and State promulgated MCLs. A further objective of the ground water remedy is to restore the ground water to its beneficial use which, at the IOC/CCC site, is a drinking water aquifer, and to prevent the further migration of the contaminant plume. Based on information obtained during the RI, and on careful analysis of all remedial alternatives, EPA and

the State of New Jersey believe that the selected ground water remedy will achieve these goals. It may become apparent, however, during implementation or operation of the ground water extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation goal over some portion of the contaminated ground water plume. In such a case, the system performance standards and/or the remedy may be reevaluated.

The remedy would include ground water extraction for an estimated period of over 30 years, during which time the system's performance would be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

- Discontinuing pumping at a well where cleanup goals have been attained;

- Alternating pumping at the wells to eliminate stagnation points;

- Pulse pumping to allow aquifer equilibration and allow adsorbed contaminants to partition into the ground water; and/or

- Installing additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup levels are maintained, the aquifer will be monitored at those wells where pumping has ceased following discontinuation of ground water extraction. These wells would be sampled on a regular basis (e.g., quarterly) for several years, followed by annual sampling thereafter for 5 to 10 years.

As stated previously, one goal of the ground water remedy is to restore the contaminated aquifer to Federal and State promulgated MCLs. NJDEPE has requested that ground water contamination at the site be remediated to the levels specified in its Proposed Cleanup Standards for Contaminated Sites (February 1992), provided in Table 6. EPA has determined that further remediation of the contaminated ground water at the Site to the levels requested by the NJDEPE, while ineligible for CERCLA funding, does not conflict, or is not inconsistent, with the selected remedy. The NJDEPE has agreed to fund the incremental costs associated with this additional cleanup.

The total estimated cost for the selected remedy is $9,647,000. Details of the costs of this remedy are shown in Chapter 8 of the Ground Water Control Feasibility Study Report.

Detailed technical specifications will be developed during the design phase of the remedy. As part of the design, treatability studies will be performed for the precipitation treatment process

to determine the specific types and amounts of precipitating agents needed. In addition, treatability studies for the carbon adsorption process will be performed to provide design data on bed life, contaminant concentrations on the spent carbon and regenerability.

The selected alternative will comply with current wetlands and floodplain regulations. A wetlands delineation/assessment will be conducted to identify any potential impacts of the remedial activities to the wetlands and to identify procedures to reduce the impacts. Also, an assessment will be conducted to delineate the floodplain and to identify any appropriate mitigation for any adverse floodplain impacts. The floodplain assessment will conducted using the 500-year contour as defined by the Federal Emergency Management Agency. The wetlands and floodplain assessments will be conducted early in the remedial design. In addition, a Stage IA cultural resource survey will be conducted in accordance with the National Historic Preservation Act.

STATUTORY DETERMINATIONS

EPA's selection of Alternative 5 for the remediation of the contaminated ground water at the IOC/CCC site will comply with the requirements of Section 121 of CERCLA, as amended. The action is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to this action, and is cost-effective. This action utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable, given the limited scope of the action. The statutory preference for treatment that reduces toxicity, mobility or volume will be addressed in this action, as appropriate. The action does not constitute the final remedy for the site. Subsequent actions are planned to fully address the remaining principle threats posed by this site. A brief, site-specific description of how the selected remedy complies with the statutory requirements is presented below.

1. <u>Protection of Human Health and the Environment</u>

The selected alternative is protective of human health and the environment and deals effectively with the threats posed by the contaminants which were identified. The principal threats include the ingestion of contaminated ground water by future residents and the migration of the ground water to Lake Lefferts, which, in addition to the Englishtown Aquifer, is a potential source of drinking water.

The selected remedy will allow for the extraction of the contaminated ground water before it migrates any further off site, and will minimize any cross-media impacts. In implementing the action, the risks associated with construction and the length of time for implementation will be minimized. The selected remedy will reduce the risks posed by each pathway to the

population by extracting the contaminated ground water and treating it to meet discharge standards developed for Birch Swamp Brook. The intent of ground water remediation is to reduce the concentration of the contaminants to meet promulgated Federal and State drinking water standards.

Promulgated Federal and State MCLs, New Jersey State Ground Water Quality Standards promulgated under State law and site specific risk based cleanup levels (for some hazardous substances) are the groundwater cleanup goals for the remedy selected in this ROD. EPA recognizes NJDEPE's request that groundwater at the Site be remediated to the levels specified in the proposed "Cleanup Standards for Contaminated sites" which NJDEPE distributed to the public for comments earlier this year. EPA has not identified these proposed State regulations as ARARs nor are they potential ARARs since they have not yet been promulgated by the State. Furthermore, EPA has not identified them as TBCs for this Site. Therefore, any additional actions which might be required (beyond the remedy selected in this ROD) to remediate groundwater at the site to the levels specified in the proposed State regulations are not required by CERCLA nor are they eligible for Federal funding under CERCLA. Any such additional actions may be undertaken if they are identified by the State in a timely manner, if EPA determines they are consistent with the remedy selected in this ROD and they are performed entirely with NJDEPE funding.

2. Compliance with Applicable or Relevant and Appropriate Requirements

All ARARs would be met by the selected remedy.

Chemical-Specific ARARs

The selected ground water remedy would achieve compliance with chemical-specific ARARs related to the contaminants found in the ground water at the site. The ARARs include the promulgated Federal Safe Drinking Water Act and the State of New Jersey Drinking Water Standards, 40 C.F.R. 141 and NJAC 7:10, respectively, which identify MCLs for the ground water. Table 7 shows these levels for the compounds detected in the ground water. The more restrictive of these levels will be used as the cleanup goals for the ground water. For those compounds which have no promulgated MCLs, risk-based drinking water cleanup goals were developed as shown on Table 8 and presented in Appendix D. The intent of the ground water remediation is to reduce the contaminants found in the ground water at the site to promulgated and calculated risk-based cleanup levels.

Action-Specific ARARs

The selected remedy would address and comply with action-specific ARARs for the construction of the treatment plant and the discharge to Birch Swamp Brook. The treatment plant would comply

with 40 CFR Section 260 through 268 of the Federal Resource Conservation and Recovery Act and the New Jersey Hazardous Waste Regulation at N.J.A.C. 7:26; both set standards for the identification, listing, generation, handling, treatment, storage, and disposal of hazardous wastes. Discharging to Birch Swamp Brook would comply with N.J.A.C. 7:14A of the New Jersey Pollutant Discharge Elimination System and New Jersey Surface Water Quality (N.J.A.C. 7:9-4). These effluent limits are provided in Table 10. The shipment of hazardous waste off site to a treatment facility should be consistent with the Off-site Policy-Directive Number 9834.11 issued by the Office of Solid Waste and Emergency Response (OSWER). This directive is intended to ensure that facilities authorized to accept CERCLA generated waste are in compliance with RCRA operating standards.

Also, the selected remedy would comply with 40 C.F.R. 761 - 761.75 of TSCA, which governs the disposal of PCB-contaminated wastes in a landfill or incinerator, if the regeneration of the spent carbon is not possible.

In addition, the selected remedy would comply with all the requirements regulating worker health and safety under the Federal Occupational Safety and Health Act.

Location-Specific

Since the site is located near wetlands and in a floodplain, the selected remedy would comply with Executive Order No. 11,990 and 11,988, which govern the protection of wetlands and the management of floodplain. The National Environmental Policy Act (NEPA) regulations (40 CFR Part 6) are applicable for actions involving construction of facilities in wetlands or alteration of wetlands.

3. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable by providing the best balance of tradeoffs among the nine evaluation criteria for all the alternatives examined. The selected remedy does offer a high degree of long-term effectiveness and permanence; it will significantly reduce the inherent hazards posed by the contaminated ground water at the site, by extracting and treating the ground water to applicable Federal and State standards.

4. Preference for Treatment as a Principal Element

The selected remedy satisfies the statutory preference for treatment as a principal element. The contaminated ground water at the site is a potential threat to human health and the environment. The selected remedy reduces the levels of contaminants in the aquifer through extraction of the ground

water. It reduces the concentration of the contaminants in the extracted ground water through treatment prior to the discharge to Birch Swamp Brook.

5. Cost-Effectiveness

Of the alternatives which most effectively address the threats posed by the contaminated ground water plume, Alternative 5, the selected remedy, affords the highest level of overall effectiveness proportional to its cost. Based on the information generated during the GWCFS, the estimated total project cost is $9,647,000. Although the estimated total project cost for Alternative 7 is lower at $9,133,000, the effectiveness of this alternative is less certain than that of the selected remedy.

DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the IOC/CCC site was released to the public on July 31, 1992. The Proposed Plan identified the preferred alternative. NJDEPE and EPA 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 selected remedy, as it was originally identified in the Proposed Plan, were necessary.

The carcinogenic and non-carcinogenic risks were revised from the initial values presented in the Proposed Plan. The overall carcinogenic risk associated with the ingestion of ground water had been calculated using a high concentration of arsenic, which exceeded the limitation of the linear low dose cancer risk equation. The carcinogenic risk as presented in this ROD does not include arsenic. However, the concentration of arsenic greatly exceeds the MCL of 50 ppb and exposure to these levels could result in a highly increased cancer incidence.

Figures and Tables

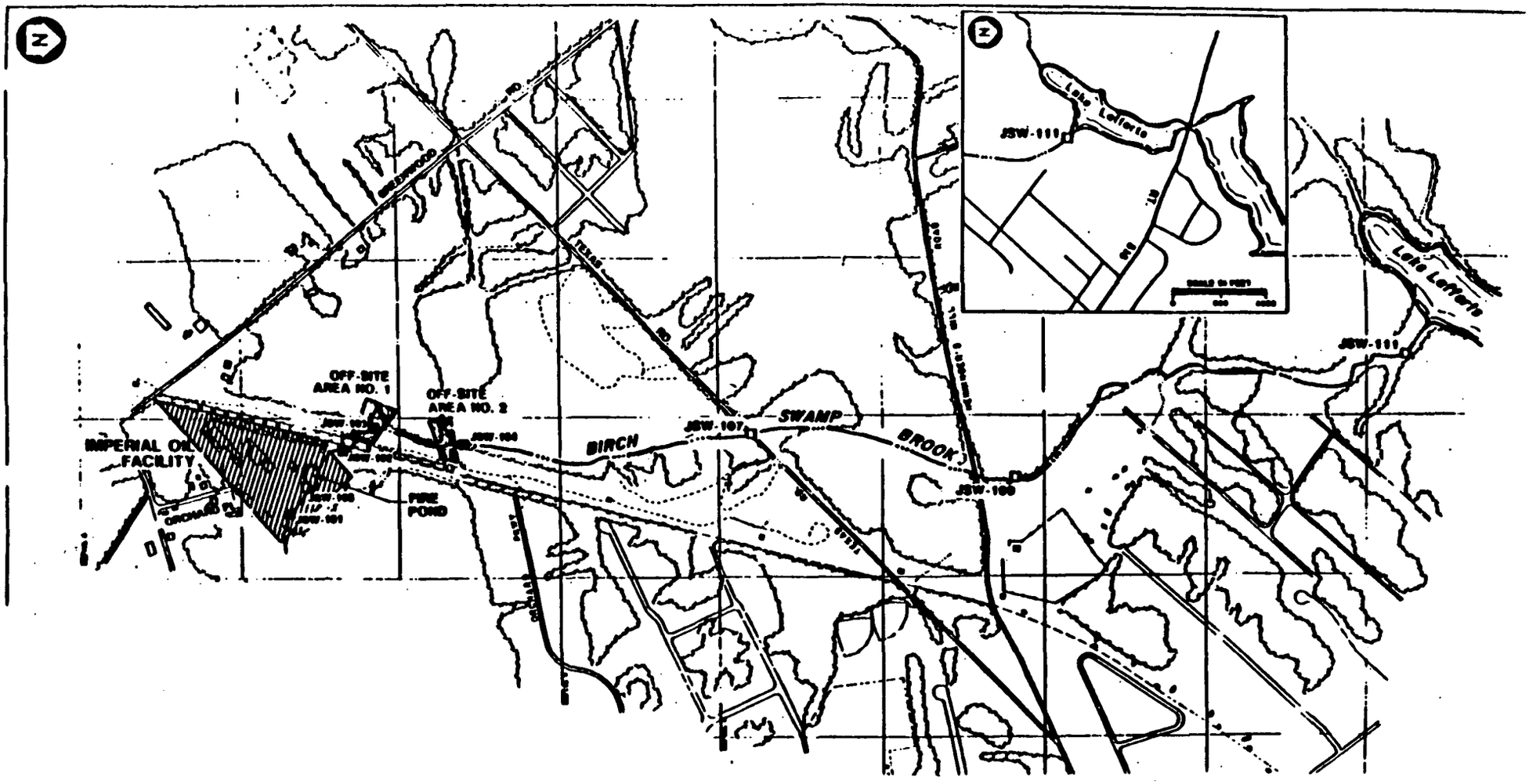
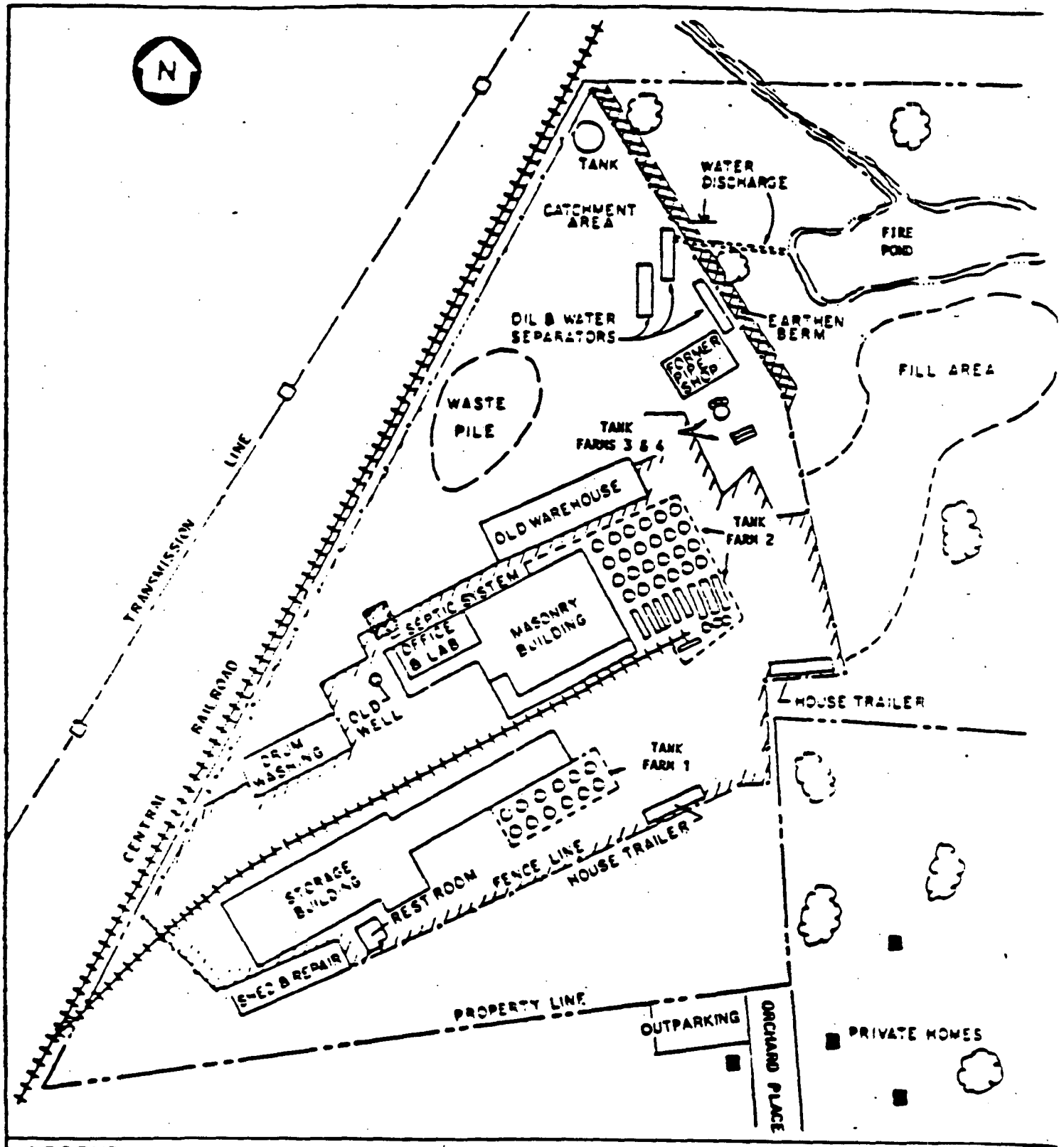


