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REMEDIAL INVESTIGATION REPORT

RIVERDALE CHEMICAL COMPANY

CHICAGO HEIGHTS, ILLINOIS

August 20, 1987

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INTERNATIONAL TECHNOLOGY CORPORATION

August 24, 1987

Project No. 302108

Mr. Neil Meldgin
Geologist
U.S. EPA Region V
230 South Dearborn Street
Chicago, IL 60604

Transmittal
Remedial Investigation Report
Riverdale Chemical Company
Chicago Heights, Illinois

Dear Mr. Melgin:

Per Dr. Michael Champion's request, I am forwarding to you a copy of the Remedial Investigation Report for the Riverdale Chemical Company Site in Chicago Heights, Illinois. This report is being forwarded for your review and comment.

If you have any questions, please feel free to contact Dr. Champion at 312-756-2010 or me at 414-359-2222.

Sincerely,

Robert Spanbauer
Project Manager

RS/lp

cc: Ms. Donna Gerst/U.S. EPA Headquarters
Ms. J. Carlson/U.S. EPA Region V
Mr. Cliff Gould/Illinois EPA

:L13

AUGUST 1987

FINAL REPORT

REMEDIAL INVESTIGATION REPORT RIVERDALE CHEMICAL COMPANY CHICAGO HEIGHTS, ILLINOIS

PREPARED BY:

IT CORPORATION

RESPONSIVE TO THE NEEDS OF ENVIRONMENTAL MANAGEMENT

EXECUTIVE SUMMARY

The Riverdale Chemical Company site (site) is located at 220 East 17th Street in the City of Chicago Heights, Illinois. During the approximately 30 years of its on-going operations, the site has been used for the formulation of various pesticides. Until several years ago, the formulation process included the use of the compound 2,4,5-T, a product known to be contaminated with the compound 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

The Riverdale site, encompassing approximately five acres of land, lies along the northern edge of an industrialized area located in the southeast portion of the City of Chicago Heights. Low density residential housing lies across East 17th Street from the site. The site is bounded on the north by the Chicago Heights Terminal Transfer Railroad (CHTT) tracks and East 17th Street, on the east by the Baltimore and Ohio Railroad tracks, on the south by the Michigan Central Railroad tracks, and on the west by a vacant lot. The site is fenced on all sides by a seven (7) foot cyclone fence with a barbed wire header.

As part of the National Dioxin Test Strategy program, a study of the site was conducted in April, 1984, by the United States Environmental Protection Agency (U.S. EPA). The study indicated the presence of 2,3,7,8-TCDD and various pesticides in the surface soils at the site. Based on this, the U.S. EPA and Riverdale Chemical Company (Riverdale) entered into negotiations to perform a Remedial Investigation/Feasibility Study (RI/FS) at the site.

Upon discovery of the 2,3,7,8-TCDD at the site, Riverdale initiated several Initial Remedial Measures to control exposure to the contaminant. These measures included:

- Placement of a geotextile fabric over an approximately 19,600 square foot area that contained the highest concentrations of 2,3,7,8-TCDD
- Construction of additional fencing to control access to those areas contaminated with 2,3,7,8-TCDD
- Placement of bails of hay in drainageways emanating from the site to entrain contaminated soils.

Field investigations for the Remedial Investigation (RI) began in October, 1985, and were completed in November, 1986. The investigations consisted of:

- Collection of 71 subsurface soil samples from 8 soil borings during the Phase I activities
- Collection of 42 surface soil samples, 21 samples each from the Phase I and Phase II activities
- Collection of two air monitoring samples during the Phase I activities
- Collection of one sanitary sewer effluent sample during the Phase I activities
- Production of a topographic map of the site.

The geology at the site consists of approximately two to five feet of fill material directly overlying very stiff yellowish-brown to gray silty clay. The fill material consists of gravel, cinders, ash, brick, and wood fragments. The unconsolidated deposits at the site are reported to be approximately 35 feet in thickness, and are underlain by Suilurian-age dolomitic limestone of the Niagara formation.

The uppermost regional aquifer at the site is the shallow dolomitic Niagara formation. Water levels within the aquifer are generally at or below the top of rock. Exploratory borings conducted at the site were advanced to a depth of approximately 14 feet. Ground water was not encountered in any of the site borings.

The results of the laboratory analyses conducted on the samples collected at the site are presented below:

- Surface Soil - the surface soil samples collected at the site contain 2,3,7,8-TCDD and various pesticides. The 2,3,7,8-TCDD is limited to Quadrants II and III of the site, while the pesticide contamination is found in all site Quadrants.
- Subsurface Soil - the subsurface soil samples of the shallow portions (0 - 3 feet) of the borings contain a variety of semi-volatiles and pesticides as well as 2,3,7,8-TCDD. Subsurface samples from the deeper

portions (6 - 8 feet) of the borings were analyzed for 2,3,7,8-TCDD only. One sample from this zone contained a low concentration (0.8 parts-per-billion) of 2,3,7,8-TCDD, however this data is suspect due to the probability of in-borehole contamination during drilling. The remaining samples from this interval did not exhibit 2,3,7,8-TCDD.

- Air - the air samples were analyzed for 2,3,7,8-TCDD concentrations only. Concentrations of 2,3,7,8-TCDD were not detected in the samples collected.

- Sanitary Sewer Effluent - one sanitary sewer effluent sample was collected during the RI, and was analyzed for 2,3,7,8-TCDD only. The sample contained 2.4 parts-per-trillion (ppt) of 2,3,7,8-TCDD. The concentration detected is believed to be the result of residual contamination of sediments within the sewer system and not a result of current processes at the site. Subsequent sampling performed as part of a Wastewater Discharge Permit requirement did not detect a concentration of 2,3,7,8-TCDD at the ppt level.

Based on the Public Health Evaluation of the RI data, the human exposure pathways are limited to:

- Site trespassers ingesting contaminated surface soils

- Persons residing downwind of the site inhaling air particulates mobilized by wind erosion.

The potential future health risks associated with the no action alternative are summarized below:

- The exposure risks based on the maximum observed concentration of 2,3,7,8-TCDD do not exceed the potential cancer risk criteria of 1×10^{-5}.

- The exposure risk based on the maximum observed concentrations for the air inhalation scenario do not exceed the potential cancer risk criteria.

- The exposure risks based on the lower bound geometric mean concentrations of pesticides do not exceed the potential cancer risk or the less than unity noncarcinogenic health risk criteria.

- The exposure risks based on the maximum observed concentrations of pesticides exceed the potential cancer risk and the noncarcinogenic health risk for the soil ingestion scenario.

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LIST OF ACRONYMS

AADIs	Adjusted Acceptable Daily Intakes
BAA	Benzo(A) Anthracene
BAP	Benzo(A) Pyrene
BBF	Benzo(B) Fluoranthene
BBP	Butyl Benzyl Phthalate
BKF	Indeno(1,2,3-c,d) Pyrene
BN/As	Base Neutral/Acid Extractable Compounds
CDC	Center for Disease Control
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CHTT	Chicago Heights Terminal Transfer Railroad
CLP	Contract Laboratories Program
DEHP	Diethylhexyl Phthalate
DNBP	Di-n-butyl Phthalate
E&E	Ecology and Environment Inc.
FIT	Field Investigation Team
FS	Feasibility Study
GI	Gastrointestinal
HSL	Hazardous Substance List
IEPA	Illinois Environmental Protection Agency
IRMs	Initial Remedial Measures
IT	International Technology Corporation
Koc	Soil Adsorption Coefficient
Kow	Octanol/Water Partition Coefficient
LOAEL	Lowest Observed Adverse Effect Level
MSL	Mean Sea Level
MG/KG	Milligrams-per-kilogram
NAPL	Non-aqueous Phase Liquid
NCHR	Noncarcinogenic Health Risks
NCP	National Contingency Plan
NCR	Noncarcinogenic Rates
NOAEL	No Observed Adverse Effect Level
PAH	Polynuclear Aromatic Hydrocarbons

LIST OF ACRONYMS
(Continued)

PCB	Polychlorinated Biphenyls
PHE	Public Health Evaluation
PPB	Parts-per-billion
PPM	Parts-per-million
PPT	Parts-per-trillion
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QRA	Quantitative Risk Assessment
RfDs	Reference Doses
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SARA	Superfund Amendments and Reauthorization Act of 1986
UG/KG	Micrograms-per-kilogram
USDA	United States Department of Agriculture
USDHHS	United States Department Of Health & Human Services
U.S. EPA	United States Environmental Protection Agency
U.S.G.S.	United States Geological Survey
VOC	Volatile Organic Compounds
2,3,7,8-TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid

1.0 INTRODUCTION

The Riverdale Chemical Company site (site) is located at 220 East 17th Street in the City of Chicago Heights, Cook County, Illinois (Figures 1 and 2). The site was determined by the United States Environmental Protection Agency (U.S. EPA) and the Illinois Environmental Protection Agency (IEPA) to potentially contain hazardous substance contamination due to past practices at the site. Because of the possibility of human and environmental exposure to surface soil potentially contaminated with hazardous substances and concern for the potential for off-site migration, the site was listed by the U.S. EPA under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

CERCLA, through Executive Order 12316, gives U.S. EPA the authority to control the actual or potential release of hazardous substances that pose a substantial threat to human health or welfare or the environment. Pursuant to Section 105 of CERCLA, U.S. EPA promulgated revisions to the National Contingency Plan (NCP) on July 16, 1982, to institute the response powers and responsibilities created by CERCLA. Subpart F of the NCP, Hazardous Substance Response, establishes methods and criteria for determining the appropriate extent of response authorized by CERCLA.

Pursuant to the authority granted by CERCLA, the U.S. EPA and Riverdale Chemical Company (Riverdale) entered into a consent agreement to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the site. The consent agreement permits Riverdale to conduct the RI/FS under the guidance of the U.S. EPA. Riverdale contracted International Technology Corporation (IT) to perform the actual RI/FS activities.

1.1 PURPOSE AND SCOPE OF THE REMEDIAL INVESTIGATION

The purpose of the Remedial Investigation (RI) was to collect data that would determine the nature and extent of contamination at the site and to assess potential public health risks that the contaminants might cause. The RI report will then be used as the data base for the Feasibility Study (FS) which uses the data to evaluate and propose remedies to minimize the threats.

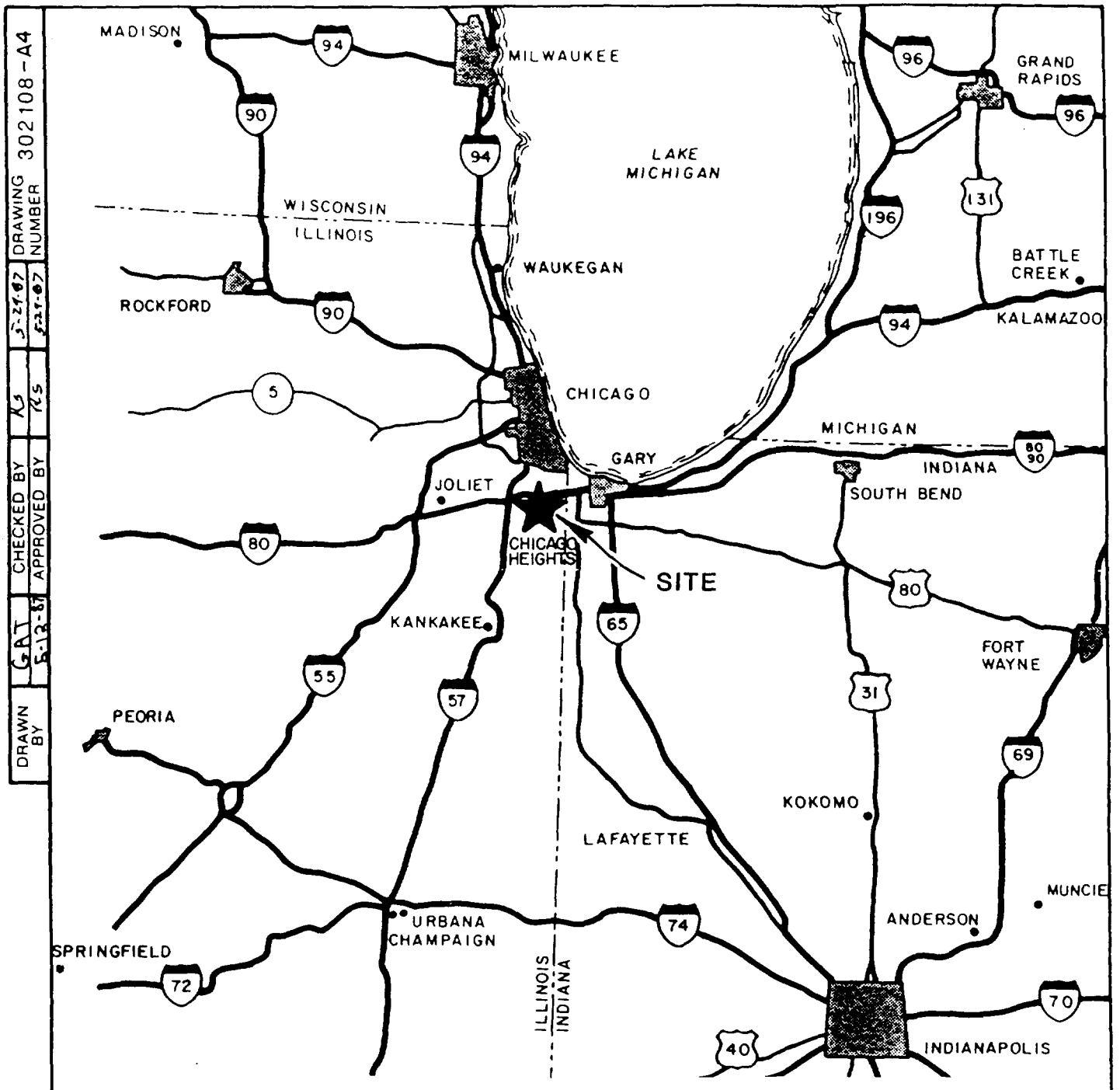

FIGURE 1

LOCATION MAP

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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CHECKED BY KS 5-27-87
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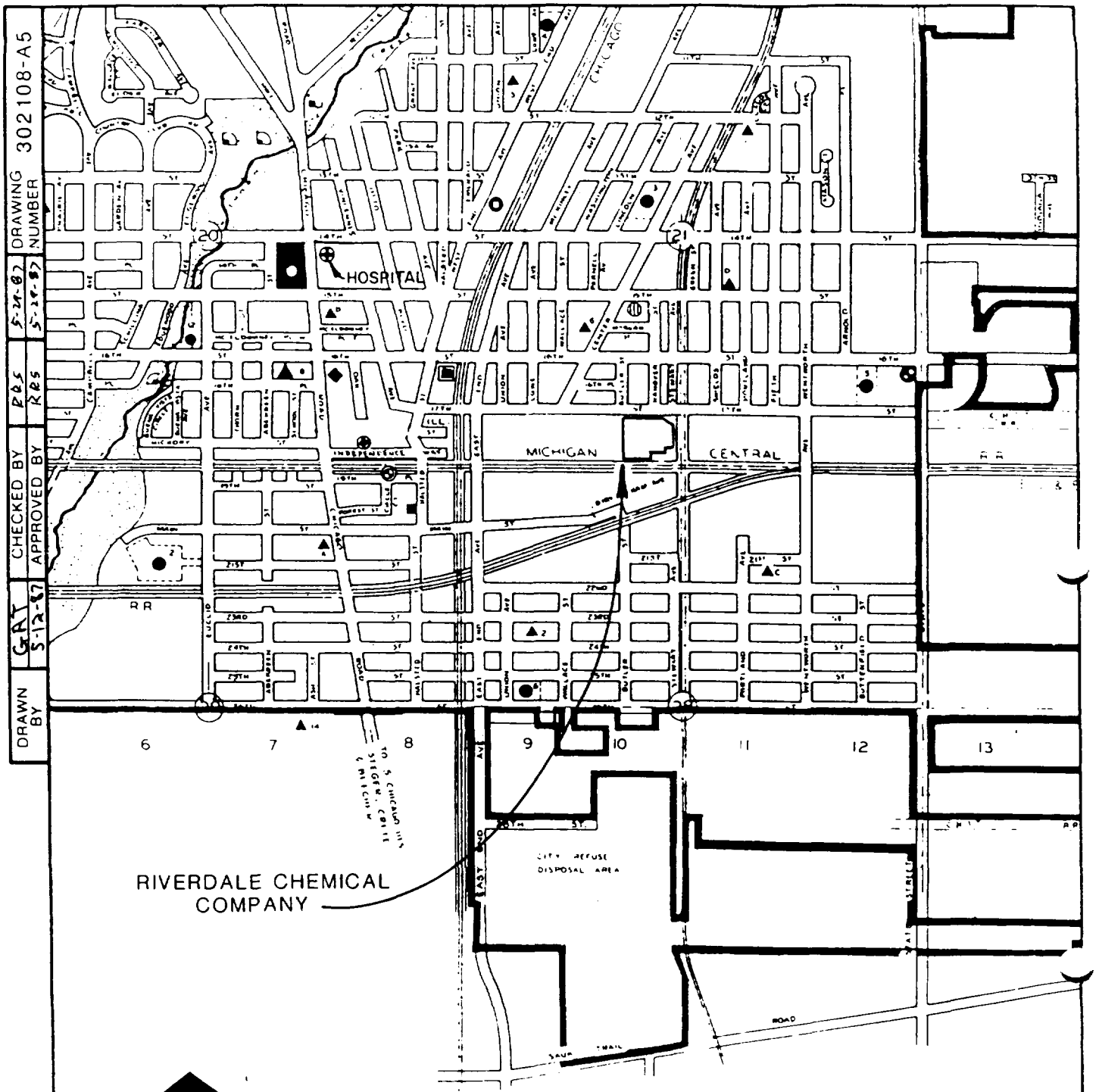

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FIGURE 2

VICINITY MAP

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The details of the scope-of-work for the RI are documented in Appendix A of the Quality Assurance Project Plan (QAPP) dated October 1, 1985 and in the Proposed Scope-of-Work, Phase II Remedial Investigation dated December 19, 1985. The Scope-of-Work documents (Appendix A) utilized a phased approach to the study. The Phase I portion of the RI characterized the types of contaminants and their levels of concentration at the site and the extent of their migration. The Phase II portion was conducted to fill Phase I data gaps by more closely defining the extent of contamination in specific areas.

1.2 SITE INFORMATION

The Riverdale Chemical Company site is located at 220 East 17th Street in the City of Chicago Heights, Illinois. Figure 3 presents a map of the site.

The site encompasses approximately five acres. The site is bounded on the north by the Chicago Heights Terminal Transfer (CHTT) Railroad tracks and East 17th Street, the Baltimore and Ohio Railroad tracks on the east, the Michigan Central Railroad tracks on the south, and a vacant lot on the west. The site lies along the northern edge of an industrialized area located in the southeast portion of the City of Chicago Heights. Low density residential housing lies across East 17th Street from the site.

The site was purchased by Riverdale in approximately 1956. Prior to that time, the site had been utilized as a carriage building, brewery, and, prior to occupancy by Riverdale, a warehouse. Since its purchase by Riverdale, the site has been utilized primarily for the formulation of pesticides.

Structures existing on the site include three main buildings, a smaller ancillary building and an aboveground storage tank area (Figure 3). Building 1 is used for formulation processing, while Buildings 2 and 3 are utilized for storage of raw products and processed materials. Liquid compounds used in the formulation processes are stored in the storage tank area.

Upon discovery of the 2,3,7,8-TCDD contamination at the site, Riverdale undertook several Initial Remedial Measures (IRMs) to control exposure and migration of the contaminant. These measures included placement of a geotextile fabric

over approximately 19,600 square feet of area that contained the highest concentration of 2,3,7,8-TCDD, construction of additional fencing to control access to the area with the contamination, and placement of bales of hay in drainageways emanating from the area to reduce the migration of contaminated soil. Appendix G contains a description of the IRMs performed.

1.3 PREVIOUS INVESTIGATIONS

As part of the National Dioxin Test Strategy program implemented by the U.S. EPA, Ecology and Environment Inc. (E&E) conducted a Field Investigation Team (FIT) study of the site on April 24, 1984. The FIT investigation consisted of collecting 15 surface soil samples which were analyzed for a variety of organic compounds. Figure 4 shows the FIT investigation sampling locations, while Table 1 presents the analytical results.

The results of the analyses indicated the presence of various pesticides, volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), phenolic compounds, and 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Due to the scope of the investigation, only limited conclusions regarding the site could be developed. Based upon this study, the U.S. EPA entered into negotiations with Riverdale to perform a RI/FS at the site.

1.4 NATURE AND EXTENT OF CONTAMINATION

The FIT investigation determined the presence of 2,3,7,8-TCDD and various pesticides in the surface soils at the site. Concentrations of 2,3,7,8-TCDD ranged from a low of not detectable to a reported high of 364 parts-per-billion (ppb). Concentrations of pesticides ranged from a low of not detectable to a reported high of 1,100,000 ppb for chlordane.

Although the FIT investigation determined the nature of the contamination, the investigation was limited to the collection of surface soil samples primarily in the southern portion of the site. Therefore, conclusions regarding the lateral and vertical extent of contamination, both on- and off-site, as well as contamination in other media near the site (i.e., surface water and sediment) could not be developed. The lack of information to develop conclusions characterizing site contamination, coupled with the fact that several of the

TABLE 1
SOIL SAMPLING ANALYTICAL RESULTS
FIT STUDY, APRIL 1984
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

PARAMETER (ppb)	SAMPLE I.D. NUMBER															
	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-10*	B-11	B-12	B-13	B-14	B-15**
VOLATILES																
1,1,2,2-TETRACHLOROETHANE		K				K										
CHLOROFORM				K		14.0										
ETHYLBENZENE						K									25.0	
METHYLENE CHLORIDE	22	40			120			51.0		10.0		26.0				
FLUOROTRICHLOROMETHANE	K	5.5		2.9	4.1	5.3	2.4	K	3.7	3.3				K		K
TETRACHLOROETHANE					4.3											
TOLUENE															4.6	
4-METHYL-2-PENTANONE						K										
STYRENE		K														
XYLENE		K													94.0	
SEMI-VOLATILES																
2,4,6-TRICHLOROPHENOL	K						4,500		K	2,600		1,100				
2,4-DICHLOROPHENOL		K			K		22,000									
PHENOL		K														
2,4,5-TRICHLOROPHENOL							9,500									
1,2,4-TRICHLOROBENZENE										870						
HEXACHLOROBENZENE									K							
FLUORANTHENE	K	630	840	1,800			120	2,200	550	1,400		410				
ISOPHORONE										K						
NAPHTHALENE							1,300	K	1,400	750					6,400	
BIS(2-ETHYLHEXYL)PHTHALATE		K	903											1,100		
DI-N-OCTYL PHTHALATE													5,100			
BENZO(A)ANTHRACENE	K	560	K	1,000			2,700	1,200	420	460						
BENZO(A)PYRENE		K		K				890		K						
BENZO(B)FLUORANTHENE		870	1,800	K			810	3,700	K	1,000						
BENZO(K)FLUORANTHENE		K	1,800	K				3,700	K	1,000						
CHRYSENE	K	700	K	1,300			650	1,100	470	800		K				
ACENAPHTHYLENE							K		470							
ANTHRACENE								430								
BENZO(GHI)PERYLENE									850	K						
PHENANTHRENE	K	460	K	1,700			400	1,700	K	970		K				
INDENO(1,2,3-CD)PYRENE									K	K						
PYRENE	500	1,600	703	2,200	K		460	2,100	550	860		K	K			
4-CHLOROANILINE					36,000											
2-METHYLNAPHTHALENE					K		4,400		6,400	1,900					19,000	

TABLE 1
SOIL SAMPLING ANALYTICAL RESULTS
FIT STUDY, APRIL 1984
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

PARAMETER (ppb)	SAMPLE I.D. NUMBER															
	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-10*	B-11	B-12	B-13	B-14	B-15**
PESTICIDES																
ALDRIN		5,400	3,000	25,000	320	2,700	71,000	250,000	11,000	14,000		2,100	300	300	35,000	
DIELDRIN		31,000	78,000	7,900	210	1,500	72,000	79,000	12,000	19,000		8,300	860	530	12,000	45
CHLORDANE	3,200		310,000	5,000		1,900		1,100,000	29,000	48,000			2,300	1,200		78
4,4'-DDT				610		450			1,400				210	580		
4,4'-DDE			9,300	190			2,200	17,000	800			4,700				
4,4'-DDD									990				57.0	360		
HEPTACHLOR		190,000	34,000	460		16,000	440	130,000	3,100			1,400	220	610		
TOXAPHENE	160,000															
SPECIAL ANALYSIS																
2,3,7,8-TCDD		3.6	1.3	1.1	31.6	5.3	364	12.9	3.6	13.9	14.2	38.3	0.76	1.68	36.4	

* - DUPLICATE ANALYSIS WAS PERFORMED ONLY FOR 2,3,7,8-TCDD PARAMETER
** - BACKGROUND SAMPLE
K - COMPOUND PRESENT AT A CONCENTRATION BELOW QUANTIFICATION LIMIT

compounds detected were hazardous substances (including known carcinogens and priority pollutants), and the proximity of the site to residential neighborhoods led to the U.S. EPA request for conducting an RI/FS at the site.

1.5 REPORT ORGANIZATION

The RI report is divided into seven chapters. Chapter 1 is an introduction to the site and previous investigations. Chapter 2 presents the site background, and Chapter 3 is a brief summary of the RI activities undertaken to study the site. Chapter 4 is the site assessment which contains the results of the chemical analyses and discusses the compounds detected. Chapter 5, based on the data contained in Chapter 4, assesses public health risks and environmental impacts which may be caused by the site if no further actions are taken at the site. The conclusions of the RI are summarized in Chapter 6, and Chapter 7 presents a list of references. The appendices contain supporting documents for the laboratory and field data, and for the procedures of various activities conducted during the RI.

2.0 SITE BACKGROUND

This chapter describes pertinent site characteristics, such as demography, geography, and climatology. These characteristics are presented in the following sections.

2.1 DEMOGRAPHY

The site is located in the southeastern portion of the City of Chicago Heights, Cook County, Illinois. The City of Chicago Heights is located along the southern perimeter of the Chicago, Illinois/Gary, Indiana metropolitan area. The population of Cook County, Illinois, according to the 1980 census, was 5,253,190, while the population of Lake County, Indiana (including the City of Gary) was 522,965. According to this same census, the population of the City of Chicago Heights was 37,026. The population within a 1-mile and 2-mile radius of the site in 1980 is estimated to be 11,100 and 29,700, respectively. It should be noted that the 2-mile radius includes portions of the Cities of South Chicago Heights and East Chicago Heights (recently renamed Ford Heights).

The residential population within a 3-mile radius of the site that has private wells for water supply is estimated to be 10,000 people. The remainder of the people are on a public water supply system using Lake Michigan water (City of Chicago Heights) or ground water (South Chicago Heights and East Chicago Heights). Nine public water supply wells are located within a 3-mile radius of the site. Twelve industrial water supply wells utilized for production purposes are located within a 3-mile radius of the site.

2.2 LAND USE

Land use in the area of the site and surrounding vicinity can be illustrated by the aerial photograph shown in Figure 5. The land use is a mixture of residential, commercial, and industrial neighborhoods with some areas of undeveloped land. The site is located in an area zoned for heavy industry and is bounded by:

- North side - the site is immediately bounded by the CHTT Railroad tracks and East 17th Street, and by an area of sparsely populated residential homes.

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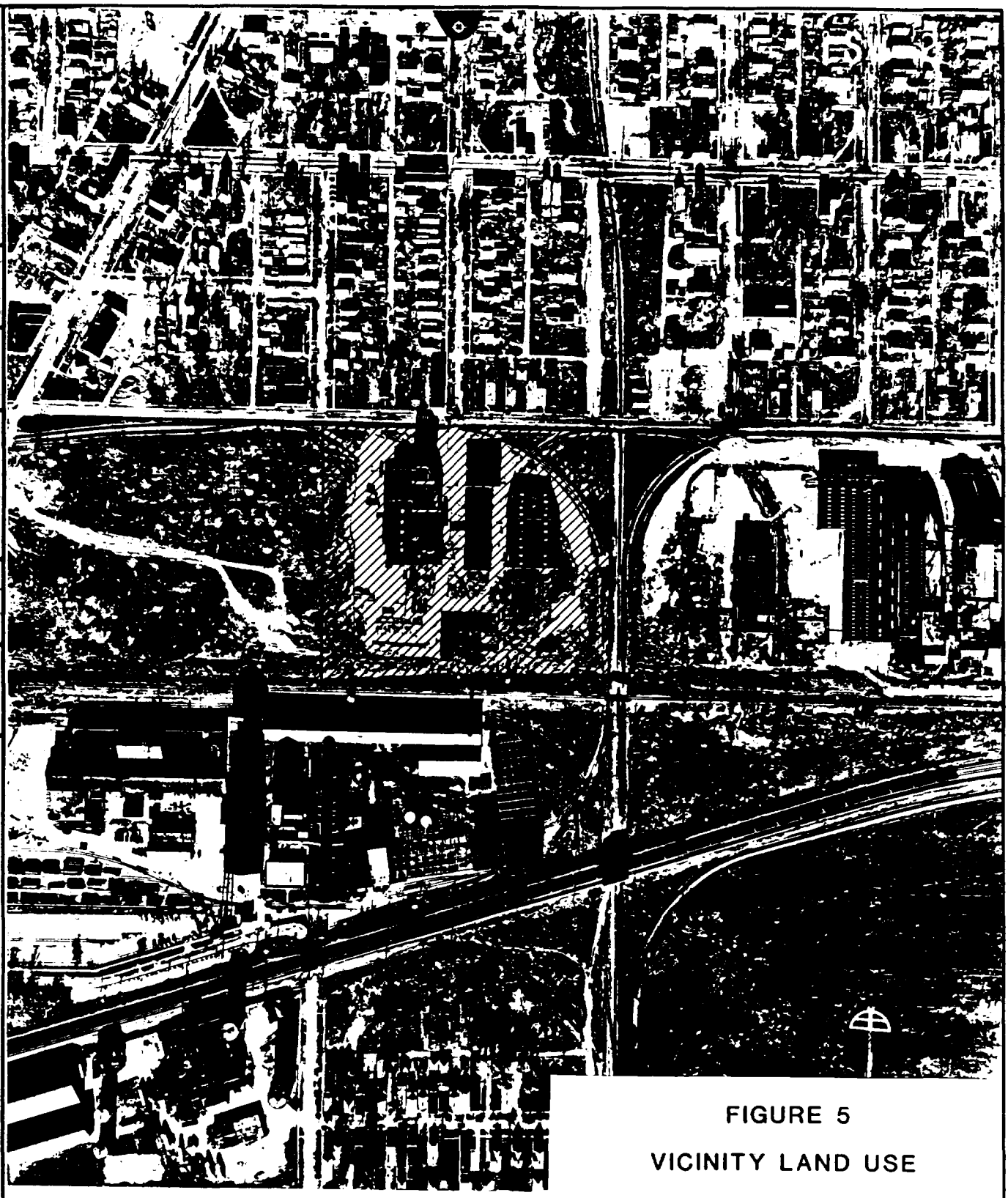

SITE AREA

N

0 660

330

SCALE IN FEET

FIGURE 5

VICINITY LAND USE

PREPARED FOR

RIVERDALE CHEMICAL COMPANY

CHICAGO HEIGHTS, ILLINOIS

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- East side - the site is bounded by the land and tracks of the Baltimore and Ohio Railroad and a large asphalt roofing company (now closed).

- South side - the site is bounded by the land and tracks of the Michigan Central Railroad (no longer in use). The tracks are located on a 15-foot high earthen embankment which separates the site from a large steel processing facility.

- West side - the site is bounded by a twenty acre vacant lot which was formerly the site of a truck manufacturing facility.

Major land use areas in the vicinity of the site include:

- A low density residential area immediately north of the site

- A commercial area northwest of the site (downtown Chicago Heights, approximately 2,000 feet northwest of site)

- Industrialized areas east and south of the site

- A municipal landfill 3,500 feet south of the site.

2.3 GEOGRAPHY

2.3.1 Physiography

The site is located in the Great Lakes Section of the Central Lowland Physiographic Province (Hunt, 1974). The Great Lakes Section is a plain of Wisconsinan glacial till. This plain is interrupted by morainal ridges, mostly about 50 feet high, arranged in concentric arcs around the rounded end of the lake.

The site is located on the boundary between the Chicago Lake Plain and the Wheaton Morainal Country units (Leighton, 1948). These units are subdivisions of the Calumet Lacustrine Plain and Valparaiso Morainal Area Physiographic Divisions, respectively. The Chicago Lake Plain is characterized by a flat surface, underlain by till, which slopes gently toward Lake Michigan. The plain is interrupted by low beach ridges and morainic headlands and islands. The sand dunes common to the Calumet Lacustrine Plain are scarcely recognizable and found only in a few scattered localities.

The Wheaton Morainal Country is characterized by glacial morainic topography. It contains a series of broad parallel morainic ridges which encircle Lake Michigan. The area is dominated by the Valparaiso Moraine, which has the highest elevation and, except where interrupted by valleys, is continuous from Wisconsin into Indiana.

2.3.2 Topography

A topographic map of the site is shown in Figure 3. The site is relatively flat with a gentle slope to the east. Elevations across the site range from approximately 672 feet above Mean Sea Level (MSL) in the southwestern portion of the site to approximately 664 feet MSL in the eastern portion of the site.

The site is topographically bounded on the south by the Michigan Central Railroad tracks (elevation between 683 and 687 feet MSL) and on the east by the Baltimore and Ohio Railroad tracks (elevation between 665 and 667 feet MSL). Due to the presence of these boundaries, a marshy area has developed along the eastern and southeastern portions of the site. The marshy area has no natural drainage and is assumed to be a perched system, deriving a majority of the water from runoff and direct precipitation.

2.4 CLIMATOLOGY

The nearest climatological monitoring station to the site is at Park Forest, Illinois, approximately five miles west of the site. Available data for the years 1951 to 1980 are presented in Appendix B. Summer temperatures averaged between 58 ^{o}F and 84 ^{o}F, with 18 days exceeding 90 ^{o}F during a typical year. Winter temperatures averaged between 13 ^{o}F and 35 ^{o}F with 123 days below 32 ^{o}F and 12 days showing temperatures of 0°F and below for a typical year.

Total precipitation at the Park Forest monitoring station (including snowfall) averaged 35.2 inches per year. Due to the frequency of winds from the north and northeast during the winter, the site area receives large amounts of precipitation from Lake Michigan in the form of snow squalls. Snowfall at Park Forest averaged 34.2 inches per year. The soil is frozen on the average of 148 days per year. During periods when the soil is not frozen, precipitation exceeds 0.1 inch an average of 48 days per year.

3.0 REMEDIAL INVESTIGATION ACTIVITIES

Table 2 summarizes the field activities completed during Phases I and II of the RI. These activities are described in greater detail below.

3.1 PREPARATION OF SITE PLANS

Field activities during the RI were conducted in accordance with the site specific plans for quality assurance, sampling, and health and safety. The Quality Assurance Project Plan (QAPP) was first submitted to the U.S. EPA on June 10, 1985. The revised QAPP was submitted to and approved by U.S. EPA on October 3, 1985. The QAPP presented the quality assurance and quality control objectives for the project along with the activities necessary to achieve the goals of the RI.

The Sampling Plan for all RI activities was incorporated in the QAPP. The Sampling Plan includes discussions of sampling methodology and equipment, sampling sites, number of samples to be taken, methods of sample preservation, analytical procedures to be used, shipping methods, chain-of-custody procedures and responsibilities of the sampling team members. The Sampling Plan is presented in Appendix C.

The Site Safety Plan was prepared based on the findings of prior investigations and incorporated into the QAPP. This plan described the types of protective gear that the site personnel should wear to minimize their exposure (either through inhalation or by direct contact) to hazardous materials, potential on-site physical hazards, decontamination procedures, an emergency response plan, the work schedule, and air monitoring requirements.

The U.S. EPA has conducted all community relations activities for the site.

3.2 SITE MAPPING

A topographic map of the site (Figure 3) was prepared by Abrams Aerial Survey Corporation from aerial photographs of the site taken on December 14, 1985. Third-order ground control was established on January 3, 1986 by IT. The map has a horizontal scale of one inch equals 50 feet and a contour interval of one foot. The area photographed consists of approximately 13 acres, and is

TABLE 2
CHRONOLOGY OF REMEDIAL INVESTIGATION ACTIVITIES
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

DATE	ACTIVITY
1984	
4/24	As part of National Dioxin Test Strategy Program, Field Investigation Team (FIT) study of the Riverdale Chemical Company (Riverdale) plant area in Chicago Heights, Illinois conducted
1985	
2/25	IT Corporation (IT) retained by Riverdale to conduct Remedial Investigation/ Feasibility Study of Riverdale's Chicago Heights, Illinois plant area
6/10	Draft Quality Assurance Project Plan (QAPP), Sampling Plan, and Health and Safety Plan submitted to Riverdale
6/18	Revised Draft QAPP, Sampling Plan, and Health and Safety Plan submitted to Riverdale
6/24	Draft QAPP, Sampling Plan, and Health and Safety Plan submitted to U.S. EPA
9/11	Revised Draft QAPP, Sampling Plan, and Health and Safety Plan submitted to Riverdale
10/1	Final QAPP, Sampling Plan, and Health and Safety Plan submitted to Riverdale and U.S. EPA
10/3	Final QAPP, Sampling Plan, and Health and Safety Plan approved by U.S. EPA
10/14 - 10/21	Phase I RI field activities conducted: 21 surface soil samples collected; 8 borings augered and sampled with 71 soil boring samples collected
10/29	Wastewater produced during Phase I field activities sampled Location and elevation survey of Phase I sampling locations conducted
11/20	Non-contact cooling water effluent discharging from Riverdale plant to Thorn Creek Sewerage District sanitary sewer sampled
12/11	Preliminary Assessment of Phase I RI report submitted to U.S. EPA
12/12	Sanitary Sewer Effluent Sampling and Analysis report submitted to Riverdale
12/14	Aerial photographs of Riverdale plant site taken for topographic map preparation
12/13	Proposed Scope of Work - Phase II RI report submitted to Riverdale
1986	
1/3	Establish third order ground control at plant site
1/8	U.S. EPA QC/QA data review for Phase I sampling completed
5/20	Phase II RI approved by U.S. EPA
6/18	Phase II sampling program initiated: 13 surface soil samples collected

TABLE 2
CHRONOLOGY OF REMEDIAL INVESTIGATION ACTIVITIES
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

DATE	ACTIVITY
1986	
6/23	Additional Phase II sampling conducted: 4 surface soil samples collected
8/1	Draft Phase II RI report submitted to Riverdale
8/15	Final Phase II RI report submitted to U.S. EPA
8/18	Surface soil sample RIV-SS35-1, collected 6/18/86, submitted for analyses
10/10	Meeting held between Riverdale, U.S. EPA, and IT to discuss results of Phase I and Phase II sampling
10/16	U.S. EPA QC/QA data review for Phase II sampling partially completed
11/17	Additional Phase II sampling conducted: 4 surface soil samples collected
12/3	Remainder of U.S. EPA QC/QA data review for Phase II sampling completed
1987	
2/2	U.S. EPA QC/QA data review for 11/17/86 Phase II sampling event completed
3/24	U.S. EPA gives verbal approval to prepare RI report

bounded by East 17th Avenue on the north, the Baltimore and Ohio Railroad on the east, the Michigan Central Railroad on the south, and a vacant lot on the west.

3.3 PHASE I ACTIVITIES

The Phase I field activities were conducted during the period of October 14, 1985 through October 21, 1985. The activities consisted of collecting soil samples from borings and selected surface locations on and adjacent to the Riverdale site. The distribution of borings and surface soil sampling locations was designed to provide comprehensive coverage of the site and to determine, as a first cut, the lateral and vertical extent of soil contamination. The specific methodologies used during the investigation are discussed in the following sections.

3.3.1 Soil Boring and Sampling

A total of eight bore holes were augered during the Phase I field program. Locations are shown in Figure 6. All bore holes were advanced using 6-inch outside diameter (3-1/4 inch inside diameter) hollow stem augers. A CME550 drill rig was used. Each boring was sampled continuously (at 1.5-foot intervals) using a 3-inch outside diameter split barrel sampler. The sampler was driven a total of 18 inches by a 140-pound hammer freely falling over a distance of 30 inches. Blow counts were recorded for each 6-inch interval. The sample spoon was opened by an IT technician and emptied into a stainless steel tray. The core was split open and scanned with an HNu photoionization analyzer or an organic vapor analyzer. The soil vapor readings are shown in Table 3. The sample was then described by the supervising hydrogeologist using the Unified Soil Classification System. The sample was composited in the tray and a portion was placed into a labeled 500 ml amber glass jar with a teflon-lined lid. The remaining sample was discarded in a spoils pile. The jar was subsequently decontaminated, placed in a ziplock plastic bag and placed in a cooler until being shipped to the laboratory. Stringent chain-of-custody procedures were observed.

Decontamination of the split barrel samplers, stainless steel trays, and stainless steel sampling tools was performed by utilizing a trisodium phosphate/tap water wash followed by a tap water rinse, a pesticide grade

TABLE 3
PHASE I SOIL BORING
ORGANIC VAPOR MONITORING RESULTS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

BORING NUMBER	SB01	SB02	SB05	SB06	SB07	SB08
BACKGROUND VALUE (ppm)	2.0-3.0	2.0-3.0	2.0-4.0	10.0	8.0	8.0
INSTRUMENT**	HNu	HNu	HNu	OVA	OVA	OVA
SAMPLE DEPTH INTERVAL (ft)						
0.0-1.5	BKGD***	BKGD	BKGD	13	BKGD	BKGD
1.5-3.0	BKGD	BKGD	BKGD	BKGD	BKGD	BKGD
3.0-4.5	BKGD	BKGD	BKGD	120	BKGD	BKGD
4.5-6.0		BKGD	BKGD		10	BKGD
5.0-6.5****	BKGD			20		
6.0-7.5		BKGD	BKGD		12	BKGD
6.5-8.0	BKGD			BKGD		
7.5-9.0		BKGD	BKGD		BKGD	BKGD
8.0-9.5	BKGD			BKGD		
9.0-10.5		BKGD	BKGD		---	BKGD
9.5-11.0	BKGD			BKGD		
10.5-12.0		BKGD	BKGD		BKGD	BKGD
11.0-12.5	NR			BKGD		
12.0-13.5		BKGD	BKGD		BKGD	BKGD
12.5-14.0	BKGD			BKGD		

* - VALUES FOR BORINGS SB03 AND SB04 NOT AVAILABLE DUE TO INSTRUMENTATION MALFUNCTION
** - INSTRUMENTATION: HNU SYSTEMS INC. MODEL PI 101 PHOTOIONIZATION ANALYZER (HNu), CENTURY SYSTEMS MODEL OVA-128 PORTABLE ORGANIC VAPOR ANALYZER (OVA)
*** - OBSERVED VALUE DID NOT EXCEED BACKGROUND VALUE/RANGE
**** - DUE TO SUBSURFACE OBSTRUCTIONS ENCOUNTERED DURING DRILLING, BORINGS SB01 AND SB06 WERE OVERDRILLED FROM APPROXIMATELY 4.5-5.0 FEET, CONTINUOUS SAMPLING RESUMED AT 5.0 FEET
--- - VALUE NOT RECORDED
NR - NO SAMPLE RECOVERY

methanol spray rinse, a purified water spray rinse and air drying. The augers and all tools that entered the bore hole were steam cleaned between each bore hole to minimize the chances of cross contamination.

All spoils and cuttings generated from on-site borings were collected to a central location (the tarped area), and were covered with visqueen and secured with bricks. Each boring was grouted from the bottom up with an expanding bentonite/cement grout via tremie pipe. Each location was marked with a wooden stake showing the boring number. Photo documentation of all field activities was performed by Riverdale.

A detailed boring log was maintained for each boring, as described in the Sampling Plan (Appendix C). The field and edited boring logs are included in Appendix D.

3.3.2 Surface Soil Sampling

Phase I surface soil samples were collected from 21 location on and adjacent to the Riverdale property. Sampling locations are shown in Figure 6. At each location a square approximately 8 X 8 inches was inscribed on the ground surface. The soil within this square was scored with a stainless steel knife into a grid comprised of approximately one inch squares. The soil within each one inch square area was scraped up with a stainless steel spoon to a depth of approximately one inch and thoroughly composited in a stainless steel tray. The contents of the tray were placed in labeled 500 ml amber glass jars with teflon-lined lids. Each location was marked with a wooden or metal stake showing the location number. Efforts were made in all cases to obtain samples from drainage ways and erosionary silts. The decontamination procedures followed were identical to those followed for soil boring sampling. Sample custody was maintained by the IT sampling team prior to shipment of the samples to the laboratory via overnight delivery service.