FIGURE 1

IMPERIAL OIL/CHAMPION CHEMICALS SITE
MORGANVILLE, NEW JERSEY

E.C. JORDAN CO.



LEGEND

EXTENT OF PAVED AREA

SCALE

0 50 100 200 FEET

FIGURE 2

SCHEMATIC LAYOUT OF
IMPERIAL OIL CO. FACILITY
IMPERIAL OIL/CHAMPION CHEMICALS SITE
MORGANVILLE, NEW JERSEY

ECJORDANCO

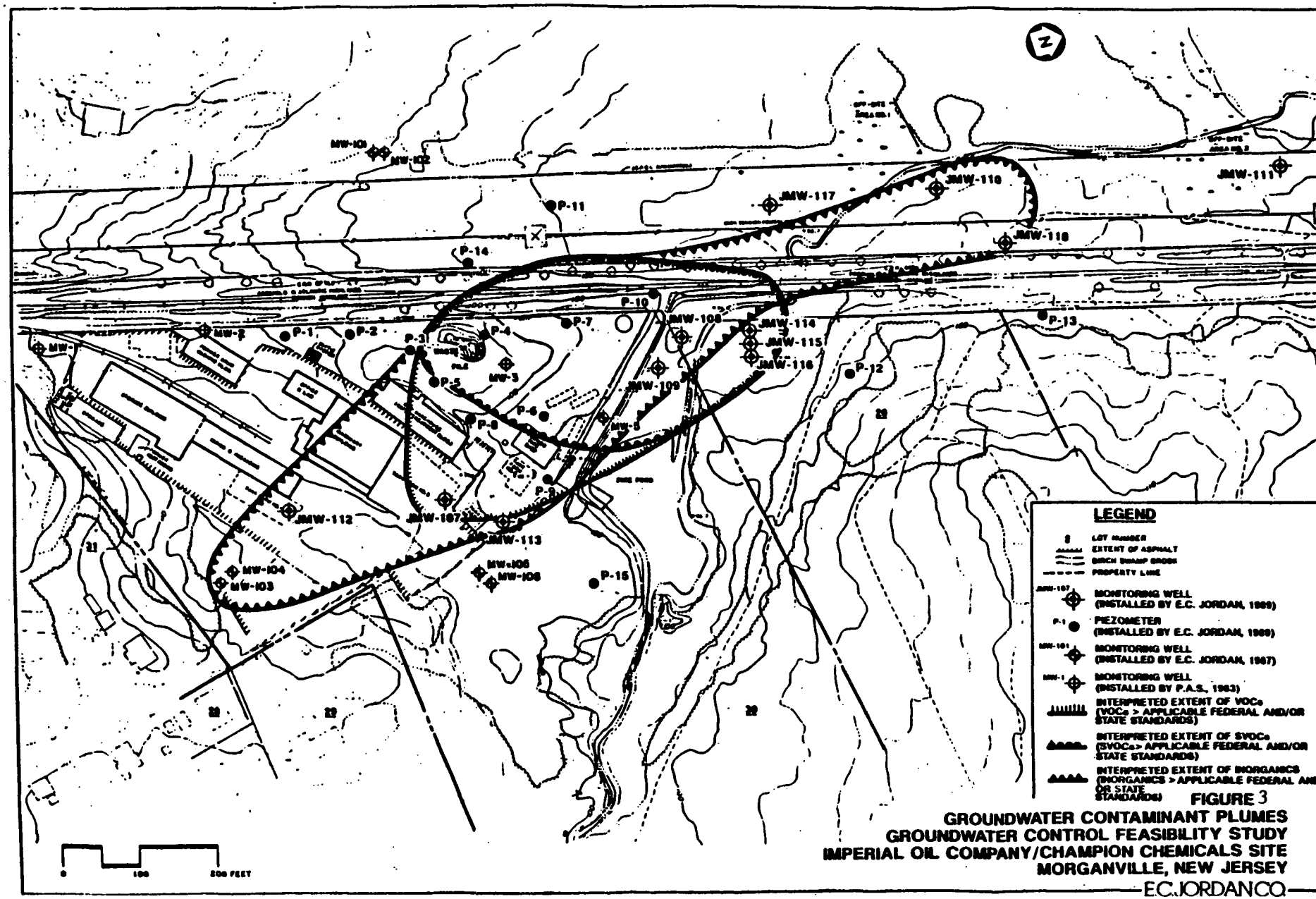


FIGURE 3

GROUNDWATER CONTAMINANT PLUMES
GROUNDWATER CONTROL FEASIBILITY STUDY
IMPERIAL OIL COMPANY/CHAMPION CHEMICALS SITE
MORGANVILLE, NEW JERSEY

E.C. JORDAN CO.

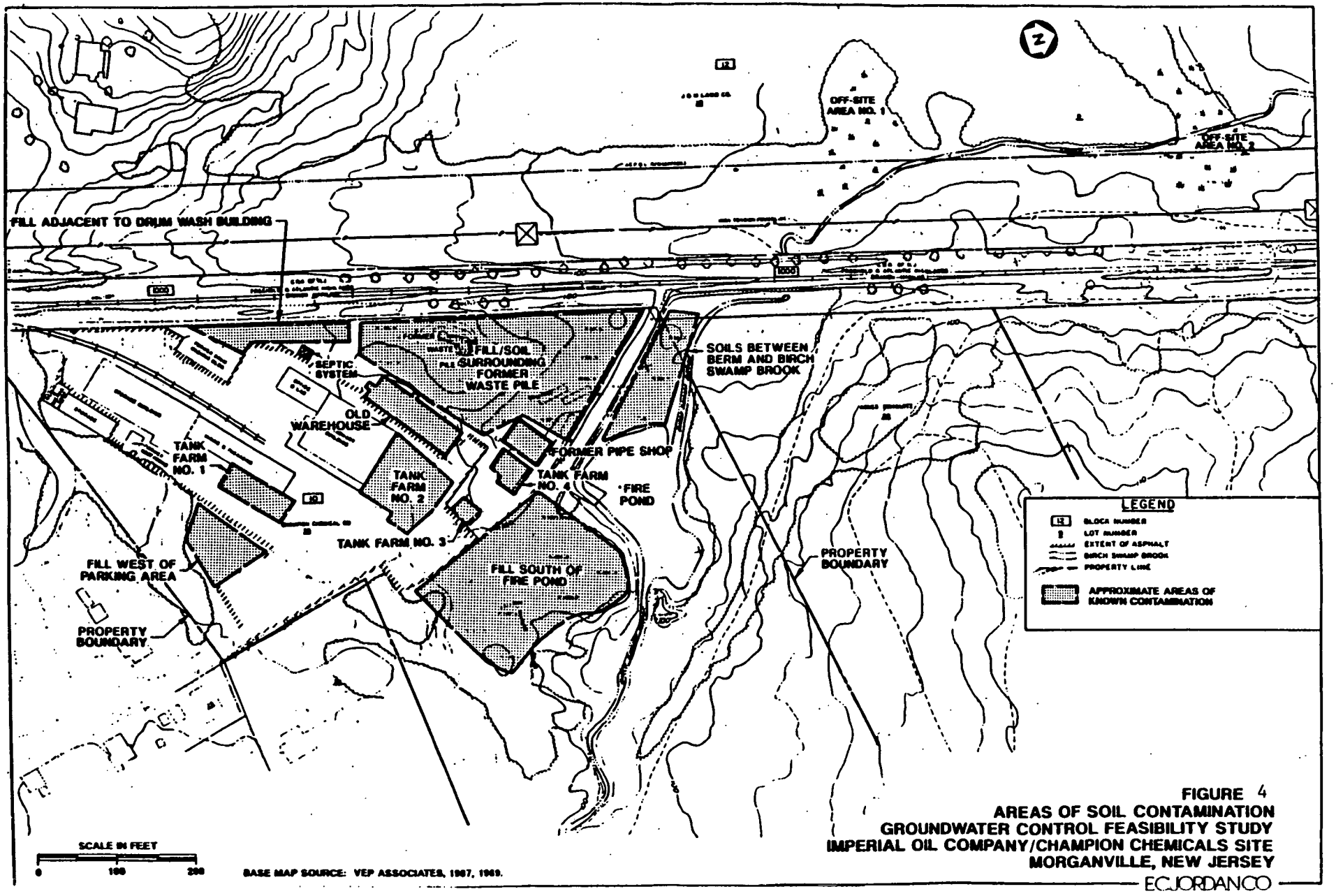


FIGURE 4
AREAS OF SOIL CONTAMINATION
GROUNDWATER CONTROL FEASIBILITY STUDY
IMPERIAL OIL COMPANY/CHAMPION CHEMICALS SITE
MORGANVILLE, NEW JERSEY

ECJORDANCO

TABLE 1

Ground water Sampling Results (ppb) and Corresponding MCLs

Contaminants	Maximum Concentrations	Federal MCL	New Jersey MCL
VOCs			
Methylene Chloride (a)	12	5	2
Benzene	55	5	1
Tetrachloroethene	35	5	1
1,2-dichloroethene (cis)	200*	70	10*
1,2-dichloroethene (trans)	200*	100	10*
1,2-Dichloroethane (a)	49	5	--
Trichloroethene	160	5	1
Ethylbenzene	120	700	--
Xylenes (total)	580	10000	44
Toluene	2200	1000	--
4-Methyl-2-pentanone (a)	490	--	--
SVOCs			
Acenaphthene	24	--	--
2-Methylphenol	6800	--	--
Bis(2-ethylhexyl)phthalate	380	6	--
4-methylphenol	210	--	--
2,4-dimethylphenol	30	--	--
Naphthalene	630	--	--
Di-n-butyl phthalate	18	--	--
Phenanthrene	64	--	--
Fluoranthene	11	--	--
Pyrene	16	--	--
Fluorene	33	--	--
1,2,4-trichlorobenzene	170	70	8
2-methylnaphthalene	1000	--	--
PCBs	390	0.5	0.5
4,4' DDT (a)	7.5	--	--

TABLE 1 (Cont.)