3.4 PHASE II ACTIVITIES

Based on the results of the Phase I RI, a Phase II investigation was proposed in December 1985 (Appendix A). The Phase II investigation was approved by U.S. EPA in May 1986. The Phase II field investigation consisted of collecting surface soil samples from 21 locations at the Riverdale site.

The Phase II investigation was conducted in a series of three sampling events. The first event (June 18, 1986) involved collection of 13 surface soil samples from areas in the southern and western portion of the site. The purpose of the sampling was to further define the lateral extent of contamination in these areas, and to resample the Phase I surface soil sample location at SS015. This location had the highest reported concentration (197 ppb) of 2,3,7,8-TCDD during the Phase I sampling event. However the analysis of the sample was determined to be questionable due to interferences caused by other chemical constituents. Therefore, a second sample (SS015-2) was obtained from the same location to better define the 2,3,7,8-TCDD concentration at the location.

The second sampling event occurred on June 23, 1986. Although the Phase II Scope-of-Work indicated that the individual components of a Phase I composite sample would be submitted for analysis, the considerable holding time between actual sample collection (October 20, 1985) and the date of resubmittal for analysis (June 18, 1986) raised QA concerns over the reliability of the analytical results that would be obtained. Therefore, the four locations (SS008, SS009, SS010, and SS011) that comprised the composite sample were resampled for analysis.

The third event (November 17, 1986) involved collection of four surface soil samples (three in the northern portion of the site, and one in the western portion) to further define the lateral extent of contamination in those areas. When consistent with the objectives of the sampling event, an effort was made to sample in topographic low areas where surface drainage might concentrate contaminants.

The methodologies used during the investigation are discussed in the following section.

3.4.1 Surface Soil Sampling

Phase II surface soil samples were collected from 21 locations on and adjacent to the Riverdale property. Locations are shown in Figure 7.

At each sampling location a square approximately 8 X 8 inches was inscribed on the ground surface. If present, grasses were carefully removed from the area prior to sampling. The soil within each area was scraped up with a stainless steel spoon to a depth of approximately one inch and thoroughly composited in a stainless steel tray. The contents of the tray were placed in labeled 120 ml (for 2,3,7,8-TCDD analysis) or 500 ml (for pesticide analysis) amber glass jars with teflon-lined lids. The jar was subsequently decontaminated, placed in a ziplock plastic bag and placed in a cooler until being shipped to the laboratory. Stringent chain-of-custody procedures were observed. Each location was marked with a wooden or metal stake.

Separate stainless steel spoons and trays were used for each sampling site. Sampling equipment was thoroughly decontaminated in a trisodium phosphate/tap water wash followed by a tap water rinse, a pesticide grade methanol rinse and a purified water rinse. The equipment was allowed to air dry following the decontamination procedure.

3.5 SANITARY SEWER SAMPLING

Due to the publicity and controversy generated by the identification of 2,3,7,8-TCDD at the site, and the fact that Riverdale discharges non-contact cooling water from its formulation processes to the sanitary sewer system, the Thorn Creek Sewerage District requested that Riverdale sample the effluent being discharged from the plant. Although this request was not a part of the consent agreement between the U.S. EPA and Riverdale, Riverdale voluntarily complied with the request from the Thorn Creek Sewerage District and provided the U.S. EPA with the analytical data.

On November 20, 1985, an effluent sample was collected from a manhole located on the east side of the main manufacturing building. The sample was collected with a stainless steel beaker attached to the end of a wooden pole. The beaker was previously cleaned with a solution containing trisodium phosphate, and rinsed in pesticide-grade methanol, followed by purified water, and allowed to air dry. The beaker was placed in a sealed plastic bag and transported to the site.

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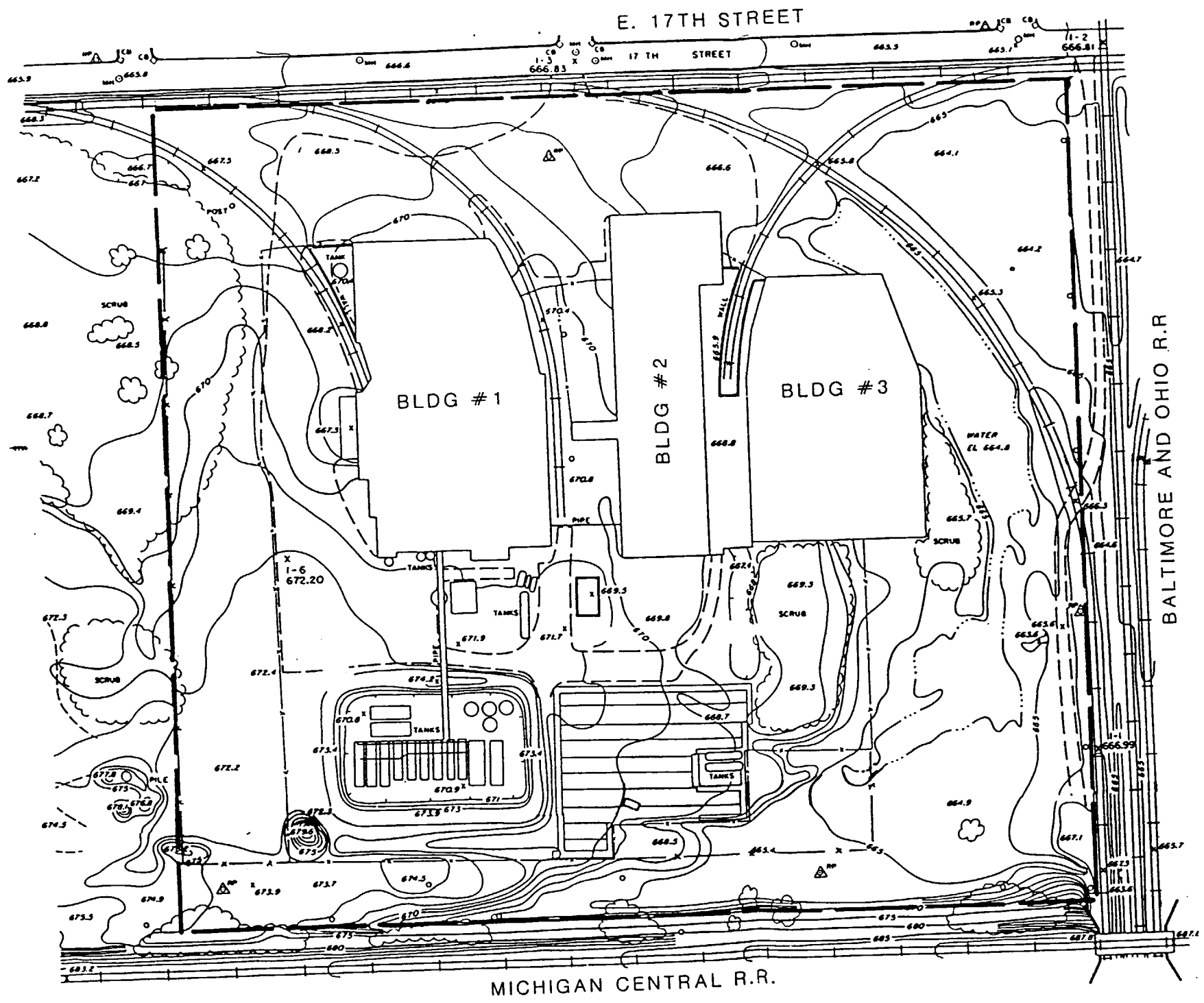

LEGEND

SITE BOUNDARY

N

0 100 200

SCALE IN FEET

FIGURE 3

SITE MAP

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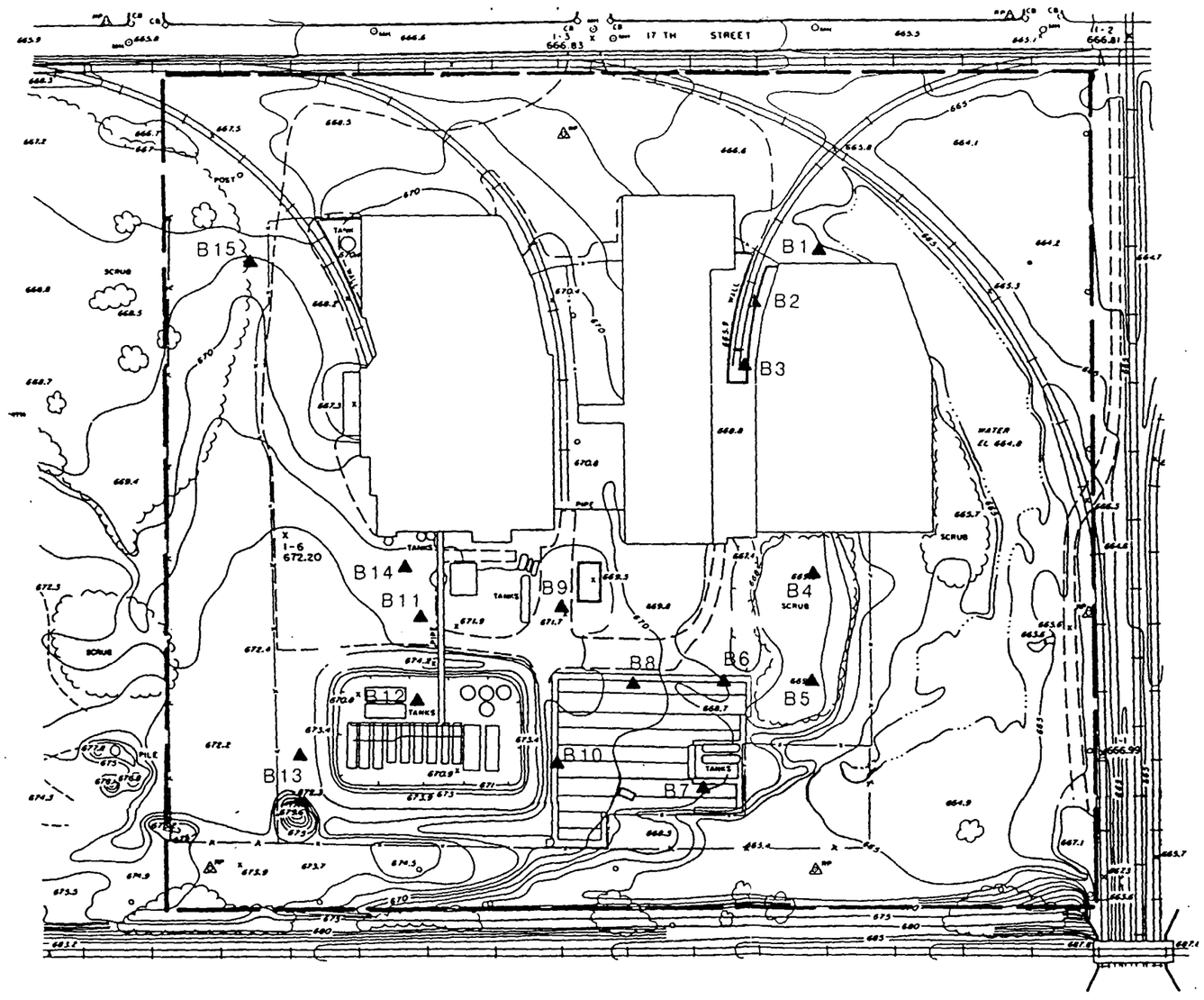

LEGEND

SITE BOUNDARY

▲ SURFACE SOIL SAMPLING LOCATION

N

0 100 200

SCALE IN FEET

FIGURE 4

SAMPLING LOCATIONS
APRIL, 1984 FIT STUDY

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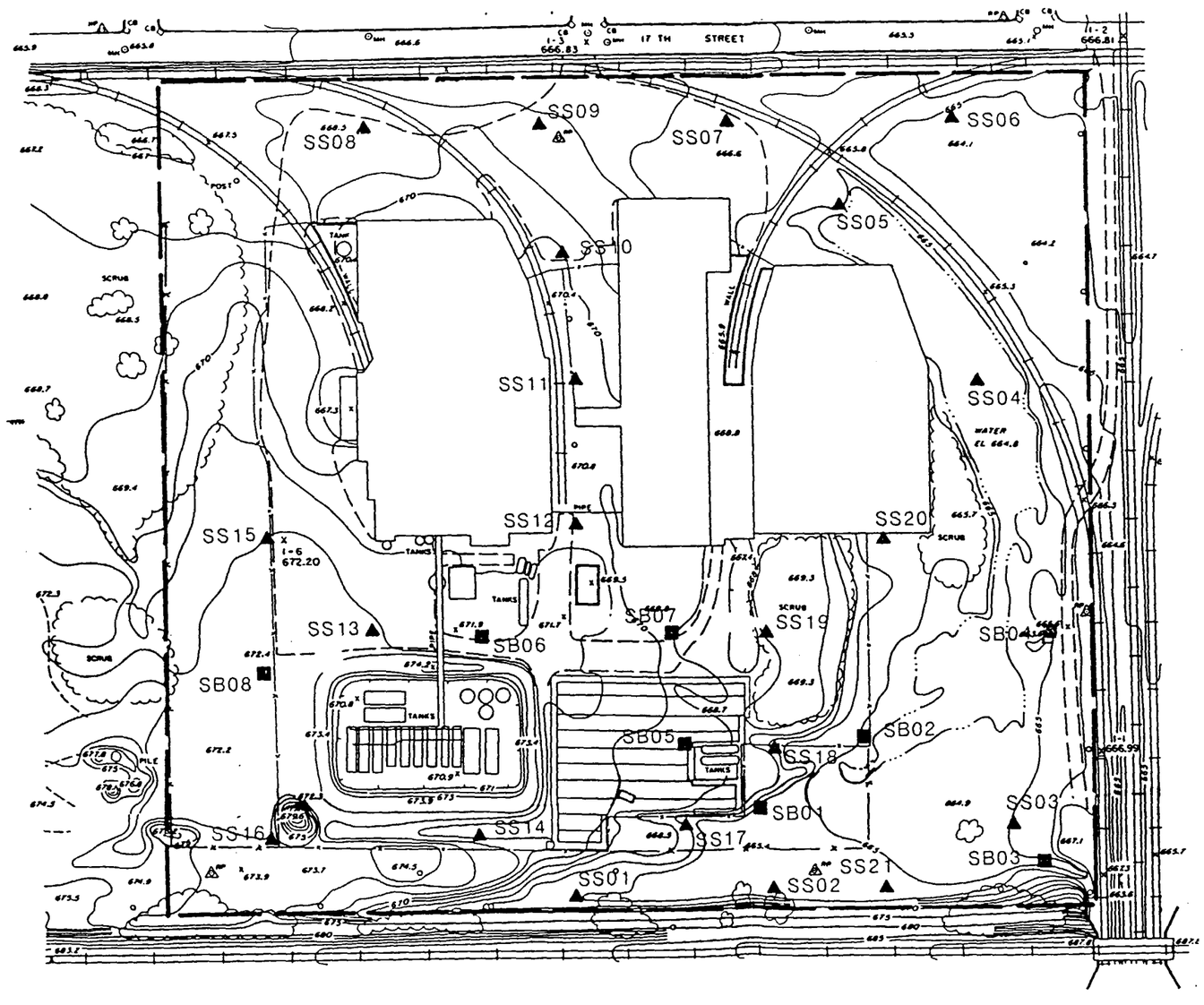

LEGEND

- SITE BOUNDARY
- ▲ SURFACE SOIL SAMPLING LOCATION
- ■ SOIL BORING SAMPLE LOCATION

N

0 100 200

SCALE IN FEET

FIGURE 6

PHASE I
SAMPLING LOCATIONS

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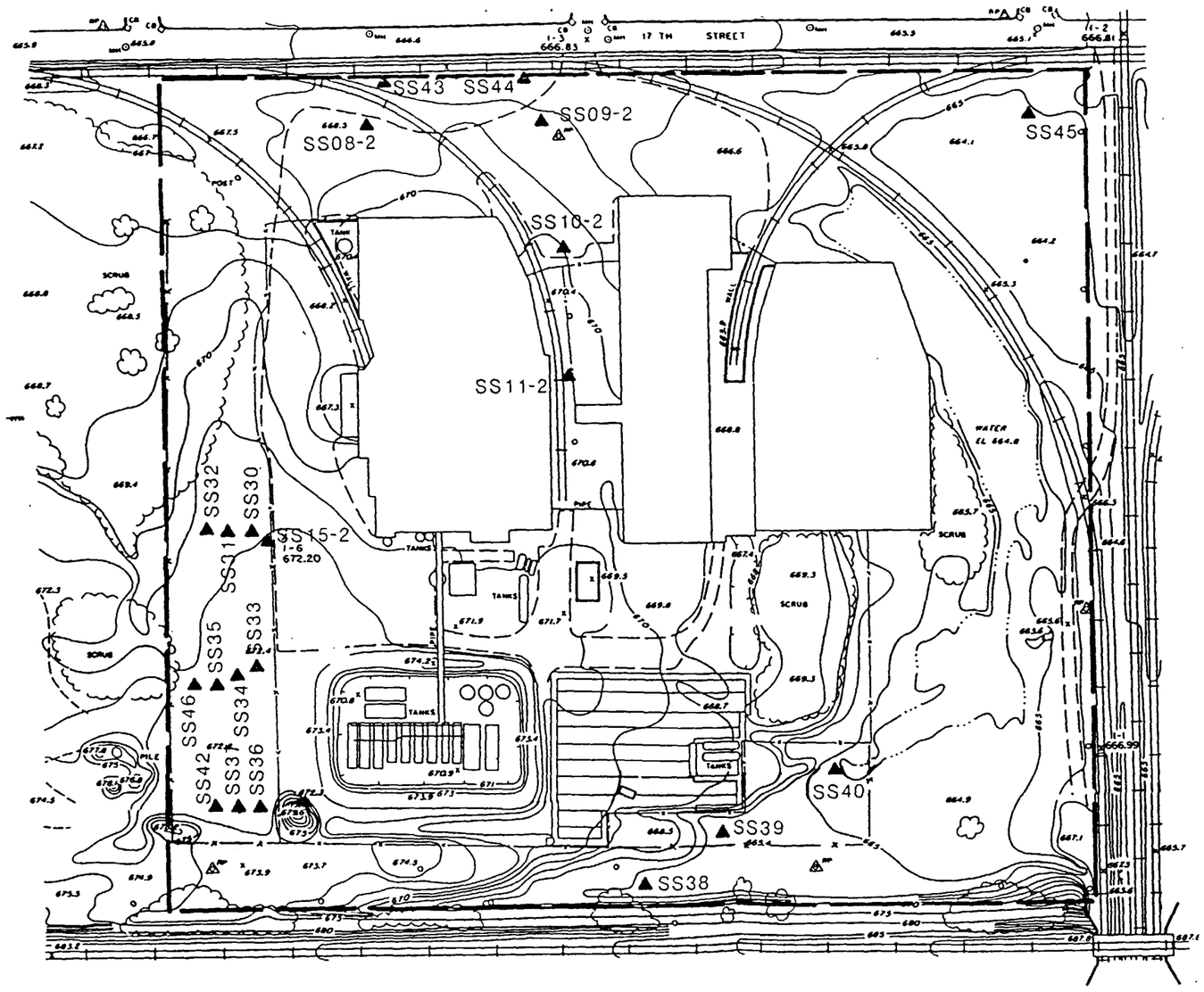

LEGEND

SITE BOUNDARY

▲ SURFACE SOIL SAMPLING LOCATIONS

N

0 100 200

SCALE IN FEET

FIGURE 7

PHASE II SURFACE SOIL SAMPLING LOCATIONS

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The sample was transferred directly to two, one-gallon amber glass bottles with teflon-lined lids. Equal volumes of sample were split between each container to ensure collection of a representative sample. The containers were decontaminated, packed in an iced cooler and shipped to IT's Analytical Laboratory in Knoxville, Tennessee via overnight courier. The laboratory was requested to analyze for 2,3,7,8-TCDD and to obtain the lowest possible detection limit. U.S. EPA Contract Laboratory Program (CLP) protocols were requested.

3.6 AIR SAMPLING

Air samples were collected through use of open-face, glass-fiber filter cassettes worn by two members of the IT investigative team on October 21, 1985. The cassettes were positioned on the team members to allow for the monitoring of the breathing zone. The cassettes were attached to Dupont Air Pumps operating at a sampling rate of three liters-per-minute. The cassettes were worn for an approximate nine hour period during surface soil sampling activities. The cassettes were analyzed for 2,3,7,8-TCDD.

3.7 SAMPLE SELECTION AND ANALYSIS

The following sections detail the sample selection process and the parameters to be analyzed for during the Phase I and Phase II RI activities.

3.7.1 Phase I Samples

As indicated in the QAPP, selected samples would be submitted for analysis of 2,3,7,8-TCDD and Hazardous Substance List (HSL) organics and pesticides. These samples were to be collected from 9 soil borings and 20 surface soil sampling locations. Due to unexpected field conditions, the Sampling Plan and QAPP were modified to substitute an additional surface soil sampling location for a soil boring location. This modification was approved by the U.S. EPA on-site coordinator, Neil Meldgin.

During the Phase I activities, a total of 72 soil samples were collected from the 8 borehole locations, and 21 soil samples were collected from the surface soil sampling locations. Selected samples, according to the following schedule, were then submitted for analysis.

- The eight surface soil samples collected from the northern portions of the site were composited into two samples and analyzed for 2,3,7,8-TCDD.
- The remaining thirteen surface soil samples were analyzed individually for 2,3,7,8-TCDD.
- Sixteen soil boring samples were analyzed for 2,3,7,8-TCDD.
- The twenty-one surface soil samples were composited into six samples and submitted for analysis of HSL organics and pesticides.
- Samples from the eight soil borings were composited into four samples and submitted for analysis of HSL organics.
- Two quality control samples provided by U.S. EPA were submitted for analysis of 2,3,7,8-TCDD.

A total of 36 samples were submitted for analysis of 2,3,7,8-TCDD. This included one duplicate and one blank. Two of the samples were composite surface soil samples as described above. Twelve soil samples were submitted for analysis of HSL organics and pesticides. This included one blank and one duplicate.

The selection of composite samples for analysis was designed to provide coverage of different zones of the site. The zones were very roughly defined on the basis of:

- Obtaining nearly complete areal coverage of the site.
- Resampling of the area where FIT study results indicated contamination.
- Communication with site personnel.

These zones are delineated for surface soils and soil boring soils in Figures 8 and 9, respectively. Table 4 lists surface and soil boring samples submitted for analysis of 2,3,7,8-TCDD and HSL organics and pesticides.

TABLE 4
PHASE I SOIL SAMPLES
SUBMITTED FOR ANALYSIS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

SAMPLE LOCATION	SAMPLING METHOD	SAMPLE I.D. NUMBER	SAMPLE DEPTH (ft)	SAMPLE TYPE	COLLECTION/ PREPARATION DATE	SHIPMENT DATE	LABORATORY (PARAMETERS) / COMMENTS
SURFACE SOIL							
SS-01	SPOON	RIV-SS01-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD) (a)
SS-02	SPOON	RIV-SS02-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-03	SPOON	RIV-SS03-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-12	SPOON	RIV-SS12-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-13	SPOON	RIV-SS13-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-14	SPOON	RIV-SS14-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-15	SPOON	RIV-SS15-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-16	SPOON	RIV-SS16-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-17	SPOON	RIV-SS17-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-18	SPOON	RIV-SS18-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-19	SPOON	RIV-SS19-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-20	SPOON	RIV-SS20-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-21	SPOON	RIV-SS21-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-13	SPOON	RIV-SS22-1	SURFACE	GRAB	10-19-85	10-23-85	ITAS (2,3,7,8-TCDD) / DUPL. OF RIV-SS13-1
SS-04,05,06,07	SPOON	RIV-SS-(04,05,06,07)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB) (b)
					10-21-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-08,09,10,11	SPOON	RIV-SS-(08,09,10,11)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB)
					10-21-85	10-23-85	ITAS (2,3,7,8-TCDD)
SS-01,02,17,18	SPOON	RIV-SS-(01,02,17,18)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB)
SS-03,19,20,21	SPOON	RIV-SS-(03,19,20,21)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB)
SS-12,13,14	SPOON	RIV-SS-(12,13,14)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB)
SS-15,16	SPOON	RIV-SS-(15,16)-1	SURFACE	COMPOSITE	10-19-85	10-22-85	ITAS (VOC,BNA,PEST./PCB)
SS-04,05,06,07	SPOON	RIV-SS-(22,23,24,25)-1	SURFACE	COMPOSITE	10-19-85	10-21-85	ITAS (VOC,BNA,PEST./PCB) / DUPL. OF RIV-SS-(04,05,06,07)-1
---	SPOON	RIV-SS23-1	---	GRAB	10-22-85	10-23-85	ITAS (VOC,BNA,PEST./PCB) / SAMPLE BLANK
---	---	RDC-1	---	---	10-18-85	10-23-85	ITAS (2,3,7,8-TCDD) / QC SAMPLE PROVIDED BY U.S. EPA
---	---	RDC-2	---	---	10-18-85	10-23-85	ITAS (2,3,7,8-TCDD) / QC SAMPLE PROVIDED BY U.S. EPA

TABLE 4
PHASE I SOIL SAMPLES
SUBMITTED FOR ANALYSIS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

SAMPLE LOCATION	SAMPLING METHOD	SAMPLE I.D. NUMBER	SAMPLE DEPTH (ft)	SAMPLE TYPE	COLLECTION/ PREPARATION DATE	SHIPMENT DATE	LABORATORY (PARAMETERS) / COMMENTS
SOIL BORINGS							
SB01	SPLIT BARREL	RIV-SB01-1.5-1	0.0-1.5	GRAB	10-15-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB01	SPLIT BARREL	RIV-SB01-6.5-1	5.0-6.5	GRAB	10-15-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB02	SPLIT BARREL	RIV-SB02-1.5-1	0.0-1.5	GRAB	10-15-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB02	SPLIT BARREL	RIV-SB02-6.0-1	4.5-6.0	GRAB	10-15-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB03	SPLIT BARREL	RIV-SB03-1.5-1	0.0-1.5	GRAB	10-16-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB03	SPLIT BARREL	RIV-SB03-6.0-1	4.5-6.0	GRAB	10-16-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB04	SPLIT BARREL	RIV-SB04-1.5-1	0.0-1.5	GRAB	10-16-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB04	SPLIT BARREL	RIV-SB04-6.0-1	4.5-6.0	GRAB	10-16-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB05	SPLIT BARREL	RIV-SB05-3.0-1	1.5-3.0	GRAB	10-21-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB05	SPLIT BARREL	RIV-SB05-7.5-1	6.0-7.5	GRAB	10-21-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB06	SPLIT BARREL	RIV-SB06-3.0-1	1.5-3.0	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB06	SPLIT BARREL	RIV-SB06-8.0-1	6.5-8.0	GRAB	10-18-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB07	SPLIT BARREL	RIV-SB07-1.5-1	0.0-1.5	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB07	SPLIT BARREL	RIV-SB07-6.0-1	4.5-6.0	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB08	SPLIT BARREL	RIV-SB08-1.5-1	0.0-1.5	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB08	SPLIT BARREL	RIV-SB08-4.5-1	3.0-4.5	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD)
SB08	SPLIT BARREL	RIV-SB09-0.0-1	3.0-4.5	GRAB	10-17-85	10-23-85	ITAS (2,3,7,8-TCDD) / DUPL. OF RIV-SB08-4.5-1
—	—	RIV-SB10-0.0-1	—	GRAB	10-22-85	10-23-85	ITAS (2,3,7,8-TCDD) / SAMPLE BLANK
SB01,02	SPLIT BARREL	RIV-SB-(01,02)-1	0.0-1.5	COMPOSITE	10-21-85	10-21-85	ITAS (VOC,BNA,PEST./PCB)
SB03,04	SPLIT BARREL	RIV-SB-(03,04)-1	0.0-1.5	COMPOSITE	10-21-85	10-21-85	ITAS (VOC,BNA,PEST./PCB)
SB05,06	SPLIT BARREL	RIV-SB-(05,06)-1	1.5-3.0	COMPOSITE	10-21-85	10-21-85	ITAS (VOC,BNA,PEST./PCB)
SB07,08	SPLIT BARREL	RIV-SB-(07,08)-1	0.0-1.5	COMPOSITE	10-21-85	10-21-85	ITAS (VOC,BNA,PEST./PCB)

(a) - INDICATES SAMPLE WAS SHIPPED TO IT ANALYTICAL SERVICES OF KNOXVILLE, TN FOR 2,3,7,8-TCDD ANALYSIS
(b) - INDICATES SAMPLE WAS SHIPPED TO IT ANALYTICAL SERVICES OF KNOXVILLE, TN FOR VOLATILE ORGANIC COMPOUND, BASE NEUTRAL/ACID EXTRACTABLE, AND PESTICIDE/PCB ANALYSES

Selection of boring samples was based on zones of visual contamination and readings of the HNu. In general, a sample was selected from the upper one and one-half feet of each boring, with the rationale being that this is the zone in which the highest levels of contamination would be expected. In those instances where recovery was poor, the sample was collected from the next sampling interval. To define the lower boundary of vertical migration, a sample was selected for analysis from the first interval of natural soil in each boring which appeared visually free of contamination. The rationale for the sample selection was that 2,3,7,8-TCDD would only migrate to the extent of the observed contaminant front due to its hydrophobic nature. All soil boring composite samples were comprised of the uppermost sampling interval (0.0-1.5) of each boring except where recovery was poor, in which case the composite was made up of soils in the 1.5-3.0 foot interval.

All samples were analyzed by IT Analytical Services of Knoxville, Tennessee. U.S. EPA CLP protocol was followed for all analytical work. A more detailed discussion of the sample selection and analytical methods is included in Appendix E, Preliminary Assessment, Phase I Remedial Investigation. A quality assurance/quality control (QA/QC) review of the analytical data is presented in Appendix F.

3.7.2 Phase II Samples

The Phase II samples collected during the three sampling events were submitted for analysis according to the following schedule:

- o June 18, 1986 Event
  - The three samples (SS038, SS039, SS040) collected along the southern portion of the site were submitted for analysis of 2,3,7,8-TCDD.
  - Samples SS015-2, SS030, SS031, SS033, SS034, SS036, and SS037 collected from the western portion of the site were submitted for HSL pesticide and 2,3,7,8-TCDD analyses.
  - In accordance with the Scope-of-Work, samples SS032, SS035 and SS042 were stored pending the results from the other samples collected in the western portion of the site. Sample SS035 was ultimately submitted for

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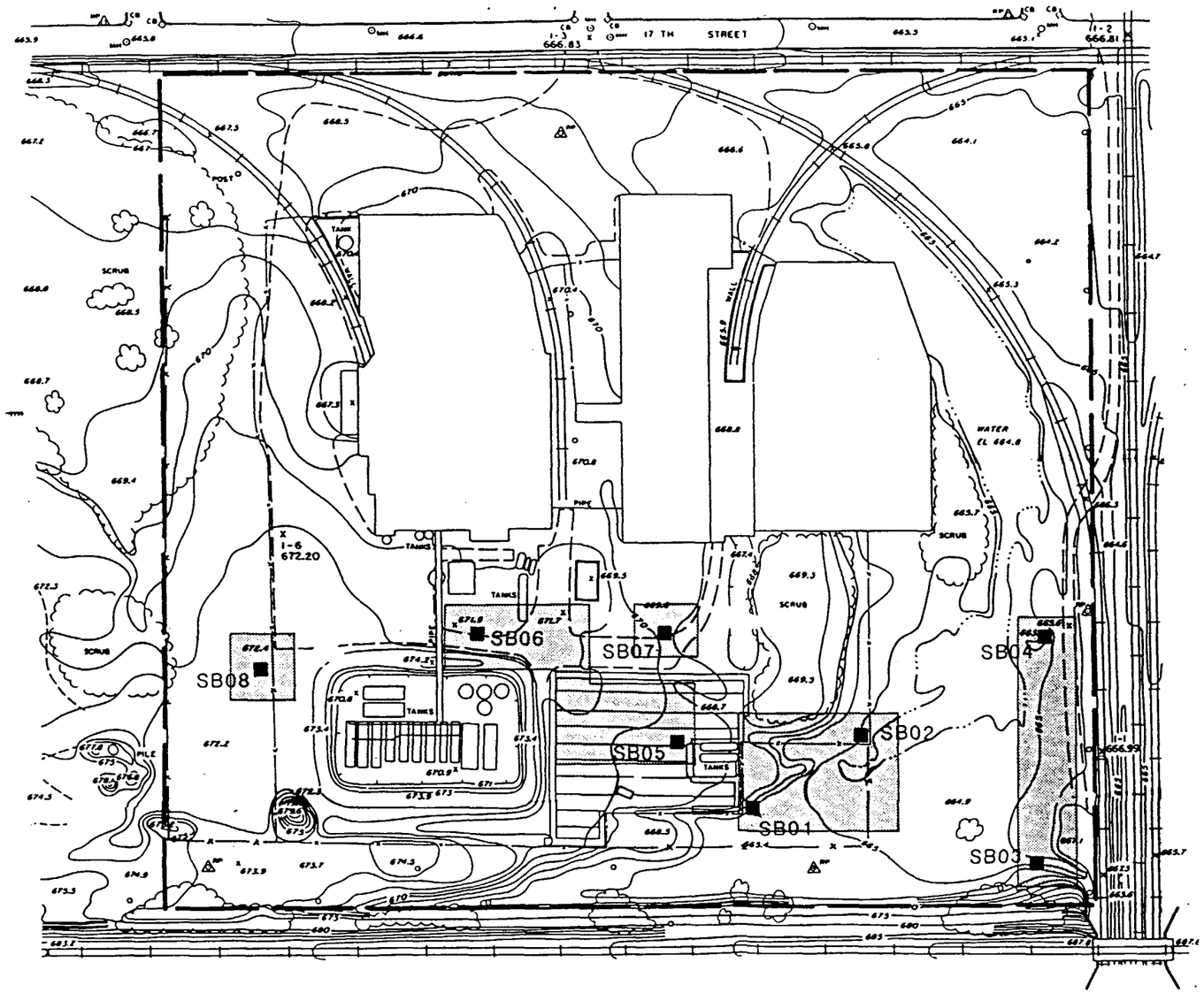
	5-14-87	APPROVED BY	RNS	5-28-87	302108-B12



LEGEND

- SITE BOUNDARY
- SOIL BORING LOCATION
- COMPOSITE AREA

N

0 100 200

SCALE IN FEET

FIGURE 9

SOIL BORING COMPOSITES

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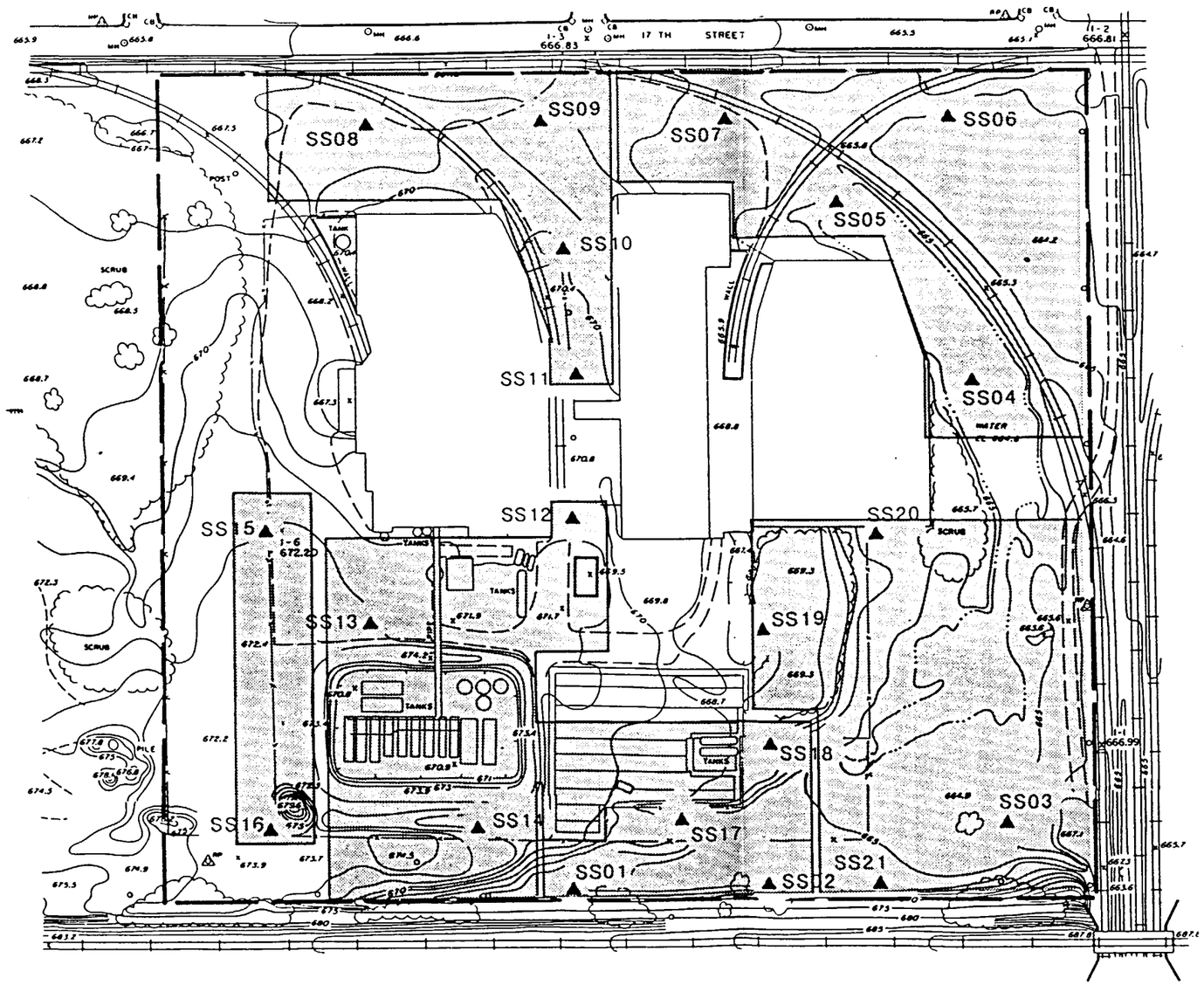

LEGEND

- SITE BOUNDARY
- ▲ SURFACE SOIL SAMPLING LOCATION
- COMPOSITE AREA

N

0 100 200

SCALE IN FEET

FIGURE 8

SURFACE SOIL COMPOSITES

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analysis of HSL pesticides and 2,3,7,8-TCDD on August 18, 1986. The remaining samples were not submitted for analysis.

- o June 23, 1986 Event
  - The four samples collected (SS008-2, SS009-2, SS010-2, and SS011-2) were submitted for analysis of HSL pesticides.
- o November 17, 1986 Event
  - The three samples collected from the northern site area (SS043, SS044 and SS045) were submitted for analysis of HSL pesticides.
  - The one sample collected from the western site area (SS046) was submitted for analysis of HSL pesticides and 2,3,7,8-TCDD.

Table 5 summarized the samples submitted and the parameters analyzed for. All samples were analyzed by IT Analytical Services of Knoxville, Tennessee. U.S. EPA CLP protocol was followed for all analytical work.

A more detailed discussion of the sample selection and analytical methods is included in Appendix G, Phase II Remedial Investigation. QA/QC review of the data is included in Appendix F.

TABLE 5
PHASE II SOIL SAMPLES
SUBMITTED FOR ANALYSIS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

SAMPLE LOCATION	SAMPLING METHOD	SAMPLE I.D. NUMBER	SAMPLE DEPTH (ft)	SAMPLE TYPE	COLLECTION DATE	SHIPMENT DATE	LABORATORY (PARAMETERS) / COMMENTS
SURFACE SOIL							
SS-08	SPOON	RIV-SS08-2	SURFACE	GRAB	6-23-86	6-23-86	ITAS (PESTICIDE) (a)
SS-09	SPOON	RIV-SS09-2	SURFACE	GRAB	6-23-86	6-23-86	ITAS (PESTICIDE)
SS-10	SPOON	RIV-SS10-2	SURFACE	GRAB	6-23-86	6-23-86	ITAS (PESTICIDE)
SS-11	SPOON	RIV-SS11-2	SURFACE	GRAB	6-23-86	6-23-86	ITAS (PESTICIDE)
SS-15	SPOON	RIV-SS15-2	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD) (b)
SS-30	SPOON	RIV-SS30-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-31	SPOON	RIV-SS31-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-33	SPOON	RIV-SS33-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-34	SPOON	RIV-SS34-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-35	SPOON	RIV-SS35-1	SURFACE	GRAB	6-18-86	8-18-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-36	SPOON	RIV-SS36-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-37	SPOON	RIV-SS37-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
SS-38	SPOON	RIV-SS38-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (2,3,7,8-TCDD) (c)
SS-39	SPOON	RIV-SS39-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (2,3,7,8-TCDD)
SS-40	SPOON	RIV-SS40-1	SURFACE	GRAB	6-18-86	6-19-86	ITAS (2,3,7,8-TCDD)
---	SPOON	RIV-SS41-1	---	GRAB	6-18-86	6-19-86	ITAS (PESTICIDE, 2,3,7,8-TCDD) / SAMPLE BLANK
SS-43	SPOON	RIV-SS43-1	SURFACE	GRAB	11-17-86	11-17-86	ITAS (PESTICIDE)
SS-44	SPOON	RIV-SS44-1	SURFACE	GRAB	11-17-86	11-17-86	ITAS (PESTICIDE)
SS-45	SPOON	RIV-SS45-1	SURFACE	GRAB	11-17-86	11-17-86	ITAS (PESTICIDE)
SS-46	SPOON	RIV-SS46-1	SURFACE	GRAB	11-17-86	11-17-86	ITAS (PESTICIDE, 2,3,7,8-TCDD)
---	SPOON	RIV-SS47-1	---	GRAB	11-17-86	11-17-86	ITAS (PESTICIDE, 2,3,7,8-TCDD) / SAMPLE BLANK

(a) - INDICATES SAMPLE WAS SHIPPED TO IT ANALYTICAL SERVICES OF KNOXVILLE, TN FOR PESTICIDE ANALYSIS
(b) - INDICATES SAMPLE WAS SHIPPED TO IT ANALYTICAL SERVICES OF KNOXVILLE, TN FOR PESTICIDE AND 2,3,7,8-TCDD ANALYSES
(c) - INDICATES SAMPLE WAS SHIPPED TO IT ANALYTICAL SERVICES OF KNOXVILLE, TN FOR 2,3,7,8-TCDD ANALYSIS

4.0 SITE ASSESSMENT

This chapter describes the site environmental media investigated and characterizes the contaminants detected in the various media.

4.1 HYDROGEOLOGIC INVESTIGATION

The hydrogeologic investigation portion of the RI consisted of two parts, a literature survey, and exploratory borings with soil sampling. The exploratory borings and sampling were conducted during the Phase I field activities. The methodology used during the soil boring and sampling activities is described in Section 3.3.1.

4.1.1 Geology

According to the United States Department of Agriculture (USDA) Soil Survey of DuPage and Part of Cook Counties, Illinois (Mapes, 1979), the land surface at and near the site is classified as Urban Land-Orthents complex, clayey. In general, this unit is comprised of less than 75 percent Urban land, with the remaining portion being Orthents, clayey.

In the Urban land portion of the unit, the landscape has been radically altered. The Urban land is covered by buildings, parking lots, and pavements. Most areas are nearly level to gently sloping as a result of extensive grading, cutting and filling.

The Orthents, clayey portion of the unit consists of fine textured soils that have been altered or mixed by cutting and filling. The soils formerly had a surface layer of silty loam to silty clay material with a subsoil of silty clay or clay materials. The underlying material is generally calcareous silty clay loam or silty clays. These soils have generally been graded so that water drains to the edges of lots or sewer systems. Some low spots and excavations in undeveloped areas of Orthents, clayey soils collect water and are slow to dry out.

The unconsolidated deposits at the site are composed of glacially-derived ground and end moraine deposits of the late Wisconsinan Age. In general, these moraines are composed of unsorted glacial tills containing boulders,

sand, silt, and clay. The deposits at the site have been derived from a silty clay loam till material (Fehrenbacher, 1967). A review of well logs in the area of the site indicate that the unconsolidated deposits attain a thickness of approximately 35 feet. Silurian-age dolomitic limestone of the Niagara formation underlie the unconsolidated deposits.

Site-specific investigations revealed that the site is underlain by approximately two to five feet of fill material which directly overlay very stiff, yellowish brown to gray silty clay. The fill material consists of gravel, cinders, ash, brick and wood fragments. A relatively thin, discontinuous layer of brown sand to yellowish silty sand was encountered between the fill and the silty clay materials in three of the eight borings conducted on-site.

Edited boring logs and definitions of geotechnical terms used on the logs and in the text are included in Appendix D. Figure 10 presents a cross-section of the site based on five of the edited boring logs.

4.1.2 Ground Water

Four aquifer systems are present in Cook County, Illinois, three of which are regionally extensive. In descending order, these are:

- Sand and gravel deposits of the glacial till
- Shallow dolomite formations, primarily of Silurian-age
- The Cambrian-Ordovician Aquifer
- The Mt. Simon Aquifer (Suter, 1959).