INORGANICS

Antimony	187	6	--
Lead	257	--	--
Arsenic	69,500	50	50
Silver	119	--	--
Beryllium	14	4	--
Vanadium	41	--	--
Chromium (total)	119	100	100
Zinc	152	--	--
Nickel (a)	102	100	--

-- Value not available
(a) Compound not identified as Chemical of Concern in RI Report for purpose of the Risk Assessment.
* Total

TABLE 2

Contaminants of Concern
Imperial Oil Company/Champion Chemical Site

Volatiles

- Benzene
- 1,2-Dichloroethene
- Ethylbenzene
- Toluene
- Tetrachloroethene
- Trichloroethene
- Xylenes

Semi-volatiles

- Acenaphthene
- Bis(2-ethylhexyl)phthalate
- 2,4-Dimethylphenol
- Di-n-butyl phthalate
- Fluoranthene
- Fluorene
- 2-Methylnaphthalene
- 2-Methylphenol
- 4-Methylphenol
- Naphthalene
- Phenanthrene
- Pyrene
- 1,2,4-Trichlorobenzene

Pesticides/PCBs

- Aroclors

Inorganics

- Antimony
- Arsenic
- Beryllium
- Chromium
- Lead
- Silver
- Vanadium
- Zinc

TABLE 3

Reference Dose for Selected Chemical of Concern

IMPERIAL OIL/CHAMPION CHEMICAL SITE

09-May-90

COMPOUND	CHRONIC RfD mg/kg/day	SOURCE	STUDY TYPE (1)	CONFIDENCE LEVEL	CRITICAL EFFECT	UNCERTAINTY AND MODIFYING FACTORS
Antimony	4.00E-04	IRIS	OW	Low	Longevity, blood glucose, and cholesterol	UF = 1000 H,A,L
Butyl benzyl Phthalate	2.00E-01	IRIS	DIET	Low	Increased liver and brain-to-body weight ratios	UF = 1000 H,A,S
Chromium III	1.00E+00	IRIS	DIET	Low	No effects observed	UF = 100 H,A MF = 10
Copper	3.70E-02	prop. MCL	OW		Local GI irritation	
Di-n-butyl phthalate	1.00E-01	IRIS	DIET	Low	Increased mortality	UF = 1000 H,A,S
t-1,2-Dichloroethylene	2.00E-02	IRIS	OW	Low	Increased serum alkaline	UF = 1000 H,A,S
2,4-Dimethylphenol (2)	6.00E-04	IRIS	GVGE	Low	Body weight and organ changes	UF = 1000 H,A,S
Ethylbenzene	1.00E-01	IRIS	GVGE	Low	Liver and kidney toxicity	UF = 1000 H,A,S
Lead *	1.40E-04	MCL	OW		CNS Effects	
2-Methylphenol (o-cresol)	5.00E-02	IRIS	GVGE	Medium	Decreased body weights Neurotoxicity	UF = 1000 H,A,S
4-Methylphenol (p-cresol)	5.00E-02	IRIS	GVGE	Medium	Decreased body weights Neurotoxicity	UF = 1000 H,A,S
Noncarcinogenic PAHs (3)	4.00E-01	HEAST (5)	DIET		Ocular and internal lesions	
Silver	3.00E-03	IRIS	DIET	Medium	Argyria	UF = 2 (4)
Styrene	2.00E-01	IRIS	GVGE	Medium	Red blood cell and liver effects	UF = 1000 H,A,S
Toluene	3.00E-01	IRIS	INH	Medium	Clinical chemistry and hematological	UF = 100 H,A

* USEPA does not have a verified RfD for lead. The risk values were recalculated to reflect this policy

TABLE 3 (Continued)

Reference Dose for Selected Chemical of Concern

IMPERIAL OIL/CHAMPION CHEMICAL SITE

COMPOUND	CHRONIC RfD mg/kg/day	SOURCE	STUDY TYPE (1)	CONFIDENCE LEVEL	CRITICAL EFFECT	UNCERTAINTY AND MODIFYING FACTORS
1,2,4-Trichlorobenzene	2.00E-02	HEAST	GVGE		Increased liver-to-body weight ratio	
Vanadium	7.00E-03	HEAST	DW		None observed	
Xylenes (total)	2.00E+00	IRIS	GVGE	Medium	Hyperactivity, decreased body weight, and increased mortality (males)	UF = 100 H,A
Zinc	2.00E-01	HEAST	DIET		Anemia	

NOTES:

Confidence level and uncertainty and modifying factors from IRIS

Uncertainty factors (UF) of 10 are applied for each of the following uncertainties:

H = variation in human sensitivity
A = animal to human extrapolation
S = extrapoloation from subchronic to chronic NOAEL
L = extrapolation from LOAEL to NOAEL

Modifying factors (MF) range from 1 to 10. The default factor is 1.
Only modifying factors greater than 1 are listed.

(1) GVGE = gavage study
DW = drinking water study
INH = inhalation study

(2) Based on oral RfD for 2,6-dimethylphenol

(3) Based on oral RfD for naphthalene

(4) The standard UF of 10 for intraspecies variability is not considered appropriate
A UF of 2 is used for the LOAEL because the critical effect is considered to be minimally severe.

(5) USEPA Health Effects Assessment Summary Tables

TABLE 4

SUMMARY OF RISK ESTIMATES
via
INGESTION OF GROUND WATER
(as calculated in the RI Report)

Wells on IOC/CC Property	Most Probable Case Exposure	Realistic Worst Case Exposure
Noncarcinogenic Risks (HI)	16.8	51.8
Carcinogenic Risks	$8x10^{-1}$	>1

Wells off IOC/CC Property	Most Probable Case Exposure	Realistic Worst Case Exposure
Noncarcinogenic Risks (HI)	5.2	25.1
Carcinogenic Risks	$2x10^{-3}$	$5x10^{-2}$

REVISED RISK CALCULATIONS

Wells on IOC/CC Property	Most Probable Case Exposure	Realistic Worst Case Exposure
Noncarcinogenic Risks (HI)[1]	8.8	19.4
Carcinogenic Risks[2]	$8x10^{-4}$	$2x10^{-3}$

Wells off IOC/CC Property	Most Probable Case Exposure	Realistic Worst Case Exposure
Noncarcinogenic Risks (HI)[1]	4.0	18.2
Carcinogenic Risks[2]	$1x10^{-3}$	$4x10^{-2}$

1. EPA recalculated all hazard indices subtracting all lead non-cancer effects based on the NJDEPE's RfD, which is not an EPA verified value.

2. Carcinogenic risk estimates shown do not include those from arsenic present in the ground water because ground water arsenic concentrations exceed the limitation of the linear low dose cancer risk equation (see text).

TABLE 5

Slope Factor for Selected Chemical of Concern

IMPERIAL OIL/CHAMPION CHEMICAL SITE

09-May-90

COMPOUND	SLOPE FACTOR (mg/kg/day)-1	SOURCE	STUDY TYPE (1)	WEIGHT OF EVIDENCE CLASSIFICATION (2)	CANCER TYPE
Arsenic	1.75E+00	IRIS	DW	A	Skin
Benzene	2.90E-02	IRIS	INH	A	Leukemia
BEHP (3)	1.40E-02	IRIS	DIET	B2	Liver
Beryllium	4.30E+00	IRIS	DW	B2	All sites
Chloroform	6.10E-03	IRIS	DW	B2	Kidney
Carcinogenic PAHs (4)	1.15E+01	HEA (5)	DIET	B2	Stomach
1,2-Dichloroethane	9.10E-02	IRIS	GVGE	B2	Circulatory System
Methylene Chloride	7.50E-03	IRIS	DW/INH	B2	Liver
PCB	7.70E+00	IRIS	DIET	B2	Liver
Tetrachloroethylene	5.10E-02	HEAST(6)	GVGE	B2	Liver
Trichloroethylene	1.10E-02	HEAST	GVGE	B2	Liver

NOTE: (1) GVGE = gavage DW = drinking water INH = inhalation

(2) A - Human carcinogen B2 - Sufficient evidence of carcinogenicity in animals

(3) BEHP = Bis(2-ethylhexyl)phthalate

(4) Based on benzo(a)pyrene

(5) USEPA Health Effects Assessment

(6) USEPA Health Effects Assessment Summary Tables

TABLE 6

NJDEPE's Proposed Cleanup Standards for Contaminated Sites and Site Contaminant Levels

Contaminants	Maximum Concentration (ppb)	NJDEPE's Proposed Standard (ppb)
VOCs		
Benzene	55	1
Methlyene Chloride	12	1
Tetrachloroethene	35	1
1,2-Dichloroethane	49	2
1,2-Dichloroethene(cis)	200	10
1,2-Dichloroethene(trans)	200	100
Trichloroethene	160	1
Ethylbenzene	120	700
Xylenes	580	40
Toluene	2200	1,000
SVOCs		
Acenaphthene	24	400
2-Methylphenol	6800	
Bis(2-ethylhexyl)phthalate	380	30
4-Methylphenol*	210	400
2,4-Dimethylphenol*	30	100
Naphthalene	630	30
Di-n-butyl phthalate*	18	900
Phenanthrene*	64	100
Fluoranthene*	11	300
Pyrene*	16	200
Fluorene*	33	300
1,2,4-Trichlorobenzene	170	9
2-Methylnaphthalene	1000	100
4,4'-DDT	7.5	0.1
PCBs	390	0.5

TABLE 6 (Cont.)

Inorganics

Antimony	201	20
Lead	257	10
Arsenic	69,500	8
Silver	119	20
Beryllium*	14	20
Vanadium*	41	100
Chromium	119	100
Zinc*	150	5,000
Nickel	102	100

* Compounds with maximum concentrations less than NJDEPE proposed standard

TABLE 7

Federal and State Maximum Contaminant Levels (MCLs) and Corresponding Site Contaminant Levels (ppb)

Contaminants	Maximum Concentration	Federal MCL	New Jersey MCL
VOCs			
Methlyene Chloride (a)	12	5	2
Benzene	55	5	1
Tetrachloroethene	35	5	1
1,2-Dichloroethene (cis)	200*	70	10*
1,2-Dichloroethene (trans)	200*	100	10*
1,2-Dichloroethane (a)	49	5	--
Trichloroethene	160	5	1
Ethylbenzene	120	700	--
Xylenes (total)	580	10000	44
Toluene	2200	1000	--
4-Methyl-2-pentanone (a)	490	--	--
SVOCs			
Acenaphthene	24	--	--
2-Methylphenol	6800	--	--
Bis(2-ethylhexyl)phthalate	380	6	--
4-Methylphenol	210	--	--
2,4-Dimethylphenol	30	--	--
Naphthalene	630	--	--
Di-n-butyl phthalate	18	--	--
Phenanthrene	64	--	--
Fluoranthene	11	--	--
Pyrene	16	--	--
Fluorene	33	--	--
1,2,4-Trichlorobenzene	170	70	8
2-Methylnaphthalene	1000	--	--
PCBs	390	0.5	0.5
4,4' DDT (a)	7.5	--	--

TABLE 7 (Cont.)

INORGANICs			
Antimony	187	6	--
Lead	257	--	--
Arsenic	69,500	50	50
Silver	119	--	--
Beryllium	14	4	--
Vanadium	41	--	--
Chromium (total)	119	100	100
Zinc	152	--	--
Nickel (a)	102	100	--

-- Value not available
(a) Compound not identified as Chemical of Concern in RI Report for purpose of the Risk Assessment.
* Total

TABLE 8

Federal Risk-Based Cleanup Levels (ppb)

Contaminants	Maximum[1] Concentration	Risk-Based[2] Cleanup Levels
Acenaphthene	24	2200
2-Methylphenol	6800	--+
4-Methylphenol	210	1800
2,4-Dimethylphenol	30	730
Naphthalene	630	1500
Di-n-butyl phthalate	18	3700
Phenanthrene	64	--+
Fluoranthene	11	1500
Pyrene	16	1095
Fluorene	33	1500
2-Methylnaphthalene	1000	--+

-- Value not available
1 Concentration in ppb
+ Toxicity number not available on IRIS or HEAST
2 Risk levels listed are derived from EPA's Region III Risk-Based Concentration Table, Third Quarter 1992.

From: Peter Moss (PMOSS)
To: TANDERSO
Date: Tuesday, January 12, 1993 3:55 pm
Subject: Imperial ROD

Thanks very much for sending me the ROD Fact Sheet.

Upon reviewing the ROD, I find Table 9 is missing. Everything else is complete.

Please provide a copy of table 9, so I can submit the ROD to the Clearinghouse. Thanks very much.

Peter D. Moss

From: Trevor Anderson (TANDERSO)
To: PMOSS
Date: Tuesday, January 12, 1993 5:26 pm
Subject: Imperial ROD -Reply

there is no table 9 in the rod. the table numbers are as follows: table 1,2,3,4,5,6,7,8,10. if you read the rod carefully, there wouldn't be any mention of a table 9.

TABLE 10

Surface Water Discharge Limitations and Monitoring Requirements

Imperial Company/Champion Chemicals Site

OUTFALL 001

Company: Imperial Oil/Champion Chemicals (IOCC)
Latitude: 40° 23' 05" N Average Flow: 25 GPM Type of Wastewater: Treated Groundwater
Longitude: 74° 14' 45" W Maximum Flow: GPM

PARAMETER	WORST CASE INFLUENT DATA	WATER QUALITY BASED LIMITS		TECHNOLOGY BASED LIMITS		METHOD DETECTION LEVEL	EPA METHOD NUMBER	PERMIT EQUIVALENT EFFLUENT LIMIT	
All values are in ug/l unless otherwise stated		MON AVG	DAY MAX	MON AVG	DAY MAX	(ug/l)		MON AVG	DAY MAX
CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS									
Flow (MGD)	0.036	-	-	-	-	-	-	0.036	Report
Total Organic Carbon (mg/l)	-	-	-	-	50 (1)	-	-	Report	50 (1)
Total Dissolved Solids (mg/l)	-	150	310	-	-	-	-	150	310
(kg/day)		20	42					20	42
Total Suspended Solids (mg/l)	-	20	40	-	-	-	-	20	40
(kg/day)		2.7	5.5					2.7	5.5
pH (s.u.)	-	-	-	6.0 min	9.0	-	-	6.0 min	9.0
Dissolved Oxygen (mg/l)	-	5.0 minimum		-	-	-	-	5.0 minimum	
Petroleum Hydrocarbons (mg/l)	609529	-	-	10	15 (2)	-	-	10 (2)	15 (2)
Chronic Toxicity (% effluent)	-	NOEC = 100% (3)		-	-	-	-	NOEC = 100% (3)	
VOLATILE COMPOUNDS									
Benzene	55	0.15	0.30	37	136 (4)	0.2	602	0.15	0.30
(kg/day)		0.000020	0.000041					-	0.000041
1,1-Dichloroethane	5	-	-	22	59 (4)	-	-	22 (4)	59 (4)
1,2-Dichloroethane	49	0.29	0.58	68	211 (4)	0.03	601	0.29	0.58
(kg/day)		0.000040	0.000080					0.000040	0.000080
1,2-trans-Dichloroethylene	200(total)	-	-	21	54 (4)	-	-	21 (4)	54 (4)
Ethylbenzene	120	-	-	32	108 (4)	-	-	32 (4)	108 (4)
Methylene Chloride	7	2.5	5.0	40	89 (4)	0.25	601	2.5	5.0
(kg/day)		0.00034	0.00068					0.00034	0.00068
4-Methyl-2-Pentanone	490	-	-	49	98 (5)	-	-	49 (5)	98 (5)
Tetrachloroethylene	35	0.39	0.78	22	56 (4)	0.03	601	0.39	0.78
(kg/day)		0.000053	0.00011					0.000053	0.00011
Toluene	290	-	-	26	80 (4)	-	-	26 (4)	80 (4)
Trichloroethylene	160	1.1	2.2	21	54 (4)	0.12	601	1.1	2.2
(kg/day)		0.00015	0.00030					0.00015	0.00030
Xylenes, Total	580	-	-	-	50 (6)	-	-	Report	50 (6)