The sand-and-gravel aquifer is regionally extensive in the northwest portion of Cook County, and only locally present in buried bedrock valleys in other portions of the county. Site-specific investigations and a review of well logs in the area of the site indicate that the sand-and-gravel aquifer is not present at or in the area of the site.

The shallow dolomite formations represent the first regionally extensive aquifer in the county. Where present, the sand-and-gravel aquifer is hydrologically connected with the shallow dolomite aquifer. Ground water in the aquifer occurs in joints, fissures and solution channels within the dolomite. The upper portion of the dolomite formation is generally the most productive

for well development. Regionally, the ground water flow in the shallow dolomite aquifer is to the southeast, however, due to extensive pumpage of the ground water for municipal and industrial use, local ground water flow directions vary greatly.

A review of well logs in the area of the site indicate that the shallow dolomite aquifer is the uppermost aquifer at the site. Water levels within the dolomite are generally at or below the top of rock. Exploratory borings conducted at the site were advanced to depths of approximately 14 feet below ground surface. Ground water was not encountered in any of the borings.

The Cambrian-Ordovician and Mt. Simon aquifers are separated from the dolomite aquifer by relatively impermeable shales. These shales cause the lower aquifers, composed primarily of sandstones, to be under confined conditions.

4.2 ATMOSPHERIC INVESTIGATION

The atmospheric investigation consisted of two parts, these being a literature survey and collecting of air samples. The air samples were collected during the Phase I field activities. The methodology used during the sample collection is presented in Section 3.6.

The results of the literature survey are presented in Section 2.4, Climatology, and in Appendix B.

It should also be noted that the U.S. EPA conducted an investigation of the site on October 2, 1985, to determine the potential for entrainment and transport of dioxin-contaminated particulate beyond the site boundaries. The investigation concluded that the site was well-controlled against the potential of particulate entrainment due to a large groundcover tarp, dense vegetation, and gravel cover at the site. A copy of the U.S. EPA results is included in Appendix B.

4.3 CHEMICAL CONCENTRATIONS IN THE ENVIRONMENTAL MEDIA

Chemical constituents were detected in only two of the environmental media investigated, these being soils at the site and the sanitary discharge from the site. This section summarizes the concentration values and ranges detected.

4.3.1 Soils

The analytical results for the soil samples and field blanks collected during the Phase I and Phase II events are presented in Tables 6 through 9. QA/QC review of the analytical data is presented in Appendix F.

The Phase I soil samples were analyzed for VOCs, Semi-Volatile Base Neutral/ Acid Extractable (BN/A) organics, pesticides, Polychlorinated Biphenyls (PCBs), and 2,3,7,8-TCDD (Tables 6 and 7). Based on the results of the Phase I analyses, the Phase II soil samples were analyzed only for pesticides and 2,3,7,8-TCDD (Tables 8 and 9).

Nine VOCs were detected in the Phase I soil samples. In general, the compounds detected had estimated values exceeding zero but less than the specified detection limits. Exceptions to this were methylene chloride, 2-butanone, and total xylenes. Both methylene chloride and 2-butanone were also detected in the method blank and are considered to be the result of laboratory contamination. Total xylene concentrations ranged from 11 ppb to 39 ppb. Total xylenes were detected in only two surface soil composite samples.

Twenty-two BN/A compounds were detected in the Phase I soil samples. The compounds detected were primarily phthalates, PAHs, and phenols. The phthalates were also detected in the method blank. The phenolic compound detected was 2,4-dichlorophenol which appeared in two surface soil composite samples at concentrations of 470 ppb and 520 ppb.

Fifteen PAHs were detected in both surface soil composite samples and soil boring samples. Concentrations for the PAH compounds ranged from estimated values exceeding zero but below the specific detection limit to 7,200 ppb for fluoranthene.

TABLE 6
PHASE I - 2,3,7,8-TCDD
SOIL CONCENTRATION ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

SAMPLE I.D. NUMBER	2,3,7,8-TCDD CONC. (ppb)
SS01	1.6
SS02	ND
SS03	ND
SS(04,05,06,07)	ND
SS(08,09,10,11)	ND
SS12	ND
SS13	3.6
SS14	7.7
SS15	197
SS16	1.1
SS17	9.6
SS18	10.5
SS19	5.1
SS20	ND
SS21	ND
SS22*	3.8
SB01-1.5	ND
SB01-6.5	ND
SB02-1.5	ND
SB02-6.0	ND
SB03-1.5	ND
SB03-6.0	ND
SB04-1.5	ND
SB04-6.0	ND
SB05-3.0	26.0
SB05-7.5	ND
SB06-3.0	33.7
SB06-8.0	0.80
SB07-1.5	1.4
SB07-6.0	ND
SB08-1.5	ND
SB08-4.5	ND
SB09-0.0**	ND
SB10-0.0***	ND
RDC-1****	ND
RDC-2****	4.8

SS - SURFACE SOIL SAMPLE
SB - SOIL BORING SAMPLE. NUMBER SUCCEEDING HYPHEN IS DEPTH FROM WHICH SAMPLE WAS COLLECTED.
ND - SAMPLE WAS ANALYZED FOR 2,3,7,8-TCDD BUT NOT DETECTED
* - SAMPLE IS DUPLICATE OF SS13
** - SAMPLE IS DUPLICATE OF SB04-6.0
*** - SAMPLE IS A TRAVEL BLANK
**** - QC SAMPLE PROVIDED BY U.S. EPA

TABLE 7
PHASE I SOIL ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

PARAMETER (ppb)	COMPOSITE SAMPLE I.D. NUMBER											
	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	SS (22,23,24,25)*	SS 23**	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
VOLATILES												
CHLOROBENZENE				2.1 J						3.5 J		
ETHYLBENZENE			2.0 J				2.9 J					
METHYLENE CHLORIDE	55 B	33 B	16 B	58 B	20 B	91 B	28 B	70 B	34 B	83 B	52 B	68 B
TETRACHLOROETHENE				3.9 J					1.8 J	4.3 J		1.6 J
TOLUENE				1.6 J					4.0 J	14		4.3 J
VINYL CHLORIDE			1.4 J,B									
ACETONE	68							160				
2-BUTANONE	21 B	13 B	13 B	8.7 J,B	9.8 J,B	10 B	10 B	28 J,B	11 B	10 B	9.0 J,B	8.9 J,B
TOTAL XYLENES	11		24				39					
SEMI-VOLATILES												
2,4-DICHLOROPHENOL			470				520					
PENTACHLOROPHENOL								210				
BENZOIC ACID								800				
2-METHYLPHENOL			300 J				310 J					
ACENAPHTHENE												150 J
FLUORANTHENE	5,000 J	3,600	930	1,700 J	4,600	4,600 J	600		560	1,800		7,200
NAPHTHALENE		300 J			170 J				160 J	520		160 J
BIS(2-ETHYLHEXYL)PHTHALATE	2,100 J	1,100	1,300		320		1,400	290	180 J	450		450
BUTYL BENZYL PHTHALATE		800	340		670		660		1,400	610		680
DI-N-BUTYL PHTHALATE		1,100 B	1,200 B		500 B		1,400 B	1,900 B	1,400 B	1,000 B		1,200 B
BENZO(A)ANTHRACENE	6,800 J,B	2,400	900		1,700		1,400		380	1,200		5,800
BENZO(A)PYRENE		2,000	930		2,000	1,900 J	1,300		410	970		4,000
BENZO(B)FLUORANTHENE		1,600	770		2,500		1,500		390	1,100		2,800
BENZO(K)FLUORANTHENE		1,600	770		2,500		1,500		390	1,100		2,800
CHRYSENE		2,800	1,300		4,100		1,700		500	1,500		6,100
ACENAPHTHYLENE		240 J	230 J				290			95 J		260 J
ANTHRACENE		490	320 J				350		150 J	270 J		1,100
BENZO(GHI)PERYLENE		990	590		1,200		960		240 J	330 J		1,900
FLUORENE					190		200 J					320 J
PHENANTHRENE		1,900	820		4,900		750		640	2,000		4,900
INDENO(1,2,3-C,D)PYRENE		1,100	540		1,300		880		210 J	320 J		1,900
PYRENE		3,800	900		6,800		1,100		700	2,000		8,700
DIBENZOFURAN					120 J							
2-METHYLNAPHTHALENE		640			290 J				250 J	720		300 J

TABLE 7
PHASE I SOIL ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

PARAMETER (ppb)	COMPOSITE SAMPLE I.D. NUMBER											
	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	SS (22,23,24,25)*	SS 23**	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
PESTICIDES/PCB'S												
ALDRIN	92,000 C	64 C	5,300 C	220,000 C	1,700 C	530,000 C	7,800 C				170,000 C	3,700 C
DIELDRIN	79,000 C	910 C	2,900 C	210,000 C	4,100 C	57,000 C	3,300 C		74	220	200,000 C	3,700 C
CHLORDANE	100,000 C,S	350 C,S	12,000 C,S	67,000 C,S	3,900 C,S	1,100,000 C	18,000 C,S			210 S	46,000 C,S	28,000 C
4,4'-DDT	25,000 C	450 C		13,000 C	4,200 C	33,000 C			120	940 C	2,300	1,400 C
4,4'-DDE	4,900	140	460		620 C		710		52	630		
4,4'-DDD	37,000 C		960 C	18,000 C	720 C		1,500 C			220	18,000 C	
ENDRIN KETONE	1,800		210	870 C	160 C	6,100					4,700	100
HEPTACHLOR	18,000 C	31 C	1,300 C	63,000 C	1,000 C	64,000 C	21,000 C				7,800	2,700 C
HEPTACHLOR EPOXIDE	2,700	80	410		280		600		93	160		
ALPHA-BHC		21			14	2,600						
BETA-BHC	2,400	21			120							
GAMMA-BHC (LINDANE)		58			32							
METHOXYCHLOR							7,100 C					

* - SAMPLE IS A DUPLICATE OF SS(04,05,06,07)
** - SAMPLE IS A FIELD BLANK
SS - SURFACE SOIL SAMPLE
SB - SOIL BORING SAMPLE
J - INDICATES AN ESTIMATED VALUE EXCEEDING ZERO BUT LESS THAN THE SPECIFIED DETECTION LIMIT
B - INDICATES ANALYTE WAS FOUND IN THE BLANK AS WELL AS THE SAMPLE
C - APPLIES TO PESTICIDE PARAMETERS WHERE THE IDENTIFICATION HAS BEEN CONFIRMED BY GC/MS
S - INDICATES VALUE IS THE SUM OF ALPHA AND GAMMA CHLORDANES DUE TO ALTERATION IN PATTERN

TABLE 8
PHASE II SOIL ANALYTICAL RESULTS
JUNE 18 AND 23, 1986 EVENT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

PARAMETER (ppb)	SAMPLE I.D. NUMBER															
	SS08-2	SS09-2	SS10-2	SS11-2	SS15-2	SS30	SS31	SS33	SS34	SS35	SS36	SS37	SS38	SS39	SS40	SS41*
PESTICIDES																
ALDRIN	120	18	120,000	91,000	18,000	170	20	9,500	61,000	26,000	5,500		--	--	--	--
DIELDRIN	2,300	49	120,000	190,000		1,000	380	12,000	27,000	16,000	8,400	210	--	--	--	--
CHLORDANE	1,900	190	90,000	68,000	120,000	860	310	19,000	180,000	340,000	26,000	170	--	--	--	--
4,4'-DDT	890		9,300	27,000		220	170	310		16,000	4,300	93	--	--	--	--
4,4'-DDD	300	20	7,100		25,000				32,000				--	--	--	--
ENDRIN	110												--	--	--	--
ENDRIN KETONE	180	77	6,000	13,000				330		1,900			--	--	--	--
HEPTACHLOR	570	33	51,000	16,000	28,000	91	29	8,700	38,000		6,000	18	--	--	--	--
HEPTACHLOR EPOXIDE	210					300	250	1,800			3,000	100	--	--	--	--
GAMMA-BHC (LINDANE)	11												--	--	--	--
METHOXYCHLOR											3,400		--	--	--	--
SPECIAL ANALYSIS																
2,3,7,8-TCDD	--	--	--	--	14.6		0.18	5.8	15.9/12.0	16.2	8.4		12.9	5.6		

* - FIELD BLANK FOR 2,3,7,8-TCDD
-- - PARAMETER NOT ANALYZED FOR

TABLE 9
PHASE II SOIL ANALYTICAL RESULTS
NOVEMBER 17, 1986 EVENT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

PARAMETER (ppb)	SAMPLE I.D. NUMBER				
	SS43	SS44	SS45	SS46	SS47*
PESTICIDES					
ALDRIN	1,000	1,100	26	1,700	
DIELDRIN	11,000	5,000	86	4,400	
CHLORDANE	17,000	9,000	130	19,000	
4,4'-DDT	16,000	3,600	110	2,600	
4,4'-DDE	3,500	1,100		690	
4,4'-DDD	19,000	1,400			
ENDRIN	5,100	110			
ENDRIN KETONE	4,800	330		420	
HEPTACHLOR	3,200	1,700	19	5,900	
HEPTACHLOR EPOXIDE	800	510	46	1,800	
ALPHA-BHC				23	
LINDANE	130	36			
SPECIAL ANALYSIS					
2,3,7,8-TCDD	---	---	---	1.6	

* - SAMPLE BLANK
--- - SAMPLE NOT ANALYZED FOR 2,3,7,8-TCDD

Thirteen chlorinated pesticide compounds were detected in the Phase I samples, while twelve chlorinated pesticide compounds were detected in the Phase II samples. The Phase I samples, taken primarily from the plant area, had a fairly uniform distribution of compounds, with concentrations ranging from 14 ppb for alpha-BHC to 1,100,000 ppb for chlordane. Concentrations in the Phase II samples ranged from 11 ppb for gamma-BHC to 340,000 ppb for chlordane.

PCB compounds were not detected in the Phase I or Phase II samples.

Concentrations of 2,3,7,8-TCDD ranged from not detected to 33.7 ppb in the Phase I samples. The areal distribution of the 2,3,7,8-TCDD was limited to the southern portion of the site. One surface soil sample (SS15) exhibited a concentration of 197 ppb of 2,3,7,8-TCDD. However, due to interference caused by other chemical constituents during analysis, this result is considered suspect. A resampling of the location during Phase II exhibited a concentration of 14.6 ppb 2,3,7,8-TCDD.

Concentrations of 2,3,7,8-TCDD were not detected in soil borings SB01, SB02, SB03, SB04 and SB08. In boring SB05, a concentration level of 26 ppb 2,3,7,8-TCDD was detected in the 1.5-3.0 foot sampling interval; however, there was no detection of 2,3,7,8-TCDD in the 6.0-7.5 foot sampling interval. Likewise, boring SB07 had a 2,3,7,8-TCDD concentration of 1.4 ppb in the 0.0-1.5 foot sampling interval with no detection of 2,3,7,8-TCDD in the 4.5-6.0 foot sampling interval. The analytical results of the two samples submitted for SB06 indicated a 2,3,7,8-TCDD concentration of 33.7 ppb in the 1.5-3.0 foot sampling interval and 0.8 ppb in the 6.5-8.0 foot sampling interval.

SB06 is the only boring where the deeper sampling interval contained detectable concentrations of 2,3,7,8-TCDD. The presence of 2,3,7,8-TCDD at this level in the boring appears to be suspect however due to difficulties encountered while drilling the borehole. As indicated in the boring log for SB06, the upper portion of the boring consisted of bricks, rocks, and cinders in a wet sandy gravel matrix. Difficulties were encountered in attempting to keep this material from entering the lower portions of the boring during

drilling operations, and the detection of 2,3,7,8-TCDD at the lower sampling interval may be the result of the inability to entirely keep this material out of the boring.

Concentrations of 2,3,7,8-TCDD in the Phase II samples ranged from 0.18 ppb to 16.2 ppb. The concentration of 2,3,7,8-TCDD decreased with distance from the plant. Figure 11 presents the spatial distribution of 2,3,7,8-TCDD at the site based on the Phase I and Phase II surface soil samples.

4.3.2 Sanitary Sewer Discharge

One sanitary sewer effluent sample was collected from the site during the RI. This sample was collected from a manhole located on the east side of the main manufacturing building. The sample was analyzed for 2,3,7,8-TCDD only. A concentration of 2.4 parts-per-trillion (ppt) was detected.

Additional sampling of the sanitary sewer effluent was conducted by Riverdale as part of Riverdale's Thorn Creek Sanitary District Wastewater Discharge Permit requirements. Concentrations of 2,3,7,8-TCDD were not detected in 24-hour composite samples collected on June 13, 1986 and January 7, 1987. Detection limits for the sample analysis were 0.2 ppt and 0.6 ppt respectively. Copies of the analytical results are presented in Appendix H.

4.3.3 Air

Air monitoring was conducted at the site using personnel air monitors. Two samples of the air in the breathing zone were collected. The samples were collected over an approximate nine hour period during surface soil sampling activities. The samples were analyzed for 2,3,7,8-TCDD only. No concentrations of 2,3,7,8-TCDD were detected. Table 10 presents the analytical results of the air monitoring activities.

4.4 OCCURRENCE, TRANSPORT & DISTRIBUTION OF CHEMICALS OF CONCERN

The objective of this section is to identify and quantify, to the extent possible, the chemicals of concern present at the site. Presentation of the data generated by the RI is arranged to facilitate discovery of distribution

TABLE 10
PERSONNEL AIR MONITORING RESULTS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

SAMPLE I.D. NUMBER	SAMPLING TIME (MIN)	VOLUME SAMPLED (LITERS)	2,3,7,8-TCDD CONC. (ppb)
001	525	1575	ND
002*			ND
003	532	1596	ND

ND - SAMPLE WAS ANALYZED FOR 2,3,7,8-TCDD BUT NOT DETECTED
* - SAMPLE IS A TRAVEL BLANK

patterns and development of remedial alternatives. Occurrence and distribution of the chemicals of concern are presented in the context of potential exposure.

For clarity of presentation and to focus the Public Health Evaluation (PHE), the site is arbitrarily divided into four quadrants. The NORTH-SOUTH dividing line runs between Buildings No. 1 and No. 2, and the EAST-WEST axis is placed just south of the buildings. The site quadrants are presented in Figure 12.

Table 11 presents the sample numbers located in each quadrant. All of the analytical results are tabulated in Tables 12 and 13 with the sample sequence arranged as described above. A summary of the results by individual sectors that illustrate the prevalence and concentration range of the chemicals of concern is given in Table 14. Prevalence is defined by the number of positive detections for the total number of samples analyzed and is further characterized by the number of positive detections above the method detection limit. The data is delineated in this manner to assist in selecting the indicator chemicals later in this section.

4.4.1 Constituents of Concern Found at the Site

The classes of constituents of concern found in the surface soils and boring soils are semi-volatile organics, pesticides and 2,3,7,8-TCDD. Two volatile organics (total xylene and toluene) were infrequently found above the method detection limit. They were found infrequently (3 of 13 samples) at concentrations that are below any toxicological significance.

Methylene chloride and 2-butanone were found frequently, but were also found in the field blank at higher concentrations. In view of the above, volatile organics are not a problem in the surface soils. Since there is an approximate 35 foot separation between ground water and the soils surface and ground water is not used for drinking purposes, there is no concern about the potential for volatile organics migrating to ground water. History of activities at the site would not indicate that volatile organics were released to the environment.

TABLE 11
SAMPLES BY SITE QUADRANT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

QUADRANT			
NORTHEAST	SOUTHEAST	SOUTHWEST	NORTHWEST
SS(04,05,06,07)	SS(01,02,17,18)	SS(12,13,14)	SS(08,09,10,11)
SS(22,23,24,25)*	SS(03,19,20,21)	SS(15,16)	SS08-2
SS45	SS38	SS13***	SS09-2
	SS39	SS15-2	SS10-2
	SS40	SS30	SS11-2
	SB(01,02)	SS31	SS43
	SB(03,04)	SS33	SS44
	SB(05,06)	SS34	
	SB(07,08)	SS35	
	SB09**	SS36	
		SS37	
		SS46	

* SAMPLE IS A DUPLICATE OF SS(04,05,06,07)
** SAMPLE IS A DUPLICATE OF SB04 FOR 2,3,7,8-TCDD ONLY
*** SAMPLE IS A DUPLICATE OF SS13 FOR 2,3,7,8-TCDD ONLY

TABLE 12
ANALYTICAL RESULTS BY QUADRANT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 3)

PARAMETER (ppb)	SAMPLE I.D. NUMBER											
	NORTHEAST			SOUTHEAST								
	SS (04,05,06,07)	SS (22,23,24,25)*	SS 45	SS (01,02,17,18)	SS (03,19,20,21)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)	SS 38	SS 39	SS 40
VOLATILES												
CHLOROBENZENE			---				3.5J			---	---	---
ETHYLBENZENE	2.0J	2.9J	---							---	---	---
METHYLENE CHLORIDE	16B	28B	---	55B	33B	34B	83B	52B	68B	---	---	---
TETRACHLOROETHENE			---			1.8J	4.3J		1.6J	---	---	---
TOLUENE			---			4.0J	14		4.3J	---	---	---
VINYL CHLORIDE	1.4J,B		---							---	---	---
ACETONE			---	68B						---	---	---
2-BUTANONE	13B	10B	---	21B	13B	11B	10B	9.0J,B	8.9J,B	---	---	---
TOTAL XYLENES	24	39	---	11						---	---	---
SEMI-VOLATILES												
2,4-DICHLOROPHENOL			---							---	---	---
PENTACHLOROPHENOL			---							---	---	---
BENZOIC ACID			---							---	---	---
2-METHYLPHENOL	380J	310J	---							---	---	---
ACENAPHTHENE			---						150J	---	---	---
FLUORANTHENE	930	600	---	5,000J	3,600	560	1,800		7,200	---	---	---
NAPHTHALENE			---		380J	160J	520		160J	---	---	---
BIS(2-ETHYLHEXYL)PHTHALATE	1,300	1,400	---	2,100J	1,100	180J	450		450	---	---	---
BUTYL BENZYL PHTHALATE	340	650	---		880	1,400	610		680	---	---	---
DI-N-BUTYL PHTHALATE	1,200B	1,400B	---		1,100B	1,400B	1,000B		1,200B	---	---	---
BENZO(A)ANTHRACENE	900	1,400	---	6,800J,B	2,400	380	1,200		5,800	---	---	---
BENZO(A)PYRENE	930	1,300	---		2,000	410	970		4,000	---	---	---
BENZO(B)FLUORANTHENE	770	1,500	---		1,600	390	1,100		2,800	---	---	---
BENZO(K)FLUORANTHENE	770	1,500	---		1,600	390	1,100		2,800	---	---	---
CHRYSENE	1,300	1,700	---		2,800	500	1,500		6,100	---	---	---
ACENAPHTHYLENE	230J	290	---		240J		95J		260J	---	---	---
ANTHRACENE	320J	350	---		490	150J	270J		1,100	---	---	---
BENZO(GHI)PERYLENE	590	960	---		990	240J	330J		1,900	---	---	---
FLUORENE		200J	---						320J	---	---	---
PHENANTHRENE	820	750	---		1,900	640	2,000		4,900	---	---	---
INDENO(1,2,3-C,D)PYRENE		880	---		1,100	210J	320J		1,900	---	---	---
PYRENE	840	1,100	---		3,800	700	2,000		8,700	---	---	---
DIBENZOFURAN	900		---							---	---	---
2-METHYLNAPHTHALENE			---		640	250J	720		300J	---	---	---
PESTICIDES/PCB'S												
ALDRIN	5,300C	7,800C	26	92,000C	64C			170,000C	3,700C	---	---	---
DIELDRIN	2,900C	3,300C	86	79,000C	910C	74	220	200,000C	3,700C	---	---	---
CHLORDANE	12,00C,S	18,000C,S	130S	100,000C,S	350C,S		210S	46,000C,S	28,000C	---	---	---
4,4'-DDT			110	25,000C	450C	120	940C	2,300	1,400C	---	---	---
4,4'-DDE	460	710		4,900	140	52	630			---	---	---
4,4'-DDD	960C	1,500C		37,000C			220	18,000C		---	---	---
ENDRIN										---	---	---
ENDRIN KETONE	210			1,800				4,700	100	---	---	---
HEPTACHLOR	1,300C	21,000C	19	18,000C	31C			7,800	2,700C	---	---	---
HEPTACHLOR EPOXIDE	410	600	46	2,700	80	93	160			---	---	---
ALPHA-BHC										---	---	---
BETA-BHC				2,400	21					---	---	---
GAMMA-BHC (LINDANE)					58					---	---	---
METHOXYCHLOR		7,100C								---	---	---

TABLE 12
ANALYTICAL RESULTS BY QUADRANT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 3)

PARAMETER (ppb)	SAMPLE I.D. NUMBER						SOUTHWEST				
	SS (12,13,14)	SS (15,16)	SS 15-2	SS 30	SS 31	SS 33	SS 34	SS 35	SS 36	SS 37	SS 46
VOLATILES											
CHLOROBENZENE			—	—	—	—	—	—	—	—	—
ETHYLBENZENE			—	—	—	—	—	—	—	—	—
METHYLENE CHLORIDE	20B	91B	—	—	—	—	—	—	—	—	—
TETRACHLOROETHENE			—	—	—	—	—	—	—	—	—
TOLUENE			—	—	—	—	—	—	—	—	—
VINYL CHLORIDE			—	—	—	—	—	—	—	—	—
ACETONE			—	—	—	—	—	—	—	—	—
2-BUTANONE	9.8J,B	10B	—	—	—	—	—	—	—	—	—
TOTAL XYLENES			—	—	—	—	—	—	—	—	—
SEMI-VOLATILES											
2,4-DICHLOROPHENOL			—	—	—	—	—	—	—	—	—
PENTACHLOROPHENOL			—	—	—	—	—	—	—	—	—
BENZOIC ACID			—	—	—	—	—	—	—	—	—
2-METHYLPHENOL			—	—	—	—	—	—	—	—	—
ACENAPHTHENE			—	—	—	—	—	—	—	—	—
FLUORANTHENE	4,800	4,600J	—	—	—	—	—	—	—	—	—
NAPHTHALENE	170J		—	—	—	—	—	—	—	—	—
BIS(2-ETHYLHEXYL)PHTHALATE	320		—	—	—	—	—	—	—	—	—
BUTYL BENZYL PHTHALATE	670		—	—	—	—	—	—	—	—	—
DI-N-BUTYL PHTHALATE	500B		—	—	—	—	—	—	—	—	—
BENZO(A)ANTHRACENE	1,700		—	—	—	—	—	—	—	—	—
BENZO(A)PYRENE	2,000	1,900J	—	—	—	—	—	—	—	—	—
BENZO(B)FLUORANTHENE	2,500		—	—	—	—	—	—	—	—	—
BENZO(K)FLUORANTHENE	2,500		—	—	—	—	—	—	—	—	—
CHRYSENE	4,100		—	—	—	—	—	—	—	—	—
ACENAPHTHYLENE			—	—	—	—	—	—	—	—	—
ANTHRACENE			—	—	—	—	—	—	—	—	—
BENZO(GHI)PERYLENE	1,200		—	—	—	—	—	—	—	—	—
FLUORENE	190		—	—	—	—	—	—	—	—	—
PHENANTHRENE	4,900		—	—	—	—	—	—	—	—	—
INDENO(1,2,3-C,D)PYRENE	1,300		—	—	—	—	—	—	—	—	—
PYRENE	6,800		—	—	—	—	—	—	—	—	—
DIBENZOFURAN	120J		—	—	—	—	—	—	—	—	—
2-METHYLNAPHTHALENE	290J		—	—	—	—	—	—	—	—	—
PESTICIDES/PCB'S											
ALDRIN	1,700C	530,000C	18,000	170	20	9,500	61,000	26,000	5,500		1,700
DIELDRIN	4,100C	57,000C		1,000	380	12,000	27,000	16,000	8,400	210	4,400
CHLORDANE	3,900C,S	1,100,000C	120,000	860	310	19,000	180,000	340,000	26,000	170	19,000
4,4'-DDT	4,200C	33,000		220	170	310	32,000	16,000	4,300	93	2,600
4,4'-DDE	620C										690
4,4'-DDD	720C		25,000								
ENDRIN											
ENDRIN KETONE	160C	6,100				330		1,900			420
HEPTACHLOR	1,000C	64,000C	28,000	91	29	8,700	38,000		6,000	18	5,900
HEPTACHLOR EPOXIDE	280	2,600		300	250	1,800			3,000	100	1,800
ALPHA-BHC											
BETA-BHC	120										
GAMMA-BHC (LINDANE)	32										
METHOXYCHLOR									3,400		

TABLE 12
ANALYTICAL RESULTS BY QUADRANT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 3)

PARAMETER (ppb)	SAMPLE I.D. NUMBER NORTHWEST						
	SS (08,09,10,11)	SS 08-2	SS 09-2	SS 10-2	SS 11-2	SS 43	SS 44
VOLATILES							
CHLOROBENZENE	2.1J	---	---	---	---	---	---
ETHYLBENZENE		---	---	---	---	---	---
METHYLENE CHLORIDE	58B	---	---	---	---	---	---
TETRACHLOROETHENE	3.9J	---	---	---	---	---	---
TOLUENE	1.6J	---	---	---	---	---	---
VINYL CHLORIDE		---	---	---	---	---	---
ACETONE		---	---	---	---	---	---
2-BUTANONE	8.7J,B	---	---	---	---	---	---
TOTAL XYLENES		---	---	---	---	---	---
SEMI-VOLATILES							
2,4-DICHLOROPHENOL		---	---	---	---	---	---
PENTACHLOROPHENOL		---	---	---	---	---	---
BENZOIC ACID		---	---	---	---	---	---
2-METHYLPHENOL		---	---	---	---	---	---
ACENAPHTHENE		---	---	---	---	---	---
FLUORANTHENE	1,700J	---	---	---	---	---	---
NAPHTHALENE		---	---	---	---	---	---
BIS(2-ETHYLHEXYL)PHTHALATE		---	---	---	---	---	---
BUTYL BENZYL PHTHALATE		---	---	---	---	---	---
DI-N-BUTYL PHTHALATE		---	---	---	---	---	---
BENZO(A)ANTHRACENE		---	---	---	---	---	---
BENZO(A)PYRENE		---	---	---	---	---	---
BENZO(B)FLUORANTHENE		---	---	---	---	---	---
BENZO(K)FLUORANTHENE		---	---	---	---	---	---
CHRYSENE		---	---	---	---	---	---
ACENAPHTHYLENE		---	---	---	---	---	---
ANTHRACENE		---	---	---	---	---	---
BENZO(GHI)PERYLENE		---	---	---	---	---	---
FLUORENE		---	---	---	---	---	---
PHENANTHRENE		---	---	---	---	---	---
INDENO(1,2,3-C,D)PYRENE		---	---	---	---	---	---
PYRENE		---	---	---	---	---	---
DIBENZOFURAN		---	---	---	---	---	---
2-METHYLNAPHTHALENE		---	---	---	---	---	---
PESTICIDES/PCB'S							
ALDRIN	220,000C	120	18	120,000	91,000	1,000	1,100
DIELDRIN	210,000C	2,300	49	120,000	190,000	11,000	5,000
CHLORDANE	67,000C,S	1,900	190	90,000	68,000	17,000	9,000
4,4'-DDT	13,000C	890		9,300	27,000	16,000	3,600
4,4'-DDE						3,500	1,100
4,4'-DDD	18,000	300	25	7,100		19,000	1,400
ENDRIN		110				5,100	110
ENDRIN KETONE	870C	180	77	6,000		4,300	330
HEPTACHLOR	63,000	570	33	51,000	16,000	3,200	1,700
HEPTACHLOR EPOXIDE		210			16,000	800	510
ALPHA-BHC							
BETA-BHC							
GAMMA-BHC (LINDANE)		11				130	36
METHOXYCHLOR							

* - SAMPLE IS A DUPLICATE OF SS(04,05,06,07)
SS - SURFACE SOIL SAMPLE
SB - SOIL BORING SAMPLE
J - INDICATES AN ESTIMATED VALUE EXCEEDING ZERO BUT LESS THAN THE SPECIFIED DETECTION LIMIT
--- - INDICATES SAMPLE WAS NOT ANALYZED FOR PARAMETER
B - INDICATES ANALYTE WAS FOUND IN LAB BLANK AS WELL AS SAMPLE
C - APPLIES TO PESTICIDE PARAMETERS WHERE THE IDENTIFICATION HAS BEEN CONFIRMED BY GC/MS
S -INDICATES VALUE IS THE SUM OF ALPHA AND GAMMA CHLORDANES DUE TO ALTERATION IN PATTERN

TABLE 13
2,3,7,8-TCDD CONCENTRATIONS BY QUADRANT
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

	SAMPLE I.D. NUMBER	2,3,7,8-TCDD CONC. (ppb)
NORTHEAST		
	SS(04,05,06,07)	ND
SOUTHEAST		
	SS01	1.6
	SS02	ND
	SS03	ND
	SS17	9.6
	SS18	10.5
	SS19	5.1
	SS20	ND
	SS21	ND
	SS38	12.9
	SS39	5.6
	SS40	ND
	SB01-1.5	ND
	SB01-6.5	ND
	SB02-1.5	ND
	SB02-6.0	ND
	SB03-1.5	ND
	SB03-6.0	ND
	SB04-1.5	ND
	SB04-6.0	ND
	SB05-3.0	26.0
	SB05-7.5	ND
	SB07-1.5	1.4
	SB07-6.0	ND
	SB09-0.0*	ND
SOUTHWEST		
	SS12	ND
	SS13	3.6
	SS14	7.7
	SS15-1	197
	SS15-2	14.6
	SS16	1.1
	SS22**	3.8
	SS30	ND
	SS31	0.2
	SS33	5.8
	SS34	15.9
	SS35	16.2
	SS36	8.4
	SS37	ND
	SS46	1.6
	SB06-3.0	33.7
	SB06-8.0	0.8
	SB08-1.5	ND
	SB08-4.5	ND
NORTHWEST		
	SS(08,09,10,11)	ND

SS - SURFACE SOIL SAMPLE
SB - SOIL BORING SAMPLE. NUMBER SUCCEEDING HYPHEN IS DEPTH FROM WHICH SAMPLE WAS COLLECTED.
ND - SAMPLE WAS ANALYZED FOR 2,3,7,8-TCDD BUT NOT DETECTED
* - SAMPLE IS DUPLICATE OF SB04-6.0
** - SAMPLE IS DUPLICATE OF SS13
*** - SAMPLE IS A TRAVEL BLANK

TABLE 14
SUMMARY OF CHEMICAL ANALYSES
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

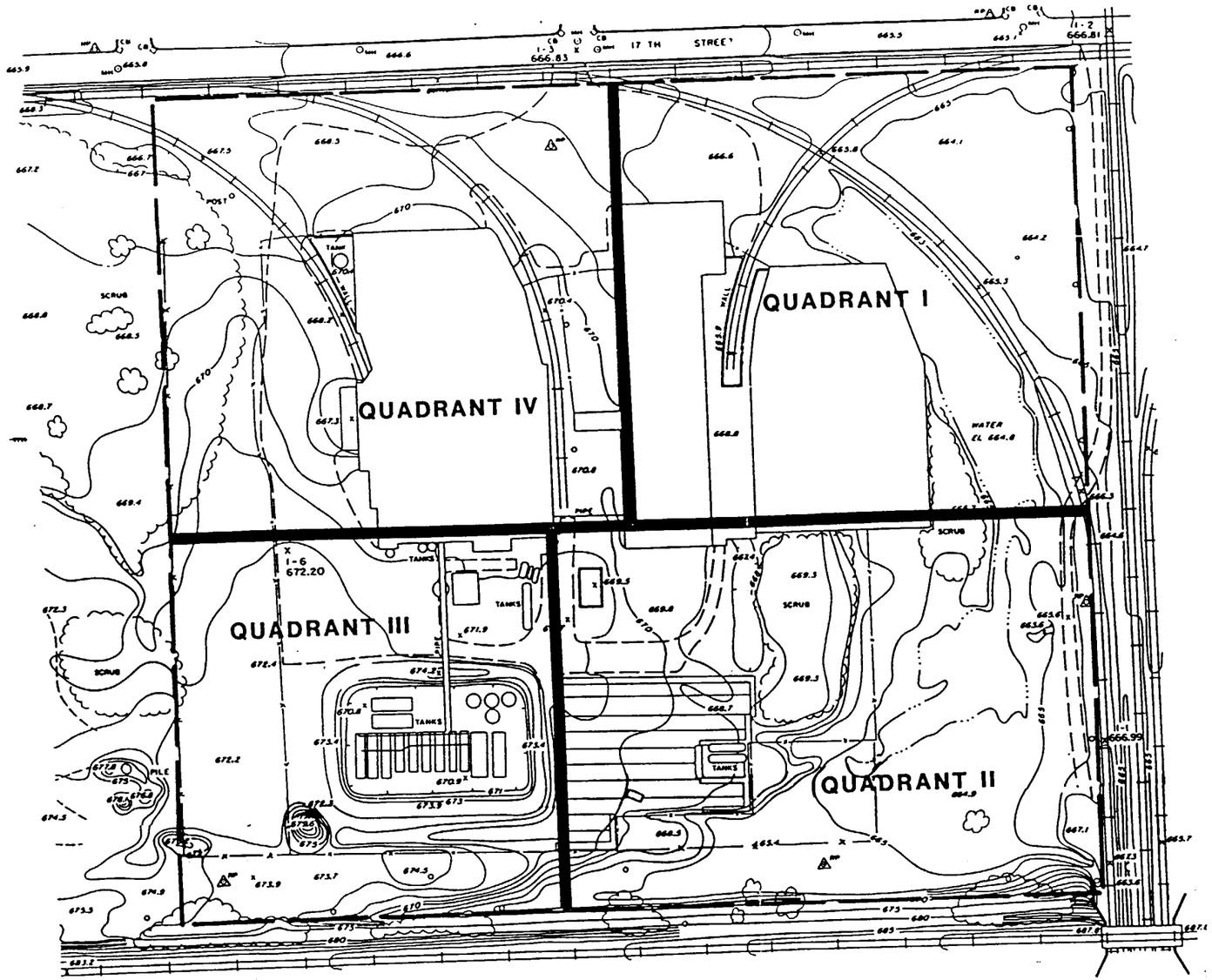
PARAMETER (ppb)	NORTHEAST QUADRANT: NUMBER OF POSITIVE DETECTIONS VS NUMBER OF SAMPLES*	NORTHEAST QUADRANT: NUMBER ABOVE DETECTION LIMIT VS NUMBER OF SAMPLES	NORTHEAST QUADRANT: CONCENTRATION RANGE	SOUTHEAST QUADRANT: NUMBER OF POSITIVE DETECTIONS VS NUMBER OF SAMPLES	SOUTHEAST QUADRANT: NUMBER ABOVE DETECTION LIMIT VS NUMBER OF SAMPLES	SOUTHEAST QUADRANT: CONCENTRATION RANGE
VOLATILES						
CHLOROBENZENE	0 / 2	0 / 2		1 / 6	0 / 6	3.5J
ETHYLBENZENE	2 / 2	0 / 2	2.0J / 2.9J	0 / 6	0 / 6	
METHYLENE CHLORIDE**	2 / 2	2 / 2	16B / 28B	6 / 6	6 / 6	33B / 83B
TETRACHLOROETHENE	0 / 2	0 / 2		3 / 6	0 / 6	1.6J / 4.3J
TOLUENE	0 / 2	0 / 2		3 / 6	1 / 6	4.0J / 14
VINYL CHLORIDE	1 / 2	0 / 2	1.4J	0 / 6	0 / 6	
ACETONE***	0 / 2	0 / 2		1 / 6	1 / 6	68B
2-BUTANONE***	2 / 2	2 / 2	10B / 13B	6 / 6	4 / 6	8.9J,B / 21B
TOTAL XYLENES	2 / 2	2 / 2	24 / 39	1 / 6	1 / 6	11
SEMI-VOLATILES						
2,4-DICHLOROPHENOL	0 / 2	0 / 2		0 / 6	0 / 6	
PENTACHLOROPHENOL	0 / 2	0 / 2		0 / 6	0 / 6	
BENZOIC ACID	0 / 2	0 / 2		0 / 6	0 / 6	
2-METHYLPHENOL	2 / 2	0 / 2	300J / 310J	0 / 6	0 / 6	
ACENAPHTHENE	0 / 2	0 / 2		1 / 6	0 / 6	150J
FLUORANTHENE	2 / 2	2 / 2	600 / 930	5 / 6	4 / 6	560 / 3,600
NAPHTHALENE	0 / 2	0 / 2		4 / 6	1 / 6	160J / 520
BIS(2-ETHYLHEXYL)PHTHALATE	2 / 2	2 / 2	1,300 / 1,400	5 / 6	3 / 6	180J / 1,100
BUTYL BENZYL PHTHALATE	2 / 2	2 / 2	340 / 660	4 / 6	4 / 6	610J / 1,400
DI-N-BUTYL PHTHALATE****	2 / 2	2 / 2	1,2000 /1,4000	4 / 6	4 / 6	1,0000 / 1,4000
BENZO(A)ANTHRACENE	2 / 2	2 / 2	900 / 1,400	4 / 6	4 / 6	300 / 5,800
BENZO(A)PYRENE	2 / 2	2 / 2	930 / 1,300	4 / 6	4 / 6	410 / 4,000
BENZO(B)FLUORANTHENE	2 / 2	2 / 2	770 / 1,500	4 / 6	4 / 6	390 / 2,600
BENZO(K)FLUORANTHENE	2 / 2	2 / 2	770 / 1,500	4 / 6	4 / 6	390 / 2,600
CHRYSENE	2 / 2	2 / 2	1,300 / 1,700	4 / 6	4 / 6	500 / 6,100
ACENAPHTHYLENE	2 / 2	0 / 2	230J / 290J	3 / 6	0 / 6	95J / 260J
ANTHRACENE	2 / 2	1 / 2	320J / 350J	4 / 6	2 / 6	150J / 1,100
BENZO(GHI)PERYLENE	2 / 2	2 / 2	590 / 960	4 / 6	2 / 6	240J / 1,900
FLUORENE	1 / 2	0 / 2	200J	1 / 6	0 / 6	320J
PHENANTHRENE	2 / 2	2 / 2	750 / 820	4 / 6	4 / 6	640 / 4,900
INDENO(1,2,3-C,D)PYRENE	1 / 2	1 / 2	800	4 / 6	2 / 6	210J / 1,900
PYRENE	2 / 2	2 / 2	840 / 1,100	4 / 6	4 / 6	700 / 8,700
DIBENZOFURAN	1 / 2	1 / 2	900	0 / 6	0 / 6	
2-METHYLNAPHTHALENE	0 / 2	0 / 2		4 / 6	2 / 6	250J / 720
PESTICIDES/PCB'S						
ALDRIN	3 / 3	3 / 3	26 / 7,000	4 / 6	4 / 6	64 /170,000
DIELDRIN	3 / 3	3 / 3	86 / 3,300	6 / 6	6 / 6	74 / 200,000
CHLORDANE	3 / 3	3 / 3	130 / 18,000	5 / 6	5 / 6	210 /100,000
4,4'-DDT	1 / 3	1 / 3	110	6 / 6	6 / 6	120 / 25,000
4,4'-DDE	2 / 3	2 / 3	460 / 710	4 / 6	4 / 6	140 / 4,900
4,4'-DDD	2 / 3	2 / 3	960 / 1,500	3 / 6	3 / 6	220 / 37,000
ENDRIN	0 / 3	0 / 3		0 / 6	0 / 6	
ENDRIN KETONE	1 / 3	1 / 3	1,300	3 / 6	3 / 6	100 / 4,700
HEPTACHLOR	3 / 3	3 / 3	19 / 21,000	4 / 6	4 / 6	31 / 18,000
HEPTACHLOR EPOXIDE	3 / 3	3 / 3	46 / 600	2 / 6	2 / 6	21 / 2,400
ALPHA-BHC	0 / 3	0 / 3		0 / 6	0 / 6	
BETA-BHC	0 / 3	0 / 3		1 / 6	1 / 6	58
GAMMA-BHC (LINDANE)	0 / 3	0 / 3		0 / 6	0 / 6	
METHOXYCHLOR	1 / 3	1 / 3	7,100	0 / 6	0 / 6	
2,3,7,8-TCDD						
SURFACE SOIL	0 / 2	0 / 2		4 / 8	4 / 8	1.6 / 18.5
BORING (SHALLOW)				2 / 6	2 / 6	1.4 / 24
BORING (DEEP)				0 / 6	0 / 6	

TABLE 14
SUMMARY OF CHEMICAL ANALYSES
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