Revised.930

Table 10 (Continued)

PARAMETER	WORST CASE INFLUENT DATA	WATER QUALITY BASED LIMITS		TECHNOLOGY BASED LIMITS		METHOD DETECTION LEVEL	EPA METHOD NUMBER	PERMIT EQUIVALENT EFFLUENT LIMIT	
All values are in ug/l unless otherwise stated		MON AVG	DAY MAX	MON AVG	DAY MAX	(ug/l)		MON AVG	DAY MAX
ACID AND BASE/NEUTRAL COMPOUNDS									
Benzoic Acid	11000	-	-	55	110 (5)	-	-	55 (5)	110 (5)
Benzyl Alcohol	220	-	-	-	-	Should be Controlled with other compounds			
2,4-Dimethylphenol	30	-	-	18	36 (4)	-	-	18 (4)	36 (4)
Bis (2-Ethylhexyl) Phthalate	380	1.8	3.5	103	279 (4)	2.0	606	1.8	3.5
(kg/day)		0.00024	0.00048					-	0.00048
2-Methylnaphthalene	1000	-	-	-	-	Controlled with Naphthalene			
2-Methylphenol	34	-	-	-	-	Controlled with 2,4-Dimethylphenol			
4-Methylphenol	130	-	-	-	-	Controlled with 2,4-Dimethylphenol			
Naphthalene	630	-	-	22	59 (4)	-	-	22 (4)	59 (4)
1,2,4-Trichlorobenzene	170	31	61	68	140 (4)	-	-	31	61
(kg/day)		0.0042	0.0084					0.0042	0.0084
PESTICIDES									
Delta-BHC	0.45	-	-	-	-	Should be Controlled with other Pesticides			
4,4'-DDT	7.5	0.00050	0.0010	-	-	0.012	608	Report	0.0010
(kg/day)		0.000000067		0.00000014				-	-
Endosulfan Sulfate	0.17	0.93	1.9	-	-	0.006	608	0.93	1.9
(kg/day)		0.00013	0.00025					0.00013	0.00025
Polychlorinated Biphenyls	390	0.00024	0.00049	-	-	ND	608	Report	0.00049
(kg/day)		0.000000033		0.000000066				-	-

(PCBs - 1242, 1254, 1221, 1232, 1248, 1260, and 1016)

Table 10 (Continued)

PARAMETER	WORST CASE INFLUENT DATA	WATER QUALITY BASED LIMITS		TECHNOLOGY BASED LIMITS		METHOD DETECTION LEVEL	EPA METHOD NUMBER	PERMIT EQUIVALENT EFFLUENT LIMIT	
All values are in ug/l unless otherwise stated		MON AVG	DAY MAX	MON AVG	DAY MAX	(ug/l)		MON AVG	DAY MAX
METALS AND CYANIDE									
Aluminum, total	8780	71	140	-	-	-	-	71	140
	(kg/day)	0.0097	0.019					0.0097	0.019
Antimony, total	173	12	24	-	-	3	204.2	12	24
	(kg/day)	0.0017	0.0033					0.0017	0.0033
Arsenic, total	71200	25	50	200	400 (7)	1.4	200.8	25	50
	(kg/day)	0.0034	0.0068					0.0034	0.0068
Barium, total	322	500	1000	1000	2000 (7)	-	-	500	1000
	(kg/day)	0.068	0.14					0.068	0.14
Beryllium, total	14	0.0077	0.015	-	-	0.02	200.9	Report	0.015
	(kg/day)	0.0000010	0.0000021					-	-
Chromium, total	72	ND	ND	500	1000 (7)	0.9	200.8	ND	ND
Copper, total	50	4.6	9.2	400	800 (7)	1	220.2	4.6	9.2
	(kg/day)	0.00062	0.0013					0.00062	0.0013
Iron	76100	820	1600	1500	3000 (7)	-	-	820	1600
	(kg/day)	0.11	0.22					0.11	0.22
Lead, total	297	ND	ND	150	300 (7)	0.6	200.8	ND	ND
Manganese	450	-	-	45	90 (5)	-	-	45 (5)	90 (5)
Mercury, total	0.36	0.0098	0.020	3	6 (7)	0.2	245.1	Report	0.020
	(kg/day)	0.0000013	0.0000027					-	-
Nickel, total	52	72	140	750	1500 (7)	-	-	72	140
	(kg/day)	0.0098	0.020					0.0098	0.020
Silver, total	26	0.60	1.2	100	200 (7)	0.5	200.9	0.60	1.2
	(kg/day)	0.000081	0.00016					0.000081	0.00016
Zinc, total	488	32	65	500	1000 (7)	-	-	32	65
	(kg/day)	0.0044	0.0089					0.0044	0.0089
Cyanide, total	20.6	4.3	8.5	100	200 (7)	5	335.3	4.3	8.5
	(kg/day)	0.00058	0.0012					-	0.0012

ND- Non-detectable using the specified analytical method.

(1) Based on Use of Indicators of Pollution Levels (N.J.A.C. 7:9-5.5) and similar effluent limits for discharges of treated groundwater into surface waters, which have been economically achievable.

(2) Based on Oil and Grease Effluent Limitations, N.J.A.C. 7:14A-14.1 et seq.

(3) This limitation is equivalent to a maximum of 1.0 TU_c's (Chronic Toxic Units).

(4) Based on final USEPA Effluent Guidelines for the Organic Chemicals, Plastics and Synthetic Fibers (OCPSF) point source category for discharges that use end-of-pipe biological treatment.

(5) Based on USEPA Water Engineering Research Laboratory (WERL) Treatability Database for similar discharges and corresponding treatment technologies commonly used.

(6) Based on "General Authorization to Discharge Decontaminated Groundwater From Gasoline Spills into Surface Waters of the State" (General GFC Permit), effective November 1,1988.

(7) Based on "Guidance for BAT-Equivalent Control of Selected Toxic Pollutants", a report prepared by James W. Patterson, Ph. D., for USEPA, May 1981.

APPENDIX A

NJDEPE LETTER OF CONCURRENCE

State of New Jersey
Department of Environmental Protection and Energy
Office of the Commissioner
CN 402
Trenton, NJ 08625-0402
Tel. # 609-292-2885
Fax. # 609-984-3962

Scott A. Weiner
Commissioner

SEP 30 1992

Mr. Constantine Sidamon-Eristoff
Administrator
U.S. Environmental Protection Agency
Region II
Jacob K. Javits Federal Building
New York, New York 10278

Dear Mr. Eristoff:

The Department of Environmental Protection and Energy has evaluated and concurs with the selected remedy for the Imperial Oil Company/Champion Chemicals Superfund site as stated below:

"This is the second of three planned operable units for the Imperial Oil Company/Champion Chemicals site. The selected remedy addresses the remediation of contaminated ground water in the underlying aquifer emanating from the site.

The major components of the selected remedy include the following:

- Extraction of the contaminated ground water via extraction wells;
- Treatment of the extracted ground water via precipitation for inorganic contaminants and carbon adsorption for organic contaminants in a facility to be constructed on the site;
- Discharge of the treated ground water to Birch Swamp Brook;
- Continuation of the floating product removal action currently being undertaken by the Environmental Protection Agency; and
- Implementation of an environmental monitoring program to ensure the effectiveness of the remedy".

The State of New Jersey appreciates the opportunity to participate in this decision making process and looks forward to future cooperation with the USEPA.

Sincerely,

Scott A. Weiner
Commissioner

dfh

APPENDIX D

MEMORANDUM

DATE: 22 September 1992

SUBJECT: Groundwater risk-based cleanup levels for the Imperial Oil Site

FROM: Marina Stefanidis Marina Stefanidis

TO: Trevor Anderson

Below is a table listing risk-based cleanup levels for groundwater contaminants identified at the Imperial Oil site. The levels listed are for only those contaminants that do not have federal or state MCLs. The majority of the risk levels listed are derived from Region III's Risk-Based Concentration Table, Third Quarter 1992.

cc: F. Cataneo ✓
D. Lynch
V. Pitruzzello

Imperial Oil
Groundwater Ingestion Numbers

Contaminant	Maximum concentration (ppb)	Risk-based number (ppb)
Methylene chloride	12	5.4
Acenaphthene	24	2200
2-Methylphenol	6800	----*
4-Methylphenol	210	1800
2,4-Dimethylphenol	30	730
Naphthalene	630	1500
Di-n-butyl phthalate	18	3700
Phenanthrene	64	----*
Fluoranthene	11	1500
Pyrene	16	1095**
Fluorene	33	1500
2-Methylnaphthalene	1000	----*
Vanadium	9	260
Zinc	152	7300

* Toxicity number not available on IRIS or HEAST.

** Recalculated risk value (i.e., not found on the Region III table).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

July 23, 1992

SUBJECT: Risk-Based Concentration Table, Third Quarter 1992

FROM: Roy L. Smith, Ph.D., Senior Toxicologist
Technical Support Section (3HW15)

TO: RBC Table mailing list

Attached is the EPA Region III risk-based concentration table, first presented and distributed at the March 1991 EPA Superfund Risk Assessors' Conference. Subsequently, it has been distributed quarterly to all interested EPA offices and private parties; this is the fifth distribution.

The table contains reference doses and carcinogenic potency slopes (obtained from IRIS through July, 1992, HEAST through April, 1992, OHEA-Cincinnati, and other miscellaneous sources) for nearly 600 chemicals. These toxicity constants have been combined with "standard" exposure scenarios to calculate chemical concentrations corresponding to fixed levels of risk (*i.e.*, a hazard quotient of 1, or lifetime cancer risk of 10^{-6}, whichever occurs at a lower concentration) in water, air, fish tissue, and soil.

The Region III toxicologists use this table as a risk-based screen for Superfund sites, and as a handy desk reference to help with emergencies and requests for immediate information. It has also been useful in evaluating preliminary site investigation data and contractor-prepared preliminary remediation goals.

The toxicity information in the table has been painstakingly assembled by hand, and (despite extensive checking and several years' use) may contain errors. It's advisable to cross-check before relying heavily on any numbers in the table. If you find any errors, please send me a note.

This sincere offer was recently taken up by EPA Region VII and the Missouri Department of Health, which cooperated in conducting an in-depth review of the toxicity information and calculations in the table. Chuck Arnold (of the Missouri Department of Health), sent me a marked-up copy of the table which identified a dozen or so redundant names, typos, and misidentified sources, plus a few incorrect or missing toxicity constants. These have been fixed.

Chuck also found a bug in the algorithm for drinking water concentrations, which gave spurious results for volatile carcinogens having inhaled potency slopes but no oral potency slopes. This algorithm has been re-thought and re-written, and the changes are

described in the attached background information. Only three compounds (bromoethene, 1,3-butadiene, and 1,4-dichloro-2-butene) were affected. I thank Region VII and MDOH for conducting this review, and Chuck for taking the time to inform me of the results.

This update of the table contains changed risk-based concentrations (resulting from changes to IRIS and from error corrections) for the following compounds:

Benzo[a]pyrene (and all other carcinogenic PAHs)
Bromoethene*
1,3-Butadiene*
1,4-Dichloro-2-butene*
Di(2-ethylhexyl) adipate
2,4-Dinitrotoluene
1,2-Epoxybutane
Isopropyl methyl phosphonic acid
2-Methoxyethanol*
Methyl ethyl ketone
Mirex
NuStar*
1,1,1-Trichloroethane*
Trichlorofluoromethane*

(*: corrected error)

Attachment

Risk-Based Concentration Table
Background Information

The risk-based concentrations were calculated as follows:

GENERAL: Separate carcinogenic and non-carcinogenic risk-based concentrations were calculated for each compound for each pathway. The concentration in the table is the lower of the two, rounded to two significant figures. For non-carcinogens, the averaging time equals the exposure duration, so the exposure duration term has been used for both. The following terms were used in the calculations:

General:

Carcinogenic potency slope oral $(mg/kg/d)^{-1}$:	CPS_o
Carcinogenic potency slope inhaled $(mg/kg/d)^{-1}$:	CPS_i
Reference dose oral (mg/kg/d):	RfD_o
Reference dose oral (mg/kg/d):	RfD_i
Target cancer risk:	TR
Target hazard quotient:	THQ
Body weight, adult (kg):	BW_a
Body weight, child age 1-6 (kg):	BW_c
Averaging time (years of life):	AT
Air breathed (m^3/d):	IR_a
Drinking water ingestion (L/d):	IR_w
Fish ingestion (g/d):	IR_f
Soil ingestion - age adjusted (mg/d)	IRS_a
Soil ingestion - age 1-6 (mg/d):	IRS_c
Soil ingestion - adult (mg/d):	IRS_a

Residential:

Exposure frequency (d/y):	EF_r
Exposure duration (y):	ED_r
Volatilization factor (L/m^3):	VF

Occupational:

Exposure frequency (d/y):	EF_o
Exposure duration (y):	ED_o

The priority among sources of toxicological constants was as follows: (1) IRIS, (2) HEAST, (3) HEAST alternative method, (4) ECAO-Cincinnati, (5) other EPA documents, (6) withdrawn from IRIS, (7) withdrawn from HEAST, (8) PHRED, and (9) non-EPA sources. Each source was used only if numbers from higher-priority sources were unavailable.