PARAMETER (ppb)	SOUTHWEST QUADRANT			NORTHWEST QUADRANT			SITE		
	NUMBER OF POSITIVE DETECTIONS VS NUMBER OF SAMPLES	NUMBER ABOVE DETECTION LIMIT VS NUMBER OF SAMPLES	CONCENTRATION RANGE	NUMBER OF POSITIVE DETECTIONS VS NUMBER OF SAMPLES	NUMBER ABOVE DETECTION LIMIT VS NUMBER OF SAMPLES	CONCENTRATION RANGE	NUMBER OF POSITIVE DETECTIONS VS NUMBER OF SAMPLES	NUMBER ABOVE DETECTION LIMIT VS NUMBER OF SAMPLES	CONCENTRATION RANGE
VOLATILES									
CHLOROBENZENE	0 / 4	0 / 4		1 / 1	0 / 1	2.1J	2 / 13	0 / 13	3.5J
ETHYLBENZENE	0 / 4	0 / 4		0 / 1	0 / 1		2 / 13	0 / 13	2.0J / 2.9J
METHYLENE CHLORIDE**	4 / 4	4 / 4	200 / 91B	1 / 1	1 / 1	58B	13 / 13	13 / 13	16B - 83B
TETRACHLOROETHENE	1 / 4	0 / 4	1.6J	1 / 1	0 / 1	3.9J	5 / 13	0 / 13	1.6J - 4.3J
TOLUENE	1 / 4	0 / 4	4.3J	1 / 1	0 / 1	1.6J	5 / 13	1 / 13	14
VINYL CHLORIDE	0 / 4	0 / 4		0 / 1	0 / 1		1 / 13	0 / 13	1.4J
ACETONE*****	0 / 4	0 / 4		0 / 1	0 / 1		1 / 13	1 / 13	68B
2-BUTANONE***	4 / 4	1 / 4	8.9J,B / 21B	1 / 1	0 / 1	8.7J,B	13 / 13	8 / 13	10B - 21B
TOTAL XYLENES	0 / 4	0 / 4		0 / 1	0 / 1		3 / 13	3 / 13	11 - 39
SEMI-VOLATILES									
2,4-DICHLOROPHENOL	0 / 4	0 / 4		0 / 1	0 / 1		0 / 13	0 / 13	
PENTACHLOROPHENOL	0 / 4	0 / 4		0 / 1	0 / 1		0 / 13	0 / 13	
BENZOIC ACID	0 / 4	0 / 4		0 / 1	0 / 1		0 / 13	0 / 13	
2-METHYLPHENOL	0 / 4	0 / 4		0 / 1	0 / 1		2 / 13	0 / 13	310J
ACENAPHTHENE	1 / 4	0 / 4	150J	0 / 1	0 / 1		2 / 13	0 / 13	150J
FLUORANTHENE	2 / 4	1 / 4	4,600J /7,200	1 / 1	0 / 1	1700J	10 / 13	7 / 13	560 - 7200
NAPHTHALENE	2 / 4	0 / 4	160J / 170J	0 / 1	0 / 1		6 / 13	1 / 13	520
BIS(2-ETHYLHEXYL)PHTHALATE	2 / 4	2 / 4	320 / 450	0 / 1	0 / 1		9 / 13	7 / 13	320 - 1100
BUTYL BENZYL PHTHALATE	2 / 4	2 / 4	670 / 680	0 / 1	0 / 1		8 / 13	8 / 13	340 - 1400
DI-N-BUTYL PHTHALATE****	2 / 4	2 / 4	5000 / 1,200B	0 / 1	0 / 1		8 / 13	8 / 13	500B - 1400B
BENZO(A)ANTHRACENE	2 / 4	2 / 4	1,700 / 5,000	0 / 1	0 / 1		8 / 13	8 / 13	380 - 5000
BENZO(A)PYRENE	3 / 4	2 / 4	1,900J / 4,000	0 / 1	0 / 1		9 / 13	8 / 13	410 - 4000
BENZO(B)FLUORANTHENE	2 / 4	2 / 4	2,500 / 2,800	0 / 1	0 / 1		8 / 13	8 / 13	390 - 2800
BENZO(K)FLUORANTHENE	2 / 4	2 / 4	2,500 / 2,800	0 / 1	0 / 1		8 / 13	8 / 13	390 - 2800
CHRYSENE	2 / 4	2 / 4	4,100 / 6,100	0 / 1	0 / 1		8 / 13	8 / 13	500 - 6100
ACENAPHTHYLENE	1 / 4	0 / 4	260J	0 / 1	0 / 1		6 / 13	0 / 13	290J
ANTHRACENE	1 / 4	1 / 4	1,100	0 / 1	0 / 1		7 / 13	4 / 13	350 - 1100
BENZO(GHI)PERYLENE	2 / 4	2 / 4	1,200 / 1,900	0 / 1	0 / 1		8 / 13	6 / 13	590 - 1900
FLUORENE	2 / 4	1 / 4	190J	0 / 1	0 / 1		4 / 13	0 / 13	190J
PHENANTHRENE	2 / 4	2 / 4	4,900	0 / 1	0 / 1		8 / 13	8 / 13	640 - 4900
INDENO(1,2,3-C,D)PYRENE	2 / 4	2 / 4	1,300 / 1,900	0 / 1	0 / 1		7 / 13	5 / 13	880 - 1900
PYRENE	2 / 4	2 / 4	6,800 / 8,700	0 / 1	0 / 1		8 / 13	8 / 13	700 - 8700
DIBENZOFURAN	1 / 4	0 / 4	120J	0 / 1	0 / 1		2 / 13	1 / 13	900
2-METHYLNAPHTHALENE	2 / 4	0 / 4	290J / 300J	0 / 1	0 / 1		6 / 13	2 / 13	720
PESTICIDES/PCB'S									
ALDRIN	12 / 13	12 / 13	20 - 530,000	7 / 7	7 / 7	18 - 220,000	26 / 29	26 / 29	18 - 220,000
DIELDRIN	12 / 13	12 / 13	210 - 200,000	7 / 7	7 / 7	49 - 210,000	28 / 29	28 / 29	74 - 210,000
CHLORDANE	13 / 13	13 / 13	170 - 1,100,000	7 / 7	7 / 7	190 - 90,000	28 / 29	28 / 29	130 - 100,000
4,4'-DDT	12 / 13	12 / 13	93 - 33,000	6 / 7	6 / 7	890 - 27,000	25 / 29	25 / 29	93 - 33,000
4,4'-DDE	2 / 13	2 / 13	620 - 690	2 / 7	2 / 7	1100 - 3,500	10 / 29	10 / 29	140 - 4,900
4,4'-DDD	3 / 13	3 / 13	720 - 2,500	6 / 7	6 / 7	25 - 19,000	14 / 29	14 / 29	25 - 37,000
ENDRIN									
ENDRIN KETONE	7 / 13	7 / 13	100 - 6,100	6 / 7	6 / 7	77 - 6,000	17 / 29	17 / 29	77 - 6,000
HEPTACHLOR	12 / 13	12 / 13	18 - 68,000	7 / 7	7 / 7	33 - 63,000	26 / 29	26 / 29	18 - 64,000
HEPTACHLOR EPOXIDE	8 / 13	8 / 13	100 - 3,000	4 / 7	4 / 7	210 - 16,000	17 / 29	17 / 29	21 - 16,000
ALPHA-BHC									
BETA-BHC	1 / 13	1 / 13	120	0 / 7	0 / 7		2 / 29	2 / 29	58 - 120
GAMMA-BHC (LINDANE)	1 / 13	1 / 13	32	3 / 7	3 / 7	11 - 130	4 / 29	4 / 29	11 - 130
METHOXYCHLOR	0 / 13	0 / 13		0 / 7	0 / 7		1 /29	1 / 29	7,100
2,3,7,8-TCDD									
SURFACE SOIL	9 / 12	9 / 12	0.18 - 197	0 / 7	0 / 7		13 / 22	13 / 22	0.18 - 197
BORING (SHALLOW)	1 / 2	1 / 2	33.7				3 / 8	3 / 8	1.4 - 33.7
BORING (DEEP)	1 / 2	1 / 2	0.8				1 / 8	1 / 8	0.8

* BOTH SAMPLES WERE COLLECTED FROM THE SAME LOCATION
** METHYLENE CHLORIDE DETECTED IN FIELD BLANK AT 70 PPB
*** 2 BUTANONE DETECTED IN FIELD BLANK AT 20 PPB
**** DI N BUTYL PHTHALATE DETECTED IN FIELD BLANK AT 1,900 PPB
***** ACETONE DETECTED IN FIELD BLANK AT 160 PPB

DRAWN BY	CHECKED BY		DRAWING NUMBER
RJS 6-10-87	RRS 6-10-87	6-10-87	302108-B15
	APPROVED BY RRS	6-10-87	



LEGEND

SITE BOUNDARY

N

0 100 200

SCALE IN FEET

FIGURE 12

SITE QUADRANTS

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RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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RRS 5-14-92	RRS 5-24-92	302108-B10
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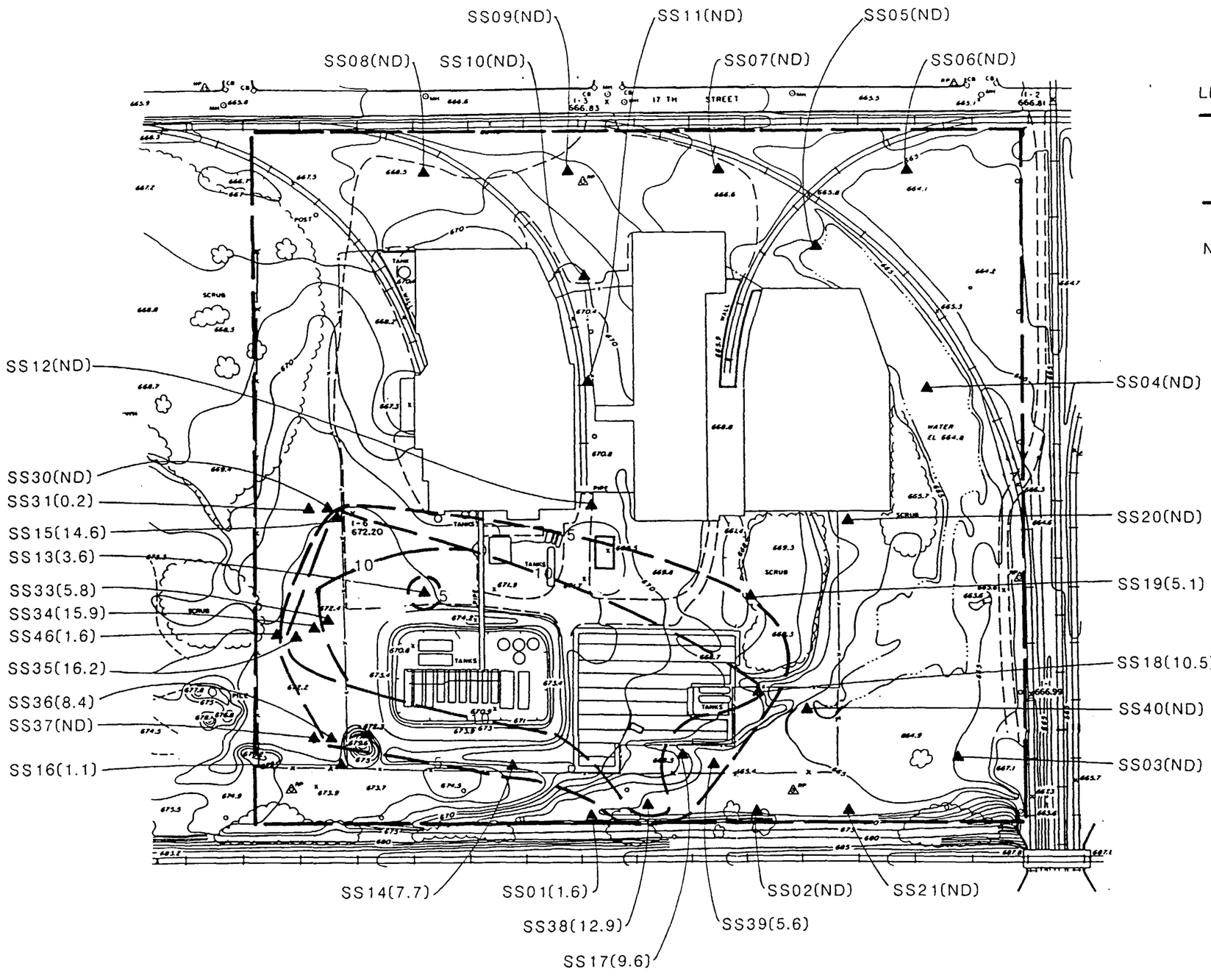

LEGEND

- SITE BOUNDARY
- ▲ SURFACE SOIL SAMPLING LOCATION NUMBER IN ( ) REPRESENTS 2,3,7,8-TCDD CONCENTRATION
- CONCENTRATION CONTOUR LINE

NOTE: CONCENTRATIONS ARE IN PPB

N

0 100 200

SCALE IN FEET

FIGURE 11

2,3,7,8-TCDD CONCENTRATIONS

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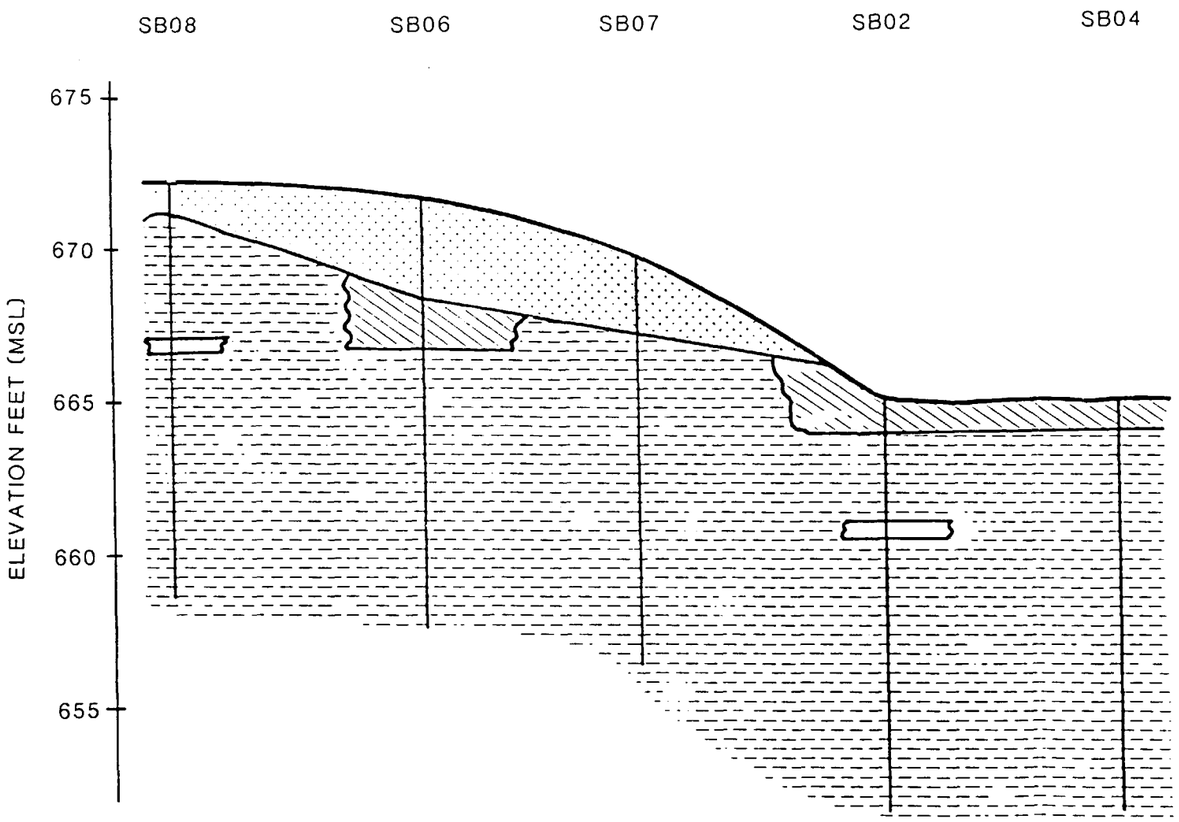
		APPROVED BY	[illegible] 5-24-87		



SECTION A-A'

HORIZONTAL SCALE

0 100 200

VERTICAL SCALE

0 5 10

LEGEND

- FILL
- SAND AND SILTY SAND
- SILT
- SILTY CLAY AND CLAY

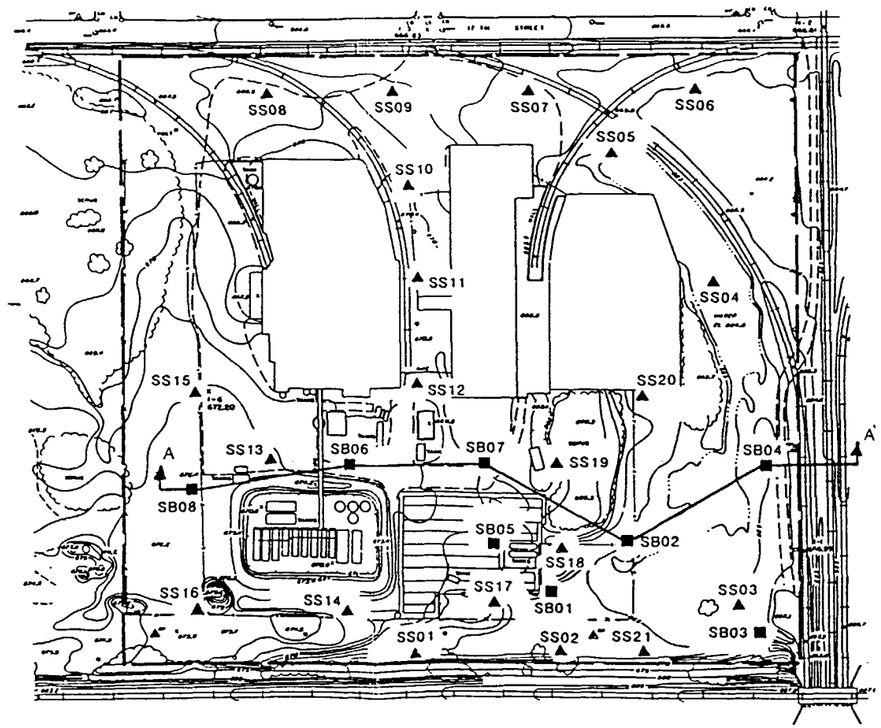


FIGURE 10

GEOLOGIC CROSS-SECTION

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Do Not Scale This Drawing

5.3 DOSE-RESPONSE RELATIONSHIPS

Dose-response relationships are most appropriate in the context of determining the potential impacts on the public health from introduction of a new chemical, or in making a decision to regulate the constituent. Dose-response relationships were adequately described in the context of environmental exposure in site-specific circumstances in the previous section. Therefore, this section is limited in scope. Dose-responses do not have any impact on the conclusions derived from the risk characterization, but may serve to clarify some of the uncertainties embedded in the risk characterization procedure.

Risk characterization, especially in cancer risk quantification, is highly dependent upon the determination of a maximum effective dose, which is defined as the concentration of the constituent that reaches the target organ (liver, kidney, lung, etc.). Thus, absorption rates through the lungs, g.i. tract, and skin are critical in the quantification.

Pharmacokinetics which describe the chemical's behavior after it enters the human body may assist in determination of the effective dose. However, there is limited information regarding this aspect. Also, it is difficult to determine the dose (that which is ingested or dermally absorbed and reaches the target organ) of the contaminants due to their physical state and compound specificity in site-specific circumstances.

All of the indicator chemicals are present as strongly bonded materials on the soil particles. Therefore, assuming that the constituents are totally bioavailable is an extremely conservative premise. For instance, animal studies have indicated that 2,3,7,8-TCDD strongly bonded to soils was absorbed at less than 0.5 percent as determined by tissue analysis as compared to 21.3 percent where the 2,3,7,8-TCDD contamination was the result of waste oils applied to the soils (Umbriet, 1986). Absorption rates as high as 30 percent have been assumed in some health risk assessments (Kimbrough, 1986).

Table 19 presents the dermal and gastrointestinal tract absorption factors cited in the toxicological literature. Except for the study cited above, none of the absorption factors were derived from studies that used impacted soils

as the test material. Bioavailability based on the tabulated factors will overstate the actual which is limited by the soil-bond strength and the sample matrix effects.

Dose-response parameters available for cancer risk estimates are those calculated by the Cancer Assessment Group of U.S. EPA. Carcinogenic potencies are listed in Table 18.

5.4 EXPOSURE ASSESSMENT

For an actual exposure to occur, or a potential exposure to be viable, there must be a complete exposure pathway. All of the components of the exposure pathway--namely, a source of the hazard, a completed pathway, and a receptor--are required.

The source and its potential exposure levels were described in the site characterization (Section 4.4.2). The indicator chemicals were found at toxicologically significant levels in all of the sectors described in the site characterization.

Hazards associated with exposure to the constituents were defined in Section 5.2 and dose-response relationships were outlined in Section 5.3. The potential for migration based on the physical and chemical nature of the contaminants was presented in Section 4.6.

This section identifies some of the possible exposure pathways and qualifies the circumstances in which exposure may (or could) happen.

Receptors can be categorized in the context of possible exposure during trespassing on impacted soil areas by plant personnel, remediation workers, and residents living in the immediate vicinity of the plant. Persons living at some distance from the site could be exposed to air particulates resulting from wind erosion or mobilization of the affected surface soils by vehicular activity.

The conventional human exposure modes to indicator chemicals, in the environmental media that affect potential health impacts are: inhalation, ingestion, and direct contact (dermal exposure). A list of possible exposure scenarios are presented in Table 20.

5.4.1 Exposure to Surface Soils

Exposure to the indicator chemicals can occur by inhalation of airborne particulates both on-site and at some distance from the site. The surface soils can be ingested during trespass by third parties, on-site plant personnel and remediation workers. This possible exposure pathway could have significance if there are high levels of the more toxic pesticides and 2,3,7,8-TCDD.

5.4.1.1 Inhalation of Surface Soils

Exposure to contaminated surface soils by inhalation could transpire during trespass by third parties (adults and children) only when sediments are dry. However, because most of the contaminated soils are within the fenced area and covered, exposure frequency will be limited.

Dust mobilization could occur during remediation, but the workers will be equipped with the necessary safety equipment to prevent exposure. Also, dust prevention measures have been implemented to mitigate emissions leaving the site.

Plant personnel and site visitors will not be exposed to surface soils constituents during the remediation. The exposure duration, if exposure does take place, will not be significant because cleanup can be accomplished in a short time. The closest downwind receptors are located in the houses along East 17th Street. They will be shielded to some extent by the building located on site.