ALGORITHMS:

1. Drinking water ($\mu g/L$). Volatilization terms were calculated only for compounds with "y" in the "Volatile" column. Compounds having a Henry's Law constant greater than 10^{-4} were

considered volatile. The list may be incomplete, but is unlikely to include false positives. The equations and the volatilization factor (VF, above) were obtained from the draft RAGS IB. Oral potency slopes and reference doses were used for both oral and inhaled exposures for volatile compounds lacking inhalation values. Inhaled potency slopes were substituted for unavailable oral potency slopes only for volatile compounds; inhaled RfDs were substituted for unavailable oral RfDs for both volatile and non-volatile compounds.

a. Carcinogens:

$$\frac{TR \cdot BW_a \cdot AT \cdot 365\frac{d}{y} \cdot 1000\frac{\mu g}{mg}}{EF_r \cdot ED_r \cdot ([VF \cdot IR_a \cdot CPS_i] + [IR_w \cdot CPS_o])}$$

b. Non-carcinogens:

$$\frac{THQ \cdot BW_a \cdot ED_r \cdot 365\frac{d}{y} \cdot 1000\frac{\mu g}{mg}}{EF_r \cdot ED_r \cdot \left(\frac{VF \cdot IR_a}{RfD_i} + \frac{IR_w}{RfD_o}\right)}$$

2. Air ($\mu g/m^3$). Oral potency slopes and references were used where inhalation values were not available.

a. Carcinogens:

$$\frac{TR \cdot BW_a \cdot AT \cdot 365\frac{d}{y} \cdot 1000\frac{\mu g}{mg}}{EF_r \cdot ED_r \cdot IR_a \cdot CPS_i}$$

b. Non-carcinogens:

$$\frac{THQ \cdot RfD_i \cdot BW_a \cdot ED_r \cdot 365\frac{d}{y} \cdot 1000\frac{\mu g}{mg}}{EF_r \cdot ED_r \cdot IR_a}$$

3. Fish (mg/kg):

a. Carcinogens:

$$\frac{TR \cdot BW_a \cdot AT \cdot 365\frac{d}{y}}{EF_r \cdot ED_r \cdot \frac{IR_f}{1000\frac{g}{kg}} \cdot CPS_o}$$

b. Non-carcinogens:

$$\frac{THQ \cdot RfD_o \cdot BW_a \cdot ED_c \cdot 365\frac{d}{y}}{EF_c \cdot ED_c \cdot \frac{IR_f}{1000\frac{g}{kg}}}$$

4. Soil occupational (mg/kg):

a. Carcinogens:

$$\frac{TR \cdot BW_a \cdot AT \cdot 365\frac{d}{y}}{EF_o \cdot ED_o \cdot \frac{IRS_o}{10^6\frac{mg}{kg}} \cdot CPS_o}$$

b. Non-carcinogens:

$$\frac{THQ \cdot RfD_o \cdot BW_a \cdot ED_o \cdot 365\frac{d}{y}}{EF_o \cdot ED_o \cdot \frac{IRS_o}{10^6\frac{mg}{kg}}}$$

5. Soil residential (mg/kg):

a. Carcinogens:

$$\frac{TR \cdot BW_c \cdot AT \cdot 365\frac{d}{y}}{EF_c \cdot ED_c \cdot \frac{IRS_{ad}}{10^6\frac{mg}{kg}} \cdot CPS_o}$$

b. Non-carcinogens:

$$\frac{THQ \cdot RfD_o \cdot BW_c \cdot ED_c \cdot 365\frac{d}{y}}{EF_c \cdot ED_c \cdot \frac{IRS_c}{10^6\frac{mg}{kg}}}$$

EXPOSURE ASSUMPTIONS:	
1-General:	
Target cancer risk:	1e-06
Target hazard quotient:	1
Body weight, adult (kg):	70
Body weight, age 1-6 (kg):	15
Averaging time (years of life):	70
Air breathed (m3/d):	20
Drinking water ingestion (l/d):	2
Fish ingestion (g/d):	54
Soil ingestion - age adjusted (mg/d):	100
Soil ingestion - age 1-6 (mg/d):	200
Soil ingestion - adult (mg/d):	100
2-Residential:	
Exposure frequency (d/y):	350
Exposure duration (y):	30
Volatilization factor (L/m3):	0.5
3-Occupational:	
Exposure frequency (d/y):	250
Exposure duration (y):	25

Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
Acephate	4.00e-03 i		8.70e-03 i			9.8	0.98	0.36	330	200
Acetaldehyde		2.57e-03 i		7.70e-03 i		94	1.1			
Acetone	1.00e-01 i					3700	370	140	100000	7800
Acetone cyanohydrin	7.00e-02 h	2.86e-03 a				2600	10	95	72000	5500
Acetonitrile	6.00e-03 i	1.43e-02 a				220	52	8.1	6100	470
Acetophenone	1.00e-01 i	5.71e-06 a				3700	0.021	140	100000	7800
Acifluorfen	1.30e-02 i					470	47	18	13000	1000
Acrolein	2.00e-02 h	5.71e-06 i				730	0.021	27	20000	1600
Acrylamide	2.00e-04 i		4.50e+00 i	4.55e+00 i		0.019	0.0019	0.0007	0.64	0.38
Acrylic acid	8.00e-02 i	8.57e-05 i				2900	0.31	110	82000	6300
Acrylonitrile		5.71e-04 i	5.40e-01 i	2.38e-01 i		0.16	0.036	0.0058	5.3	3.2
Alachlor	1.00e-02 i		8.05e-02 h			1.1	0.11	0.039	36	21
Alar	1.50e-01 i					5500	550	200	150000	12000
Aldicarb	2.00e-04 i					7.3	0.73	0.27	200	16
Aldicarb sulfone	3.00e-04 x					11	1.1	0.41	310	23
Aldrin	3.00e-05 i		1.70e+01 i	1.72e+01 i		0.005	0.0005	0.00019	0.17	0.1
Ally	2.50e-01 i					9100	910	340	260000	20000
Allyl alcohol	5.00e-03 i					180	18	6.8	5100	390
Allyl chloride	5.00e-02 h	2.86e-04 i				1800	1	68	51000	3900
Aluminum	2.90e+00 o					110000	11000	3900	3000000	230000
Aluminum phosphide	4.00e-04 i					15	1.5	0.54	410	31
Amdro	3.00e-04 i					11	1.1	0.41	310	23
Ametryn	9.00e-03 i					330	33	12	9200	700
m-Aminophenol	7.00e-02 h					2600	260	95	72000	5500
4-Aminopyridine	2.00e-05 h					0.73	0.073	0.027	20	1.6
Amitraz	2.50e-03 i					91	9.1	3.4	2600	200
Ammonia		2.86e-02 i				1000	100			
Ammonium sulfamate	2.00e-01 i					7300	730	270	200000	16000
Aniline		2.86e-04 i	5.70e-03 i			10	1	0.55	500	300
Antimony and compounds	4.00e-04 i					15	1.5	0.54	410	31
Antimony pentoxide	5.00e-04 h					18	1.8	0.68	510	39
Antimony potassium tartrate	9.00e-04 h					33	3.3	1.2	920	70
Antimony tetroxide	4.00e-04 h					15	1.5	0.54	410	31
Antimony trioxide	4.00e-04 h					15	1.5	0.54	410	31
Apollo	1.30e-02 i					470	47	18	13000	1000
Aramite	5.00e-02 h		2.50e-02 i	2.49e-02 i		3.4	0.34	0.13	110	68
Arsenic	3.00e-04 i					11	1.1	0.41	310	23
Arsenic (as carcinogen)			1.75e+00 i	1.51e+01 i		0.049	0.00057	0.0018	1.6	0.97
Assure	9.00e-03 i					330	33	12	9200	700

Key to Data Sources: i=IRIS x=Withdrawn from IRIS h=HEAST a=HEAST alternate method y=Withdrawn from HEAST p=PHRED e=EPA-ECAO o=Other EPA documents n=Non-EPA sources

Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
Asulam	5.00e-02 i					1800	180	68	51000	3900
Atrazine	5.00e-03 i		2.22e-01 h			0.38	0.038	0.014	13	7.7
Avermectin B1	4.00e-04 i					15	1.5	0.54	410	31
Azobenzene			1.10e-01 i	1.09e-01 i		0.77	0.078	0.029	26	15
Barium and compounds	7.00e-02 i	1.43e-04 a				2600	0.52	95	72000	5500
Baygon	4.00e-03 i					150	15	5.4	4100	310
Bayleton	3.00e-02 i					1100	110	41	31000	2300
Baythroid	2.50e-02 i					910	91	34	26000	2000
Benefin	3.00e-01 i					11000	1100	410	310000	23000
Benomyl	5.00e-02 i					1800	180	68	51000	3900
Bentazon	2.50e-03 i					91	9.1	3.4	2600	200
Benzaldehyde	1.00e-01 i					3700	370	140	100000	7800
Benzene			2.90e-02 i	2.91e-02 i	y	0.49	0.29	0.11	99	59
Benzidine	3.00e-03 i		2.30e+02 i	2.30e+02 i		0.00037	0.000037	0.000014	0.012	0.0074
Benzoic acid	4.00e+00 i					150000	15000	5400	4100000	310000
Benzotrichloride			1.30e+01 i			0.0066	0.00066	0.00024	0.22	0.13
Benzyl alcohol	3.00e-01 h					11000	1100	410	310000	23000
Benzyl chloride			1.70e-01 i		y	0.083	0.05	0.019	17	10
Beryllium and compounds	5.00e-03 i		4.30e+00 i	8.40e+00 i		0.02	0.001	0.00073	0.67	0.4
Bidrin	1.00e-04 i					3.7	0.37	0.14	100	7.8
Biphenthrin (Talstar)	1.50e-02 i					550	55	20	15000	1200
1,1-Biphenyl	5.00e-02 i					1800	180	68	51000	3900
Bis(2-chloroethyl)ether			1.10e+00 i	1.16e+00 i	y	0.012	0.0074	0.0029	2.6	1.5
Bis(2-chloroisopropyl)ether	4.00e-02 i		7.00e-02 h	3.50e-02 h	y	0.35	0.24	0.045	41	24
Bis(chloromethyl)ether			2.20e+02 i	2.17e+02 i	y	0.000065	0.000039	0.000014	0.013	0.0077
Bis(2-chloro-1-methylethyl)ether			7.00e-02 y	7.00e-02 y		1.2	0.12	0.045	41	24
Bis(2-ethylhexyl)phthalate (DEHP)	2.00e-02 i		1.40e-02 i			6.1	0.61	0.23	200	120
Bisphenol A	5.00e-02 i					1800	180	68	51000	3900
Boron	9.00e-02 i	5.71e-03 h				3300	21	120	92000	7000
Boron trifluoride		2.00e-04 h				7.3	0.73			
Bromodichloromethane	2.00e-02 i		1.30e-01 i		y	0.11	0.066	0.024	22	13
Bromoethene				1.10e-01 h	y	0.13	0.077			
Bromoform (tribromomethane)	2.00e-02 i		7.90e-03 i	3.85e-03 i	y	3.1	2.2	0.4	360	220
Bromomethane	1.40e-03 i	1.43e-03 i			y	8.7	5.2	1.9	1400	110
4-Bromophenyl phenyl ether	5.80e-02 o					2100	210	78	59000	4500
Bromophos	5.00e-03 h					180	18	6.8	5100	390
Bromoxynil	2.00e-02 i					730	73	27	20000	1600
Bromoxynil octanoate	2.00e-02 i					730	73	27	20000	1600
1,3-Butadiene				9.80e-01 i	y	0.014	0.0087			

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EPA Region III Risk-Based Concentrations v.6.2 (07/23/92): Roy L. Smith, Ph.D.

Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
1-Butanol	1.00e-01 i					3700	370	140	100000	7800
Butylate	5.00e-02 i					1800	180	68	51000	3900
Butyl benzyl phthalate	2.00e-01 i					7300	730	270	200000	16000
Butylphthalyl butylglycolate	1.00e+00 i					37000	3700	1400	1000000	78000
Cacodylic acid	3.00e-03 h					110	11	4.1	3100	230
Cadmium and compounds	5.00e-04 i			6.30e+00 i		18	0.0014	0.68	510	39
Caprolactam	5.00e-01 i					18000	1800	680	510000	39000
Captafol	2.00e-03 i		8.60e-03 h			9.9	0.99	0.37	330	160
Captan	1.30e-01 i		3.50e-03 h			24	2.4	0.9	820	490
Carbaryl	1.00e-01 i					3700	370	140	100000	7800
Carbazole			2.00e-02 h			4.3	0.43	0.16	140	85
Carbofuran	5.00e-03 i					180	18	6.8	5100	390
Carbon disulfide	1.00e-01 i	2.86e-03 h			y	21	10	140	100000	7800
Carbon tetrachloride	7.00e-04 i		1.30e-01 i	5.25e-02 i	y	0.22	0.16	0.024	22	13
Carbosulfan	1.00e-02 i					370	37	14	10000	780
Carboxin	1.00e-01 i					3700	370	140	100000	7800
Chloral	2.00e-03 i					73	7.3	2.7	2000	160
Chloramben	1.50e-02 i					550	55	20	15000	1200
Chloranil			4.03e-01 h			0.21	0.021	0.0078	7.1	4.2
Chlordane	6.00e-05 i		1.30e+00 i	1.30e+00 i		0.066	0.0066	0.0024	2.2	1.3
Chlorimuron-ethyl	2.00e-02 i					730	73	27	20000	1600
Chlorine dioxide		5.71e-05 i				2.1	0.21			
Chloroacetaldehyde	6.90e-03 o					250	25	9.3	7100	540
Chloroacetic acid	2.00e-03 h					73	7.3	2.7	2000	160
2-Chloroacetophenone		8.57e-06 i				0.31	0.031			
4-Chloroaniline	4.00e-03 i					150	15	5.4	4100	310
Chlorobenzene	2.00e-02 i	5.71e-03 a			y	39	21	27	20000	1600
Chlorobenzilate	2.00e-02 i					730	73	27	20000	1600
p-Chlorobenzoic acid	2.00e-01 h					7300	730	270	200000	16000
4-Chlorobenzotrifluoride	2.00e-02 h					730	73	27	20000	1600
2-Chloro-1,3-butadiene	2.00e-02 y	2.86e-02 a			y	160	100	27	20000	1600
1-Chlorobutane	4.00e-01 h				y	2400	1500	540	410000	31000
2-Chloroethyl vinyl ether	2.50e-02 o				y	150	91	34	26000	2000
Chloroform	1.00e-02 i		6.10e-03 i	8.05e-02 i	y	0.21	0.11	0.52	470	280
Chloromethane			1.30e-02 h	6.30e-03 h	y	1.9	1.4	0.24	220	130
4-Chloro-2-methylaniline			5.80e-01 h			0.15	0.015	0.0054	4.9	2.9
4-Chloro-2,2-methylaniline hydrochloride			4.60e-01 h			0.19	0.019	0.0069	6.2	3.7
beta-Chloronaphthalene	8.00e-02 i					2900	290	110	82000	6300

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
o-Chloronitrobenzene			2.50e-02 h		y	0.57	0.34	0.13	110	68
p-Chloronitrobenzene			1.80e-02 h		y	0.79	0.47	0.18	160	95
2-Chlorophenol	5.00e-03 i					180	18	6.8	5100	390
2-Chloropropane		2.86e-02 h			y	170	100			
Chlorothalonil	1.50e-02 i		1.10e-02 h			7.7	0.77	0.29	260	150
o-Chlorotoluene	2.00e-02 i				y	120	73	27	20000	1600
Chlorpropham	2.00e-01 i					7300	730	270	200000	16000
Chlorpyrifos	3.00e-03 i					110	11	4.1	3100	230
Chlorpyrifos-methyl	1.00e-02 h					370	37	14	10000	780
Chlorsulfuron	5.00e-02 i					1800	180	68	51000	3900
Chlorthiophos	8.00e-04 h					29	2.9	1.1	820	63
Chromium III and compounds	1.00e+00 i	5.71e-07 y				37000	0.0021	1400	1000000	78000
Chromium VI and compounds	5.00e-03 i			4.20e+01 i		180	0.0002	6.8	5100	390
Coal tars				2.20e+00 h			0.0039			
Cobalt		2.86e-04 e				10	1			
Coke Oven Emissions				2.17e+00 i			0.0039			
Copper and compounds	3.71e-02 h					1400	140	50	38000	2900
Crotonaldehyde	1.00e-02 x		1.90e+00 h	1.90e+00 y		0.045	0.0045	0.0017	1.5	0.9
Cumene	4.00e-02 i	2.57e-03 h				1500	9.4	54	41000	3100
Cyanazine	2.00e-03 x					73	7.3	2.7	2000	160
Cyanides										
Barium cyanide	1.00e-01 h					3700	370	140	100000	7800
Copper cyanide	5.00e-03 i					180	18	6.8	5100	390
Calcium cyanide	4.00e-02 i					1500	150	54	41000	3100
Cyanogen	4.00e-02 i					1500	150	54	41000	3100
Cyanogen bromide	9.00e-02 i					3300	330	120	92000	7000
Cyanogen chloride	5.00e-02 i					1800	180	68	51000	3900
Free cyanide	2.00e-02 i					730	73	27	20000	1600
Hydrogen cyanide	2.00e-02 i					730	73	27	20000	1600
Potassium cyanide	5.00e-02 i					1800	180	68	51000	3900
Potassium silver cyanide	2.00e-01 i					7300	730	270	200000	16000
Silver cyanide	1.00e-01 i					3700	370	140	100000	7800
Sodium cyanide	4.00e-02 i					1500	150	54	41000	3100
Zinc cyanide	5.00e-02 i					1800	180	68	51000	3900
Cyclohexanone	5.00e+00 i				y	30000	18000	6800	5100000	390000
Cyclohexlamine	2.00e-01 i					7300	730	270	200000	16000
Cyhalothrin/Karate	5.00e-03 i					180	18	6.8	5100	390
Cypermethrin	1.00e-02 i					370	37	14	10000	780
Cyromazine	7.50e-03 i					270	27	10	7700	590

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Dacthal	5.00e-01 i					18000	1800	680	510000	39000
Dalapon	3.00e-02 i					1100	110	41	31000	2300
Danitol	5.00e-04 i					18	1.8	0.68	510	39
DDD			2.40e-01 i			0.35	0.035	0.013	12	7.1
DDE			3.40e-01 i			0.25	0.025	0.0093	8.4	5
DDT	5.00e-04 i		3.40e-01 i	3.40e-01 i		0.25	0.025	0.0093	8.4	5
Decabromodiphenyl ether	1.00e-02 i				y	61	37	14	10000	780
Demeton	4.00e-05 i					1.5	0.15	0.054	41	3.1
Diallate			6.10e-02 h		y	0.23	0.14	0.052	47	28
Diazinon	9.00e-04 h					33	3.3	1.2	920	70
1,4-Dibromobenzene	1.00e-02 i				y	61	37	14	10000	780
Dibromochloromethane	2.00e-02 i		8.40e-02 i		y	0.17	0.1	0.038	34	20
1,2-Dibromo-3-chloropropane		5.71e-05 i	1.40e+00 h	2.40e-03 h	y	0.06	0.21	0.0023	2	1.2
1,2-Dibromoethane			8.50e+01 i	7.70e-01 i	y	0.00096	0.011	0.000037	0.034	0.02
Di-n-butyl phthalate	1.00e-01 i					3700	370	140	100000	7800
Dicamba	3.00e-02 i					1100	110	41	31000	2300
1,2-Dichlorobenzene	9.00e-02 i	5.71e-02 a			y	370	210	120	92000	7000
1,3-Dichlorobenzene	8.90e-02 o				y	540	320	120	91000	7000
1,4-Dichlorobenzene		2.00e-01 h	2.40e-02 h		y	0.59	0.35	0.13	120	71
3,3*-Dichlorobenzidine			4.50e-01 i			0.19	0.019	0.007	6.4	3.8
1,4-Dichloro-2-butene				9.30e+00 h	y	0.0015	0.00092			
Dichlorodifluoromethane	2.00e-01 i	5.71e-02 a			y	390	210	270	200000	16000
1,1-Dichloroethane	1.00e-01 h	1.43e-01 a			y	810	520	140	100000	7800
1,2-Dichloroethane (EDC)			9.10e-02 i	9.10e-02 i	y	0.16	0.094	0.035	31	19
1,1-Dichloroethylene	9.00e-03 i		6.00e-01 i	1.75e-01 i	y	0.058	0.049	0.0053	4.8	2.8
1,2-Dichloroethylene (cis)	1.00e-02 h				y	61	37	14	10000	780
1,2-Dichloroethylene (trans)	2.00e-02 i				y	120	73	27	20000	1600
2,4-Dichlorophenol	3.00e-03 i					110	11	4.1	3100	230
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	8.00e-03 i					290	29	11	8200	630
2,4-Dichlorophenoxyacetic Acid (2,4-D)	1.00e-02 i				y	61	37	14	10000	780
1,2-Dichloropropane		1.14e-03 i	6.80e-02 h		y	0.21	0.13	0.046	42	25
1,3 Dichloropropene	3.00e-04 i	5.71e-03 i	1.80e-01 h	1.30e-01 h	y	0.1	0.066	0.018	16	9.5
2,3 Dichloropropanol	3.00e-03 i					110	11	4.1	3100	230
Dichlorvos	8.00e-04 x		2.90e-01 i			0.29	0.029	0.011	9.9	5.9
Dicofol			4.40e-01 x			0.19	0.019	0.0072	6.5	3.9
Dicyclopentadiene	3.00e-02 h	5.71e-05 a			y	0.42	0.21	41	31000	2300
Dieldrin	5.00e-05 i		1.60e+01 i	1.61e+01 i		0.0053	0.00053	0.0002	0.18	0.11

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
Diethylene glycol, monoethyl ether	2.00e+00 h					73000	7300	2700	2000000	160000
Diethylformamide	1.10e-02 h					400	40	15	11000	860
Di(2-ethylhexyl)adipate	6.00e-01 i		1.20e-03 i			71	7.1	2.6	2400	1400
Diethyl phthalate	8.00e-01 i					29000	2900	1100	820000	63000
Diethylstilbestrol			4.70e+03 h			0.000018	0.0000018	0.00000067	0.00061	0.00036
Difenzoquat (Avenge)	8.00e-02 i					2900	290	110	82000	6300
Diflubenzuron	2.00e-02 i					730	73	27	20000	1600
Diisopropyl methylphosphonate	8.00e-02 i					2900	290	110	82000	6300
Dimethipin	2.00e-02 i					730	73	27	20000	1600
Dimethoate	2.00e-04 i					7.3	0.73	0.27	200	16
3,3'-Dimethoxybenzidine			1.40e-02 h			6.1	0.61	0.23	200	120
Dimethylamine		5.71e-06 x				0.21	0.021			
N-N-Dimethylaniline	2.00e-03 i					73	7.3	2.7	2000	160
2,4-Dimethylaniline			7.50e-01 h			0.11	0.011	0.0042	3.8	2.3
2,4-Dimethylaniline hydrochloride			5.80e-01 h			0.15	0.015	0.0054	4.9	2.9
3,3'-Dimethylbenzidine			9.20e+00 h			0.0093	0.00093	0.00034	0.31	0.19
1,1-Dimethylhydrazine			2.60e+00 h	3.50e+00 h		0.033	0.0024	0.0012	1.1	0.66
1,2-Dimethylhydrazine			3.70e+01 h	3.70e+01 h		0.0023	0.00023	0.000085	0.077	0.046
N,N-Dimethylformamide	1.00e-01 h	8.57e-03 i				3700	31	140	100000	7800
2,4-Dimethylphenol	2.00e-02 i					730	73	27	20000	1600
2,6-Dimethylphenol	6.00e-04 i					22	2.2	0.81	610	47
3,4-Dimethylphenol	1.00e-03 i					37	3.7	1.4	1000	78
Dimethyl phthalate	1.00e+01 h					370000	37000	14000	10000000	780000
Dimethyl terephthalate	1.00e-01 i					3700	370	140	100000	7800
4,6-Dinitro-o-cyclohexyl phenol	2.00e-03 i					73	7.3	2.7	2000	160
1,3-Dinitrobenzene	1.00e-04 i					3.7	0.37	0.14	100	7.8
1,2-Dinitrobenzene	4.00e-04 h					15	1.5	0.54	410	31
1,4-Dinitrobenzene	4.00e-04 h					15	1.5	0.54	410	31
2,4-Dinitrophenol	2.00e-03 i					73	7.3	2.7	2000	160
Dinitrotoluene mixture			6.80e-01 i			0.13	0.013	0.0046	4.2	2.5
2,4-Dinitrotoluene	2.00e-03 i		i			73	7.3	2.7	2000	160
2,6-Dinitrotoluene			6.80e-01 i			0.13	0.013	0.0046	4.2	2.5
Dinoseb	1.00e-03 i					37	3.7	1.4	1000	78
di-n-Octyl phthalate	2.00e-02 h					730	73	27	20000	1600
1,4-Dioxane			1.10e-02 i			7.7	0.77	0.29	260	150
Diphenamid	3.00e-02 i					1100	110	41	31000	2300
Diphenylamine	2.50e-02 i					910	91	34	26000	2000
1,2-Diphenylhydrazine			8.00e-01 i	7.70e-01 i		0.11	0.011	0.0039	3.6	2.1
Diquat	2.20e-03 i					80	8	3	2200	170

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
Direct black 38			8.60e+00 h			0.0099	0.00099	0.00037	0.33	0.2
Direct blue 6			8.10e+00 h			0.011	0.0011	0.00039	0.35	0.21
Direct brown 35			9.30e+00 h			0.0092	0.00092	0.00034	0.31	0.18
Disulfoton	4.00e-05 i					1.5	0.15	0.054	41	3.1
Diuron	2.00e-03 i					73	7.3	2.7	2000	160
Dodine	4.00e-03 i					150	15	5.4	4100	310
Endosulfan	5.00e-05 i					1.8	0.18	0.068	51	3.9
Endothall	2.00e-02 i					730	73	27	20000	1600
Endrin	3.00e-04 i					11	1.1	0.41	310	23
Epichlorohydrin	2.00e-03 x	2.86e-04 i	9.90e-03 i	4.20e-03 i		8.6	1	0.32	290	160
1,2-Epoxybutane		5.71e-03 i				210	21			
EPTC (S-Ethyl dipropylthiocarbamate)	2.50e-02 i					910	91	34	26000	2000
Ethephon (2-chloroethyl phosphonic acid)	5.00e-03 i					180	18	6.8	5100	390
Ethion	5.00e-04 i					18	1.8	0.68	510	39
2-Ethoxyethanol	4.00e-01 h	5.71e-02 i				15000	210	540	410000	31000
2-Ethoxyethanol acetate	3.00e-01 a					11000	1100	410	310000	23000
Ethyl acetate	9.00e-01 i					33000	3300	1200	920000	70000
Ethyl acrylate			4.80e-02 h			1.8	0.18	0.066	60	35
Ethylbenzene	1.00e-01 i	2.86e-01 i			y	1300	1000	140	100000	7800
Ethylene cyanohydrin	3.00e-01 h					11000	1100	410	310000	23000
Ethylene diamine	2.00e-02 h					730	73	27	20000	1600
Ethylene glycol	2.00e+00 i					73000	7300	2700	2000000	160000
Ethylene glycol, monobutyl ether		5.71e-03 h				210	21			
Ethylene oxide			1.02e+00 h	3.50e-01 h		0.083	0.024	0.0031	2.8	1.7
Ethylene thiourea (ETU)	8.00e-05 i		6.00e-01 h			0.14	0.014	0.0053	4.8	2.8
Ethyl chloride	2.00e-02 e	2.86e+00 i			y	710	10000	27	20000	1600
Ethyl ether	2.00e-01 i				y	1200	730	270	200000	16000
Ethyl methacrylate	9.00e-02 h					3300	330	120	92000	7000
Ethyl p-nitrophenyl phenylphosphorothioate	1.00e-05 i					0.37	0.037	0.014	10	0.78
Ethylnitrosourea			3.30e+01 p			0.0026	0.00026	0.000096	0.087	0.052
Ethylphthalyl ethyl glycolate	3.00e+00 i					110000	11000	4100	3100000	230000
Express	8.00e-03 i					290	29	11	8200	630
Fenamiphos	2.50e-04 i					9.1	0.91	0.34	260	20
Fluometuron	1.30e-02 i					470	47	18	13000	1000
Fluoride	6.00e-02 i					2200	220	81	61000	4700
Fluoridone	8.00e-02 i					2900	290	110	82000	6300
Flurprimidol	2.00e-02 i					730	73	27	20000	1600

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Flutolanil	6.00e-02 i					2200	220	81	61000	4700
Fluvalinate	1.00e-02 i					370	37	14	10000	780
Folpet	1.00e-01 i		3.50e-03 i			24	2.4	0.9	820	490
Fomesafen			1.90e-01 i			0.45	0.045	0.017	15	9
Fonofos	2.00e-03 i					73	7.3	2.7	2000	160
Formaldehyde	2.00e-01 i			4.55e-02 i		7300	0.19	270	200000	16000
Formic Acid	2.00e+00 h					73000	7300	2700	2000000	160000
Fosetyl-al	3.00e+00 i					110000	11000	4100	3100000	230000
Furan	1.00e-03 i					37	3.7	1.4	1000	78
Furazolidone			3.80e+00 h			0.022	0.0022	0.00083	0.75	0.45
Furfural	3.00e-03 i	1.43e-02 a				110	52	4.1	3100	230
Furium			5.00e+01 h			0.0017	0.00017	0.000063	0.057	0.034
Furmecyclox			3.00e-02 i			2.8	0.28	0.11	95	57
Glufosinate-ammonium	4.00e-04 i					15	1.5	0.54	410	31
Glycidaldehyde	4.00e-04 i	2.86e-04 h				15	1	0.54	410	31
Glyphosate	1.00e-01 i					3700	370	140	100000	7800
Haloxyfop-methyl	5.00e-05 i					1.8	0.18	0.068	51	3.9
Harmony	1.30e-02 i					470	47	18	13000	1000
Heptachlor	5.00e-04 i		4.50e+00 i	4.55e+00 i	y	0.0031	0.0019	0.0007	0.64	0.38
Heptachlor epoxide	1.30e-05 i		9.10e+00 i	9.10e+00 i	y	0.0016	0.00094	0.00035	0.31	0.19
Hexabromobenzene	2.00e-03 i				y	12	7.3	2.7	2000	160
Hexachlorobenzene	8.00e-04 i		1.60e+00 i	1.61e+00 i	y	0.0088	0.0053	0.002	1.8	1.1
Hexachlorobutadiene	2.00e-03 i		7.80e-02 i	7.70e-02 i	y	0.18	0.11	0.04	37	22
HCH (alpha)			6.30e+00 i	6.30e+00 i		0.014	0.0014	0.0005	0.45	0.27
HCH (beta)			1.80e+00 i	1.80e+00 i		0.047	0.0047	0.0018	1.6	0.95
HCH (gamma) Lindane	3.00e-04 i		1.30e+00 h			0.066	0.0066	0.0024	2.2	1.3
HCH-technical			1.80e+00 i	1.79e+00 i		0.047	0.0048	0.0018	1.6	0.95
Hexachlorocyclopentadiene	7.00e-03 i	2.00e-05 h			y	0.15	0.073	9.5	7200	550
Hexachlorodibenzo-p-dioxin mixture (HxCDD)			6.20e+03 i	4.55e+03 i		0.000014	0.0000019	0.00000051	0.00046	0.00027
Hexachloroethane	1.00e-03 i		1.40e-02 i	1.40e-02 i	y	1	0.61	0.23	200	78
Hexachlorophene	3.00e-04 i					11	1.1	0.41	310	23
n-Hexane	6.00e-02 h	5.71e-02 i			y	350	210	81	61000	4700
Hexazinone	3.30e-02 i					1200	120	45	34000	2600
Hydrazine, hydrazine sulfate			3.00e+00 i	1.72e+01 i		0.028	0.0005	0.0011	0.95	0.57
Hydrogen chloride		2.00e-03 i				73	7.3			
Hydrogen sulfide	3.00e-03 i	2.57e-04 i				110	0.94	4.1	3100	230
p-Hydroquinone	4.00e-02 h					1500	150	54	41000	3100
Imazalil	1.30e-02 i					470	47	18	13000	1000

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Imazaquin	2.50e-01 i					9100	910	340	260000	20000
Iprodione	4.00e-02 i					1500	150	54	41000	3100
Isobutanol	3.00e-01 i					11000	1100	410	310000	23000
Isophorone	2.00e-01 i		4.10e-03 i			21	2.1	0.77	700	420
Isopropalin	1.50e-02 i					550	55	20	15000	1200
Isopropyl methyl phosphonic acid	1.00e-01 i					3700	370	140	100000	7800
Isoxaben	5.00e-02 i					1800	180	68	51000	3900
Kepone			1.80e+01 e			0.0047	0.00047	0.00018	0.16	0.095
Lactofen	2.00e-03 i					73	7.3	2.7	2000	160
Lead (tetraethyl)	1.00e-07 i					0.0037	0.00037	0.00014	0.1	0.0078
Linuron	2.00e-03 i					73	7.3	2.7	2000	160
Lithium	2.00e-02 e					730	73	27	20000	1600
Londax	2.00e-01 i					7300	730	270	200000	16000
Malathion	2.00e-02 i					730	73	27	20000	1600
Maleic anhydride	1.00e-01 i					3700	370	140	100000	7800
Maleic hydrazide	5.00e-01 i					18000	1800	680	510000	39000
Malononitrile	2.00e-05 h					0.73	0.073	0.027	20	1.6
Mancozeb	3.00e-02 h					1100	110	41	31000	2300
Maneb	5.00e-03 i					180	18	6.8	5100	390
Manganese and compounds	1.00e-01 i	1.14e-04 i				3700	0.42	140	100000	7800
Mephosfolan	9.00e-05 h					3.3	0.33	0.12	92	7
Mepiquat	3.00e-02 i					1100	110	41	31000	2300
Mercury and compounds (methyl)	3.00e-04 i					11	1.1	0.41	310	23
Mercury and compounds (inorganic)	3.00e-04 h	8.57e-05 h				11	0.31	0.41	310	23
Merphos	3.00e-05 i					1.1	0.11	0.041	31	2.3
Merphos oxide	3.00e-05 i					1.1	0.11	0.041	31	2.3
Metalaxyl	6.00e-02 i					2200	220	81	61000	4700
Methacrylonitrile	1.00e-04 i	2.00e-04 a				3.7	0.73	0.14	100	7.8
Methamidophos	5.00e-05 i					1.8	0.18	0.068	51	3.9
Methanol	5.00e-01 i					18000	1800	680	510000	39000
Methidathion	1.00e-03 i					37	3.7	1.4	1000	78
Methomyl	2.50e-02 i					910	91	34	26000	2000
Methoxychlor	5.00e-03 i					180	18	6.8	5100	390
2-Methoxyethanol	4.00e-03 h	5.71e-03 i				150	21	5.4	4100	310
2-Methoxyethanol acetate	2.00e-03 a					73	7.3	2.7	2000	160
2-Methoxy-5-nitroaniline			4.60e-02 h			1.9	0.19	0.069	62	37
Methyl acetate	1.00e+00 h					37000	3700	1400	1000000	78000
Methyl acrylate	3.00e-02 a					1100	110	41	31000	2300

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2-Methylaniline (o-toluidine)			2.40e-01 h			0.35	0.035	0.013	12	7.1
2-Methylaniline hydrochloride			1.80e-01 h			0.47	0.047	0.018	16	9.5
Methyl chlorocarbonate	1.00e+00 x					37000	3700	1400	1000000	78000
2-Methyl-4-chlorophenoxyacetic acid	5.00e-04 i					18	1.8	0.68	510	39
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	1.00e-02 i					370	37	14	10000	780
2-(2-Methyl-4-chlorophenoxy) propionic acid	1.00e-03 i					37	3.7	1.4	1000	78
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)	1.00e-03 i					37	3.7	1.4	1000	78
Methylcyclohexane		8.57e-01 h				31000	3100			
4,4'-Methylenediphenyl isocyanate		5.71e-06 h			y	0.035	0.021			
4,4'-Methylenebisbenzeneamine			2.50e-01 h			0.34	0.034	0.013	11	6.8
4,4'-Methylene bis(2-chloroaniline)	7.00e-04 h		1.30e-01 h	1.30e-01 h		0.66	0.066	0.024	22	13
4,4'-Methylene bis(N,N'-dimethyl)aniline			4.60e-02 i			1.9	0.19	0.069	62	37
Methylene bromide	1.00e-02 a				y	61	37	14	10000	780
Methylene chloride	6.00e-02 i	8.57e-01 h	7.50e-03 i	1.65e-03 i	y	5.4	5.2	0.42	380	230
Methyl ethyl ketone	5.00e-02 h	2.86e-01 i				1800	1000	68	51000	3900
Methyl hydrazine			1.10e+00 h			0.077	0.0077	0.0029	2.6	1.5
Methyl isobutyl ketone	5.00e-02 h	2.29e-02 a				1800	83	68	51000	3900
Methyl methacrylate	8.00e-02 h					2900	290	110	82000	6300
2-Methyl-5-nitroaniline			3.30e-02 h			2.6	0.26	0.096	87	52
Methyl parathion	2.50e-04 i					9.1	0.91	0.34	260	20
2-Methylphenol	5.00e-02 x					1800	180	68	51000	3900
3-Methylphenol	5.00e-02 x					1800	180	68	51000	3900
4-Methylphenol	5.00e-02 h					1800	180	68	51000	3900
Methyl styrene (mixture)	6.00e-03 a	1.14e-02 a			y	60	42	8.1	6100	470
Methyl styrene (alpha)	7.00e-02 a				y	430	260	95	72000	5500
Methylnitrosourea			3.00e+02 p			0.00028	0.000028	0.000011	0.0095	0.0057
Methyl tertbutyl ether (MTBE)	5.00e-03 e	1.43e-01 i				180	520	6.8	5100	390
Metolaclor (Dual)	1.50e-01 i					5500	550	200	150000	12000
Metribuzin	2.50e-02 i					910	91	34	26000	2000
Mirex	2.00e-04 i		1.80e+00 h			0.047	0.0047	0.0018	1.6	0.95
Molinate	2.00e-03 i					73	7.3	2.7	2000	160
Molybdenum	5.00e-03 h					180	18	6.8	5100	390
Naled	2.00e-03 i					73	7.3	2.7	2000	160
Napropamide	1.00e-01 i					3700	370	140	100000	7800
Nickel and compounds	2.00e-02 i					730	73	27	20000	1600

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Nickel refinery dust				8.40e-01 i			0.01			
Nickel subsulfide				1.70e+00 i			0.005			
Nitrapyrin	1.50e-03 x					55	5.5	2	1500	120
Nitrate	1.60e+00 i					58000	5800	2200	1600000	130000
Nitric Oxide	1.00e-01 i					3700	370	140	100000	7800
Nitrite	1.00e-01 i					3700	370	140	100000	7800
2-Nitroaniline	6.00e-05 h	5.71e-05 h				2.2	0.21	0.081	61	4.7
3-Nitroaniline	3.00e-03 o					110	11	4.1	3100	230
4-Nitroaniline	3.00e-03 o					110	11	4.1	3100	230
Nitrobenzene	5.00e-04 i	5.71e-04 a				18	2.1	0.68	510	39
Nitrofurantoin	7.00e-02 h					2600	260	95	72000	5500
Nitrofurazone			1.50e+00 h	9.40e+00 h		0.057	0.00091	0.0021	1.9	1.1
Nitrogen dioxide	1.00e+00 i					37000	3700	1400	1000000	78000
Nitroguanidine	1.00e-01 i					3700	370	140	100000	7800
4-Nitrophenol	6.20e-02 o					2300	230	84	63000	4800
2-Nitropropane		5.71e-03 i		9.40e+00 h		210	0.00091			
N-Nitrosodi-n-butylamine			5.40e+00 i	5.60e+00 i		0.016	0.0015	0.00058	0.53	0.32
N-Nitrosodiethanolamine			2.80e+00 i			0.03	0.003	0.0011	1	0.61
N-Nitrosodiethylamine			1.50e+02 i	1.51e+02 i		0.00057	0.000057	0.000021	0.019	0.011
N-Nitrosodimethylamine			5.10e+01 i	4.90e+01 i		0.0017	0.00017	0.000062	0.056	0.033
N-Nitrosodiphenylamine			4.90e-03 i			17	1.7	0.64	580	350
N-Nitroso di-n-propylamine			7.00e+00 i			0.012	0.0012	0.00045	0.41	0.24
N-Nitroso-N-methylethylamine			2.20e+01 i			0.0039	0.00039	0.00014	0.13	0.077
N-Nitrosopyrrolidine			2.10e+00 i	2.14e+00 i		0.041	0.004	0.0015	1.4	0.81
m-Nitrotoluene	1.00e-02 h					370	37	14	10000	780
p-Nitrotoluene	1.00e-02 h					370	37	14	10000	780
Norflurazon	4.00e-02 i					1500	150	54	41000	3100
NuStar	7.00e-04 i					26	2.6	0.95	720	55
Octabromodiphenyl ether	3.00e-03 i					110	11	4.1	3100	230
Octahydro-1357-tetranitro-1357-tetrazocine (HMX)	5.00e-02 i					1800	180	68	51000	3900
Octamethylpyrophosphoramide	2.00e-03 h					73	7.3	2.7	2000	160
Oryzalin	5.00e-02 i					1800	180	68	51000	3900
Oxadiazon	5.00e-03 i					180	18	6.8	5100	390
Oxamyl	2.50e-02 i					910	91	34	26000	2000
Oxyfluorfen	3.00e-03 i					110	11	4.1	3100	230
Paclobutrazol	1.30e-02 i					470	47	18	13000	1000
Paraquat	4.50e-03 i					160	16	6.1	4600	350
Parathion	6.00e-03 h					220	22	8.1	6100	470

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Pebulate	5.00e-02 h					1800	180	68	51000	3900
Pendimethalin	4.00e-02 i					1500	150	54	41000	3100
Pentabromo-6-chloro cyclohexane			2.30e-02 h			3.7	0.37	0.14	120	74
Pentabromodiphenyl ether	2.00e-03 i					73	7.3	2.7	2000	160
Pentachlorobenzene	8.00e-04 i				y	4.9	2.9	1.1	820	63
Pentachloronitrobenzene	3.00e-03 i		2.60e-01 h		y	0.055	0.033	0.012	11	6.6
Pentachlorophenol	3.00e-02 i		1.20e-01 i			0.71	0.071	0.026	24	14
Permethrin	5.00e-02 i					1800	180	68	51000	3900
Phenmedipham	2.50e-01 i					9100	910	340	260000	20000
Phenol	6.00e-01 i					22000	2200	810	610000	47000
m-Phenylenediamine	6.00e-03 i					220	22	8.1	6100	470
p-Phenylenediamine	1.90e-01 h					6900	690	260	190000	15000
Phenylmercuric acetate	8.00e-05 i					2.9	0.29	0.11	82	6.3
Phenylphenol			1.94e-03 h			44	4.4	1.6	1500	880
Phorate	2.00e-04 h					7.3	0.73	0.27	200	16
Phosmet	2.00e-02 i					730	73	27	20000	1600
Phosphine	3.00e-04 h	8.57e-06 h				11	0.031	0.41	310	23
Phosphorus (white)	2.00e-05 i					0.73	0.073	0.027	20	1.6
p-Phthalic acid	1.00e+00 h					37000	3700	1400	1000000	78000
Phthalic anhydride	2.00e+00 i					73000	7300	2700	2000000	160000
Picloram	7.00e-02 i					2600	260	95	72000	5500
Pirimiphos-methyl	1.00e-02 i					370	37	14	10000	780
Polybrominated biphenyls	7.00e-06 h		8.90e+00 h			0.0096	0.00096	0.00035	0.32	0.19
Polychlorinated biphenyls (PCBs)			7.70e+00 i			0.011	0.0011	0.00041	0.37	0.22
Polychlorinated terphenyls (PCTs)			4.50e+00 e			0.019	0.0019	0.0007	0.64	0.38
Polynuclear aromatic hydrocarbons										
Acenaphthene	6.00e-02 i					2200	220	81	61000	4700
Anthanthrene			2.34e+00 n	1.95e+00 n		0.036	0.0044	0.0014	1.2	0.73
Anthracene	3.00e-01 i					11000	1100	410	310000	23000
Benz[a]anthracene			1.06e+00 n	8.85e-01 n		0.08	0.0096	0.003	2.7	1.6
Benzo[b]fluoranthene			1.02e+00 n	8.54e-01 n		0.083	0.01	0.0031	2.8	1.7
Benzo[j]fluoranthene			4.45e-01 n	3.72e-01 n		0.19	0.023	0.0071	6.4	3.8
Benzo[k]fluoranthene			4.82e-01 n	4.03e-01 n		0.18	0.021	0.0065	5.9	3.5
Benzo[ghi]perylene			1.61e-01 n	1.34e-01 n		0.53	0.063	0.02	18	11
Benzo[a]pyrene			7.30e+00 i	6.10e+00 h		0.012	0.0014	0.00043	0.39	0.23
Benzo[e]pyrene			2.92e-02 n	2.44e-02 n		2.9	0.35	0.11	98	58
Cyclopentadieno[cd]pyrene			1.68e-01 n	1.40e-01 n		0.51	0.061	0.019	17	10
Chrysene			3.21e-02 n	2.68e-02 n		2.7	0.32	0.098	89	53
Dibenz[ah]anthracene			8.10e+00 n	6.77e+00 n		0.011	0.0013	0.00039	0.35	0.21

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Fluoranthene	4.00e-02	i								1500	150	54	41000	3100
Fluorene	4.00e-02	i								1500	150	54	41000	3100
Indeno[1,2,3-cd]pyrene					1.69e+00	n	1.42e+00	n		0.05	0.006	0.0019	1.7	1
Naphthalene	4.00e-02	h								1500	150	54	41000	3100
Phenanthrene	2.90e-02	o								1100	110	39	30000	2300
Pyrene	3.00e-02	i			5.91e-01	n	4.94e-01	n		0.14	0.017	0.0053	4.8	2.9
Prochloraz	9.00e-03	i			1.50e-01	i				0.57	0.057	0.021	19	11
Profluralin	6.00e-03	h								220	22	8.1	6100	470
Prometon	1.50e-02	i								550	55	20	15000	1200
Prometryn	4.00e-03	i								150	15	5.4	4100	310
Pronamide	7.50e-02	i								2700	270	100	77000	5900
Propachlor	1.30e-02	i								470	47	18	13000	1000
Propanil	5.00e-03	i								180	18	6.8	5100	390
Propargite	2.00e-02	i								730	73	27	20000	1600
Propargyl alcohol	2.00e-03	i								73	7.3	2.7	2000	160
Propazine	2.00e-02	i								730	73	27	20000	1600
Propham	2.00e-02	i								730	73	27	20000	1600
Propiconazole	1.30e-02	i								470	47	18	13000	1000
Propylene glycol	2.00e+01	h								730000	73000	27000	20000000	1600000
Propylene glycol, monoethyl ether	7.00e-01	h								26000	2600	950	720000	55000
Propylene glycol, monomethyl ether	7.00e-01	h	5.71e-01	i						26000	2100	950	720000	55000
Propylene oxide			8.57e-03	i	2.40e-01	i	1.30e-02	i		0.35	0.66	0.013	12	7.1
Pursuit	2.50e-01	i								9100	910	340	260000	20000
Pydrin	2.50e-02	i								910	91	34	26000	2000
Pyridine	1.00e-03	i								37	3.7	1.4	1000	78
Quinalphos	5.00e-04	i								18	1.8	0.68	510	39
Quinoline					1.20e+01	h				0.0071	0.00071	0.00026	0.24	0.14
RDX (Cyclonite)	3.00e-03	i			1.10e-01	i				0.77	0.077	0.029	26	15
Resmethrin	3.00e-02	i								1100	110	41	31000	2300
Ronnel	5.00e-02	h								1800	180	68	51000	3900
Rotenone	4.00e-03	i								150	15	5.4	4100	310
Savey	2.50e-02	i								910	91	34	26000	2000
Selenious Acid	5.00e-03	i								180	18	6.8	5100	390
Selenium	5.00e-03	i								180	18	6.8	5100	390
Selenourea	5.00e-03	h								180	18	6.8	5100	390
Sethoxydim	9.00e-02	i								3300	330	120	92000	7000
Silver and compounds	5.00e-03	i								180	18	6.8	5100	390
Simazine	2.00e-03	h			1.20e-01	h				0.71	0.071	0.026	24	14
Sodium azide	4.00e-03	i								150	15	5.4	4100	310

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Contaminant	Oral RfD (mg/kg/d)	Inhaled RfD (mg/kg/d)	Oral Potency Slope 1/(mg/kg/d)	Inhaled Potency Slope 1/(mg/kg/d)	VOC	Tap water (µg/l)	Ambient air (µg/m3)	Fish (mg/kg)	Occupational soil (mg/kg)	Residential soil (mg/kg)
Sodium diethyldithiocarbamate	3.00e-02 i		2.70e-01 h			0.32	0.032	0.012	11	6.3
Sodium fluoroacetate	2.00e-05 i					0.73	0.073	0.027	20	1.6
Sodium metavanadate	1.00e-03 h					37	3.7	1.4	1000	78
Strontium, stable	8.80e-01 h					32000	3200	1200	900000	69000
Strychnine	3.00e-04 i					11	1.1	0.41	310	23
Styrene	2.00e-01 i		3.00e-02 o		y	0.47	0.28	0.11	95	57
Systhane	2.50e-02 i					910	91	34	26000	2000
2,3,7,8-TCDD (dioxin)			1.50e+05 h	1.50e+05 h		0.00000057	0.000000057	0.000000021	0.000019	0.000011
Tebuthiuron	7.00e-02 i					2600	260	95	72000	5500
Temephos	2.00e-02 h					730	73	27	20000	1600
Terbacil	1.30e-02 i					470	47	18	13000	1000
Terbufos	2.50e-05 h					0.91	0.091	0.034	26	2
Terbutryn	1.00e-03 i					37	3.7	1.4	1000	78
1,2,4,5-Tetrachlorobenzene	3.00e-04 i				y	1.8	1.1	0.41	310	23
1,1,1,2-Tetrachloroethane	3.00e-02 i		2.60e-02 i	2.59e-02 i	y	0.55	0.33	0.12	110	66
1,1,2,2-Tetrachloroethane			2.00e-01 i	2.03e-01 i	y	0.07	0.042	0.016	14	8.5
Tetrachloroethylene (PCE)	1.00e-02 i		5.20e-02 e	2.03e-03 e	y	1.4	4.2	0.061	55	33
2,3,4,6-Tetrachlorophenol	3.00e-02 i					1100	110	41	31000	2300
p,a,a,a-Tetrachlorotoluene			2.00e+01 h		y	0.00071	0.00043	0.00016	0.14	0.085
Tetrachlorovinphos	3.00e-02 i		2.40e-02 h			3.5	0.35	0.13	120	71
Tetraethyldithiopyrophosphate	5.00e-04 i					18	1.8	0.68	510	39
Tetrahydrofuran	2.00e-03 o					73	7.3	2.7	2000	160
Thallic oxide	7.00e-05 h					2.6	0.26	0.095	72	5.5
Thallium acetate	9.00e-05 i					3.3	0.33	0.12	92	7
Thallium carbonate	8.00e-05 i					2.9	0.29	0.11	82	6.3
Thallium chloride	8.00e-05 i					2.9	0.29	0.11	82	6.3
Thallium nitrate	9.00e-05 i					3.3	0.33	0.12	92	7
Thallium selenite	9.00e-05 i					3.3	0.33	0.12	92	7
Thallium sulfate	8.00e-05 i					2.9	0.29	0.11	82	6.3
Thiobencarb	1.00e-02 i					370	37	14	10000	780
2-(Thiocyanomethylthio)-benzothiazole (TCMTB)	3.00e-02 y					1100	110	41	31000	2300
Thiofanox	3.00e-04 h					11	1.1	0.41	310	23
Thiophanate-methyl	8.00e-02 i					2900	290	110	82000	6300
Thiram	5.00e-03 i					180	18	6.8	5100	390
Tin and compounds	6.00e-01 h					22000	2200	810	610000	47000
Toluene	2.00e-01 i	1.14e-01 h			y	750	420	270	200000	16000
Toluene-2,4-diamine			3.20e+00 h			0.027	0.0027	0.00099	0.89	0.53
Toluene-2,5-diamine	6.00e-01 h					22000	2200	810	610000	47000

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Toluene-2,6-diamine	2.00e-01 h					7300	730	270	200000	16000
Toxaphene			1.10e+00 i	1.12e+00 i		0.077	0.0076	0.0029	2.6	1.5
Tralomethrin	7.50e-03 i					270	27	10	7700	590
Triallate	1.30e-02 i					470	47	18	13000	1000
Triasulfuron	1.00e-02 i					370	37	14	10000	780
1,2,4-Tribromobenzene	5.00e-03 i				y	30	18	6.8	5100	390
Tributyltin oxide (TBTO)	3.00e-05 i					1.1	0.11	0.041	31	2.3
2,4,6-Trichloroaniline			3.40e-02 h			2.5	0.25	0.093	84	50
2,4,6-Trichloroaniline hydrochloride			2.90e-02 h			2.9	0.29	0.11	99	59
1,2,4-Trichlorobenzene	1.00e-02 i	2.57e-03 a			y	18	9.4	14	10000	780
1,1,1-Trichloroethane	9.00e-02 h	2.86e-01 a			y	1300	1000	120	92000	7000
1,1,2-Trichloroethane	4.00e-03 i		5.70e-02 i	5.60e-02 i	y	0.25	0.15	0.055	50	30
Trichloroethylene (TCE)	6.00e-03 e		1.10e-02 y	1.70e-02 y	y	0.89	0.5	0.29	260	150
Trichlorofluoromethane	3.00e-01 i	2.00e-01 a			y	1300	730	410	310000	23000
2,4,5-Trichlorophenol	1.00e-01 i					3700	370	140	100000	7800
2,4,6-Trichlorophenol			1.10e-02 i	1.09e-02 i		7.7	0.78	0.29	260	150
2,4,5-Trichlorophenoxyacetic Acid	1.00e-02 i					370	37	14	10000	780
2-(2,4,5-Trichlorophenoxy) propionic acid	8.00e-03 i					290	29	11	8200	630
1,1,2-Trichloropropane	5.00e-03 i				y	30	18	6.8	5100	390
1,2,3-Trichloropropane	6.00e-03 i				y	37	22	8.1	6100	470
1,2,3-TCP as carcinogen			2.70e+00 e		y	0.0053	0.0032	0.0012	1.1	0.63
1,2,3-Trichloropropene	5.00e-03 h				y	30	18	6.8	5100	390
1,1,2-Trichloro-1,2,2-trifluoroethane	3.00e+01 i	7.71e+00 h			y	54000	28000	41000	31000000	2300000
Tridiphane	3.00e-03 i					110	11	4.1	3100	230
Triethylamine		2.00e-03 i				73	7.3			
Trifluralin	7.50e-03 i		7.70e-03 i			11	1.1	0.41	370	220
Trimethyl phosphate			3.70e-02 h			2.3	0.23	0.085	77	46
1,3,5-Trinitrobenzene	5.00e-05 i					1.8	0.18	0.068	51	3.9
Trinitrophenylmethylnitramine	1.00e-02 h					370	37	14	10000	780
2,4,6-Trinitrotoluene	5.00e-04 i		3.00e-02 i			2.8	0.28	0.11	95	39
Uranium (soluble salts)	3.00e-03 i					110	11	4.1	3100	230
Vanadium	7.00e-03 h					260	26	9.5	7200	550
Vanadium pentoxide	9.00e-03 i					330	33	12	9200	700
Vanadyl sulfate	2.00e-02 h					730	73	27	20000	1600
Vernam	1.00e-03 i					37	3.7	1.4	1000	78
Vinclozolin	2.50e-02 i					910	91	34	26000	2000
Vinyl acetate	1.00e+00 h	5.71e-02 i				37000	210	1400	1000000	78000
Vinyl chloride			1.90e+00 h	3.00e-01 h	y	0.025	0.028	0.0017	1.5	0.9

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Warfarin	3.00e-04	i						11	1.1	0.41	310	23
m-Xylene	2.00e+00	i	2.00e-01	y			y	1400	730	2700	2000000	160000
o-Xylene	2.00e+00	i	2.00e-01	y			y	1400	730	2700	2000000	160000
p-Xylene			8.57e-02	y			y	520	310			
Xylene (mixed)	2.00e+00	i					y	12000	7300	2700	2000000	160000
Zinc	2.00e-01	h						7300	730	270	200000	16000
Zinc phosphide	3.00e-04	i						11	1.1	0.41	310	23
Zineb	5.00e-02	i						1800	180	68	51000	3900

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