TABLE 20
HUMAN EXPOSURE SCENARIOS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

SCENARIOS	INGESTION	INHALATION	DIRECT CONTACT	GAS VAPOR INHALATION
3RD PARTY TRESPASS	MOST LIKELY	I (a)	I (d)	I (c)
PLANT OPERATIONS	I (b)	I (a)	I (d)	I (c)
REMEDIATION	I (b)	I (b)	I (b)	I (c)
RESIDENTIAL SETTING	NA	LIKELY	NA	I (c)

I = INSIGNIFICANT NA = NOT APPLICABLE

(a) - Exposure levels will be below toxicological significance.
(b) - Plant and remediation personnel will wear protective clothing and work gloves as routine safety procedures.
(c) - Indicator chemicals are not expected to vaporize under ambient conditions.
(d) - Dermal absorption is minimal during short time duration of exposure.

NOTE: Subsurface soils will be subject to human exposure only in the case of excavation for remediation.

5.4.1.2 Ingestion of Surface Soils

Exposure by ingestion of sediment could only logically occur in the trespass exposure scenario where a third-party trespass results in ingesting contaminated surface soils that adhere to the hands and body surface. Of greatest concern is child "pica" ingestion of pesticides and 2,3,7,8-TCDD at levels which may pose health risks.

Remediation and plant personnel are not considered to be at risk in this pathway due to adequate protection provided by work clothing and gloves. Site visitors would not be expected to be exposed by ingestion since they do not have access to the impacted areas.

The likelihood of trespass occurring is limited by the presence of a 7-foot barbed wire topped fence around the perimeter of the site and the distance that separates the site from residential areas to the north. Growth of vegetation over most of the area has also tended to limit air mobilization of the indicator chemicals.

5.4.2 Ground and Surface Water

Both ground water and surface water are not impacted by the presence of very immobile pesticides and 2,3,7,8-TCDD found in the surface soils. Ground water is located far below (approximately 35 feet) the surface and there is no evidence of vertical migration of the indicator chemicals. There are no receiving streams in the vicinity of the site. Consequently, exposure pathways associated with drinking water, bathing and household use of ground water, and recreational use of surface water do not exist at this site.

5.4.3 Food Chain Uptake

Uptake of pesticides and 2,3,7,8-TCDD in food crops and forage with subsequent introduction to the food chain via milk and meat is technically possible. However, the site is located in an urban setting where grazing and agriculture are not in evidence or to be expected. Food uptake of pesticides and 2,3,7,8-TCDD from the surface soils is not a viable exposure pathway.

5.4.4 Receptors Subject to Exposure

There is some precedent for setting cleanup levels for toxic constituents on the basis of proximity to the potential exposure site (Falco, 1985). The nearest houses are located north of the site along East 17th Street. Distances from the various quadrants range from 300 to 800 feet, or approximately 0.1 km from the center of the closest quadrant. Also, most of the houses on the street facing the plant are not presently occupied. Consequently, the number of potential trespassers may range from 8 to 16 period.

Specific potential receptors include: (1) Site trespassers gaining entry into a fenced area and ingesting impacted soils, and (2) persons residing downwind of the site inhaling air particulates mobilized by wind erosion.

The most susceptible receptor (for chronic exposure) will be the 25 kilogram child because this weight is more appropriate for the postulated trespass scenario (age 7 and up). For lifetime exposure (70 years) ingestion rates geared to age are used to characterize the exposure. A 70 kilogram adult is defined as the receptor. Prorating weight for the adolescent years will have very little impact on the calculations.

5.4.5 Extent of Exposure

In this evaluation, the dose to which the human receptor is exposed is defined by the following factors:

- Concentration of the hazardous constituents in the environmental media at the site.
- Frequency and the duration of the exposure to contaminants at the above concentrations. In some cases, the duration is defined by the health end points, i.e., for chronic exposure it is up to two years and for cancer risk calculations the time period is considered to be lifetime (70 years). Appropriate time periods may be chosen based on the most sensitive segment of the exposed population, e.g., children during the most sensitive age.

5.4.5.1 Calculation of the Exposure Dose

In this assessment, the dose that is expected to reach the target organ to cause the health impact is dependent upon the following factors: (1) concentration of the hazardous constituents in the pertinent environmental media (air, water, soils/sediment) at the receptor exposure location; (2) the frequency of exposure, its duration, and time period (acute, subchronic and chronic, lifetime); (3) the rate of absorption of the constituent through skin, lungs, and gastrointestinal (GI) tract, i.e., in the direct contact, inhalation and ingestion exposure modes.

In order to utilize animal test data, the postulated exposure must be normalized to the study test conditions that generated the health risk parameter. Subchronic exposure is defined as a time interval which does not constitute a significant portion of the lifespan of the test animal, generally 30 to 90 days. Chronic exposure concerns a significant portion of the lifespan, and lifetime exposure is considered to be the full lifespan of the test animal.

5.4.5.2 Exposure Levels

Exposure levels are based on the concentration of the hazardous constituent at the receptor location. For the soil ingestion exposure pathway, the exposure level is the concentration of the constituents in the surface soils.

In order to illustrate the range of risk associated with exposure to the sediments via ingestion, the maximum observed concentration is considered to be the upper-bound risk, i.e., the risk is not likely to be any higher. This is a highly overestimated value because the assumption of uniform distribution of the contaminants over a large area is refuted by the analytical data. This assumption has the effect of making the risk assessment extremely conservative, and serves only to determine an ultra-worst case exposure scenario.

An average risk value is derived by using the geometric mean concentration of the constituents. The mean value is calculated in this assessment by using all of the reported values. All results that are listed as "non-detects" are assumed to be at the lowest detection limit. This risk value is also conservative as the phased sampling program was deliberately biased to sample the most affected surface soils.

The intent of the exposure assessment guidelines (Federal Register, 1986d) is consistent with this approach when data are limited:

> "The Guidelines do not encourage the use of worst-case assessment, but rather the development of realistic assessments based on the best data available." (51 FR 34053).

Table 21 shows the maximum observed concentrations (upper bound) and calculated geometric mean concentrations. Median values where they can be meaningfully determined are included as another descriptor of the distribution of concentrations.

5.4.5.3 Exposure Duration and Time Period

Exposure duration and frequency are hypothesized on the basis of general experience and judgment. Ingestion of affected surface soils is considered to be an unlikely but potential exposure pathway due to limited accessibility based on distance, physical barriers and lack of trespass motivation. Consequently, an infrequent trespass scenario by adolescents (7 to 18 years of age) would be the only potential exposure pathway, with a lower likelihood of adult trespass occurring.

Two random trespass scenarios were presumed in order to estimate the health risks associated with chronic exposure and cancer risks based on lifetime exposure due to ingestion of sediments. Both scenarios assume a random trespass occurring one time per week for six months of the year, or 26 exposure events.

For the ingestion exposure mode, the time duration of the trespass (or the elapsed time in which the constituent is on the hands) is not relevant because the ingestion rate of 0.1 gram per day is independent of that time.

Absorption through the dermal barrier is time-dependent and is assumed to be an average of three hours. However, the contribution to the dose via dermal absorption of the indicator chemicals is considered to be insignificant when compared to the ingestion route. Absorption rates of topically administered herbicides and pesticides dissolved in a suitable carrier, ranged from 0.004

TABLE 21
INDICATOR CHEMICALS: RISK CHARACTERIZATION LEVELS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	QUADRANT I(a)		QUADRANT II (b)		QUADRANT III		QUADRANT IV	
		MAXIMUM	MEAN*	MAXIMUM	MEAN** (MEDIAN)	MAXIMUM	MEAN** (MEDIAN)	MAXIMUM	MEAN** (MEDIAN)
BIS(2-ETHYLHEXYL) PHTHALATE	320 - 1,400	1,400	1,350	2,100J	369 (450)	450	354 (330)	ND	---
BENZO(A)PYRENE	410 - 4,000	1,400	1,115	4,000	838 (631)	4,000	842 (1,949)	ND	---
ALDRIN	18 - 530,000	7,800	6,550	170,000	1,018 (487)	530,000	3,903 (5,500)	220,000	3,441 (1,100)
DIELDRIN	74 - 210,000	3,300	3,100	200,000	3,087 (1,835)	57,000	5,544 (4,400)	210,000	9,170 (11,000)
ENDRIN (KETONE) ***	77 - 6,100	210	---	4,700	146 (50)	6,100	149 (48)	6,000	447 (330)
CHLORDANE	130 - 1,100,000	18,000	15,000	100,000	1,443 (3,130)	1,100,000	9,526 (19,000)	90,000	11,239 (17,000)
4,4'-DDT	93 - 33,000	ND	---	25,000	1,264 (1,147)	33,000	1,144 (2,300)	27,000	3,088 (9,300)

TABLE 21
INDICATOR CHEMICALS: RISK CHARACTERIZATION LEVELS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	QUADRANT I(a)		QUADRANT II (b)		QUADRANT III		QUADRANT IV	
		MAXIMUM	MEAN*	MAXIMUM	MEAN** (MEDIAN)	MAXIMUM	MEAN** (MEDIAN)	MAXIMUM	MEAN** (MEDIAN)
4,4'-DDD	25 - 37,000	1,500	1,230	37,000	434 (132)	ND	—	19,000	1,159 (1,400)
4,4'-DDE	140 - 4,900	710	585	4,900	254 (124)	ND	—	ND	—
HEPTACHLOR	18 - 64,000	21,000	11,150	18,000	332 (289)	64,000	1,322 (5,900)	63,000	3,401 (3,200)
HEPTACHLOR EPOXIDE	21 - 160,000	600	505	2,700	92.6 (86)	3,000	375 (250)	16,000	132 (210)
2,3,7,8-TCDD	0.18 - 197****	ND	—	SS 10.5 SB 25	1.1 0.3 (ND)	SS 14.6 SB 33.7	1.8 (5.8) —	ND	—

(a) - Sample set includes two samples from the same location and one other distant location.
(b) - Sample set comprised of a total of six surface and soil boring samples.
* - Mean is arithmetic of two samples collected at same location
** - Mean is the geometric mean. Non-detects (NDs) are assumed to be at the lowest reported detection limit for that constituent.
*** - Surrogate for Endrin Epoxide, a breakdown product
**** - Verification sample at same location contained 14.6 ug/kg 2,3,7,8-TCDD

to 0.351 percent per hour during the first four hours of exposure (Feldman and Maibach, 1974). Less than 0.2 percent of these chemicals (on an average) would be absorbed due to direct contact. The soil matrix would further mitigate the absorption rate to a great extent.

5.4.5.4 Effective Dose

A fraction of the toxic constituents found in the soil sediments will pass through the body unchanged (unmetabolized) for any of the following reasons:

- Bioavailability appears to be dependent upon the nature of the sorption bond between the chemical and the soil/sediment (Umbriet, et al., 1986). 2,3,7,8-TCDD was absorbed through the GI tract in animal studies at a 60 percent rate, in soils where the chemical was applied in an oil base at 20 percent, and in soil (2,3,7,8-TCDD deposited over long periods and containing some organic carbon) at 0.5 percent.

- Physical and chemical nature of the indicator chemicals as they exist in the surface soils (as adsorbed and mechanically bonded film on the soil particles), e.g., 95 percent of DDT in a vegetable oil suspension was absorbed by the test animals as compared to 20 percent in a water suspension. The reported absorption factors are listed in Table 19.

5.5 RISK CHARACTERIZATION

Risks associated with exposure to the indicator chemicals found in the surface soils are qualitatively and quantitatively characterized to define the site. A qualitative evaluation will compare the constituent concentrations to some appropriate health parameter, qualify the probability of exposure in site-specific circumstances and reach some conclusion about the health risks. Tables 11 through 14 and the acute and chronic toxicity sections (5.2.1 and 5.2.2) contain a qualitative risk evaluation. This section will present the quantitative estimate of cancer risk and potential health effects due to chronic exposure to all of the indicator chemicals in site-specific exposure scenarios. It combines the quantitive aspects of toxicity and exposure levels and uses the data presented in the hazard identification and exposure assessment tasks.

Characterization of the health risks associated with the Riverdale site is separated into two main categories based on the RI data. Since cancer risk is considered to be present if exposure occurs at any level above zero, incremental risk values are estimated, i.e., that incremental risk of the exposed population over an unexposed group. For any health impact (other than cancer) that has an associated threshold, exposure levels are used to calculate daily intakes which are compared to RfDs (the threshold parameter).

Cancer risk estimates are estimated for each individual indicator chemical. In the absence of specific toxicological data related to the toxic behavior of mixed chemicals, the total cancer risk is assumed to be additive in accordance with the recommended guidelines (Federal Register, 1986a). Therefore, total cancer risk is the sum of the individual risk values.

Cancer risk is stated in terms of additional cancer cases attributed to exposure to the suspect animal carcinogen at the estimated effective dose. Thus, a 1×10^{-6} cancer risk would be equivalent to one additional cancer case expected in the exposed population (of one million) over that expected in an unexposed population.

The general population faces a lifetime risk of one in two hundred of getting any kind of cancer due to any reason (dietary habits, smoking, radiation, and occupational exposure, etc.). This high risk level is based on annual mortality statistics for 1976 (Crouch and Wilson, 1984).

Risk of a health impact occurring due to chronic exposure to noncarcinogens and carcinogens is evaluated in terms of RfDs (Rodericks, 1984). The criterion used for characterization is the sum of the individual chronic exposure risks (or the sum of the fractional RfDs) exceeding 100 percent. Again, health risks are considered to be additive where exposure to multiple chemicals is possible, and the one exposure/week frequency is assumed to be sufficient to elicit the response although animal test data are based on daily exposure via the diet.

5.5.1 Assumptions and Limitations

The quantitative risk characterization has many built-in assumptions and limitations that are related to toxicological factors, the interpretation of the chemical analytical data, and the appraisal of exposure.

A conservative approach has been taken to estimate the exposure levels and their duration and to characterize the hazards associated with the pesticides and 2,3,7,8-TCDD detected in the surface soils.

5.5.1.1 Toxicological Aspects

Assumptions used in determining the toxicological aspects are:

- Carcinogenic potency is based on a 95 percent upper bound limit and assumes a linear response for low dose extrapolation from higher doses in animal studies, interspecies (animal to man) correlation based on body area, and the conditional probability that a chemical that exhibits carcinogenicity in animals will have the same health impact on humans. The potency values were estimated using the most potent dose-response animal study data.

- In the absence of specific information regarding synergistic or antagonistic dose responses, exposure to multiple chemicals is assumed to produce an additive response.

- There is a limited toxicological data base for some contaminants that are present on site. Hence, these constituents are assumed to have the same toxicological impact as similar chemicals that have been well studied, e.g., acenaphthalene for chronic toxicity of PAHs.

- For the chemicals that exhibit a threshold below which the adverse effect is not expected to occur, LOAELs or NOAELs are used to develop RfDs for chronic and sub-chronic exposure for the most appropriate exposure mode.

- Unless there is information available in the toxicology data base concerning dermal and g.i. tract absorption rates, the assumed absorption rate is 100 percent. This will greatly overstate the toxicity because the highly immobile indicator chemicals found in the surface soils, e.g., pesticides, 2,3,7,8-TCDD and PAHs have already undergone physical transformation to

strongly adsorbed materials on the surface of the soil particles. Matrix effects have not been factored into the toxicity identification.

5.5.1.2 Exposure Considerations

Assumptions used to determine the exposure are:

- The contaminants are assumed to have infinite mass and the transport mechanisms are assumed to have reached equilibrium, i.e., the levels will not decrease due to exhaustion of the source and the levels will not reach a higher concentration.

  Environmental fate and transport mechanisms may attenuate actual concentrations over time, especially in the framework of life-time exposure (assumed to be 70 years for cancer risk quantitation). This assumption will tend to overestimate the actual risk.

- Exposure to indicator chemicals in surface soils by ingestion or inhalation is based on assumptions that characterize the probability of exposure, i.e., proximity to the site, accessibility, climatological conditions, and setting. This may tend to overstate/ understate the risks that are quantified.

- In quantifying exposure levels, the contaminants are assumed to be uniformly distributed over the defined area to result in a uniform exposure level. Chemical analytical data obtained from a biased sampling program, i.e., phased sampling locations were selected on the basis of where the contaminants are expected to be present and selecting atypical soil samples, would greatly overstate the soil contaminant levels.

  No contaminants, organic or inorganic are uniformly distributed in the soil media, they are usually confined to very small areas unless the contamination was caused by a massive liquid spill. This assumption will tend to greatly overestimate risk.

- Exposure to contaminants is assumed to remain constant over a lifetime, i.e., lifestyle changes due to age and actual residence time would tend to reduce exposure duration; thus, the quantitation of risk may be overstated.

- Intake of individual constituents in the sediments is considered to be the only source of exposure. This assumption may understate the quantified risks by assigning total body burden to the sediments, but it does represent the incremental risk posed by the site.

5.5.2 Limitations

There are several constraints on the assessment that limit the estimation of risk associated with contaminants found in the soils. The following factors, although they may not be all-inclusive, may limit the PHE.

5.5.2.1 Toxicological Aspects

- The assumptions regarding body weight, average lifetime of exposure, intake of contaminants, population characteristics, and lifestyle may not be representative for the actual exposed population. The most sensitive individual in the population is not identified. This may tend to overestimate/underestimate the actual risk.

- The assumption that infrequent exposure, i.e., 26 exposure episodes per year, will evoke the health effect similar to that exhibited in animal studies with daily exposure may be too conservative. There is no specific data addressing this aspect of chronic exposure.

- Detailed pharmacokinetic parameters, i.e., absorption rates, metabolic pathways, metabolic products, and elimination rates, etc., are not available for all of the detected compounds. When available, these factors are utilized in the risk assessment in a quantitative manner for differences in response due to the nature of constituents in sediments and the pure constituent administered in a corn oil or an olive oil carrier in the animal studies.

- An assumption of addivity to account for the toxic effects of exposure to multiple constituents in various physical and chemical forms does not allow any other quantification approach.

- The RfDs used in the chronic toxicity evaluation are based on ingestion of drinking water (not soils) with integral safety factors, i.e., allowance of 20 percent contribution only from drinking water, that may not be appropriate for this site-specific exposure pathway. Consequently, the PHE is limited by the lack of specific health based criteria for soil ingestion.

5.5.2.2 Exposure Considerations

- o Only "indicator chemicals" are considered in quantification of risks associated with the site. This is not considered to be a limitation because the risks associated with other chemical constituents will be several orders of magnitude lower than those associated with the selected contaminants.

- o This assessment is based on a present understanding of the site using the RI chemical analytical data. Conditions may have changed over time.

- o Human and environmental receptors are not delineated to any great extent. A door-to-door canvas would yield more accurate census figures and demographics. However, the evaluation uses conservative published estimates that most likely overstate the exposures.

5.5.2.3 Chemical Analytical Data

- o The extent of the sediment sampling program does not allow for a sharp delineation of the contaminant levels in the surface soils. However, the data base may be adequate to qualitatively characterize the extent of contamination and identify the areas of concern at the site.

- o The data base is not adequate to establish time trends for changes in environmental media concentrations.

- o Uncertainties associated with the quantitation of risk cannot be statistically quantified.

5.6 QUANTITATIVE RISK ASSESSMENT FOR INGESTION OF SURFACE SOILS

A quantitative risk assessment (QRA) for exposure to the pesticides and 2,3,7,8-TCDD via ingestion of contaminated surface soils focuses on the carcinogenic effects and those health impacts that may result from chronic exposure. The QRA calculates the cancer risk associated with each of the quadrants separately in order to focus remediation efforts that are most effective in reducing health risks.

5.6.1 Estimation of Cancer Risks

The definition of risks of a carcinogenic health effect is expressed as a linear model:

$P = 1 - e$ (dose X potency), where P = probability of health effect, or cancer risk (unitless)

where $P < 10^{-3}$, P (Cancer Risk) = dose X potency (5-1)

In the usual range of quantified cancer risks for environmental exposures, the cancer risk is essentially the product of the effective dose and carcinogenic potency. The calculations of cancer risks posed by each of the four zones of the site are presented in Appendix H.

The effective dose, or chronic daily intake (CDI) for ingestion of indicator chemicals in the surface soils is calculated by using the following equation:

$$D_e = \frac{(C_i)\ (SIR)\ (K)\ (EI)\ (YR)\ (AF)}{(L)\ (BW)\ (DY)} \qquad (5\text{-}2)$$

where:

D_e = effective dose (mg/kg/day);

C_i = concentration of chemical i in surface soils (mg/kg);

SIR = soil ingestion rate (100 mg/exposure incident);

K = conversion factor (1 kg/10^6 mg soils);

EI = exposure incidents (26/year)

YR = number of years of exposure (Scenario 1 - 11 years); (Scenario 2 - 63 years);

L = lifetime exposure (70-year equivalent of animal study lifetime);

BW = average body weight over number of years of exposure (Scenario 1 - 45.4 kg) (Scenario 2 - 65.7 kg);

DY = days per year (365.25 days/year);

AF = absorption factor (unitless).

By substituting the lower-bound estimates for soil ingestion rates, number of exposure incidents and number of years of exposure, and geometric mean concentrations; an excess cancer risk level based on most reasonable conditions can be calculated. Also, by using maximum observed concentrations and the upper-bound estimates for the above, a worst-case condition can be estimated.

The cancer risk estimates are presented in Table 22. These estimates are most likely overestimated. All of the indicator chemicals are present onsite as adsorbed material on soil particles; therefore, bioavailability is limited. Use of an absorption factor of 100% is extremely conservative. Also, the assumption of uniform distribution based on a few samples also overestimates the exposure level.

5.6.2 Estimation of Chronic Toxicity Risks

Quantification of noncarcinogenic risks (NCR) due to chronic exposure is accomplished by determination of the ratio of the effective dose (D_e) to the risk reference dose (RfD) established by U.S. EPA.

$$\text{Noncarcinogenic Risk (NCR)} = D_e/\text{RfD} \qquad (5\text{-}3)$$

A ratio that exceeds unity is indicative of a potential health risk due to chronic exposure to the indicator chemicals. A two-year exposure period is implicit in the determination and infrequent exposure is assumed to produce the same impact as daily exposure had in the animal studies used to establish the RfDs. The effective dose is estimated by the following equation:

$$D_e = \frac{(C_i)\ (SIR)\ (K)\ (EI)\ (AF)}{(BW)\ (DY)} \qquad (5\text{-}4)$$

where:

D_e = effective dose (mg/kg/day);
C_i = concentration of chemical i in surface soils (mg/kg);
SIR = soil ingestion rate (100 mg/exposure incident);
K = conversion factor (1 kg soils/10^6 mg soils);

TABLE 22
POTENTIAL EXCESS LIFETIME CANCER RISK
FROM INGESTION OF SURFACE SOILS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

INDICATOR CHEMICALS	QUADRANT I		QUADRANT II		QUADRANT III		QUADRANT IV	
	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND
BIS(2-ETHYLHEXYL) PHTHALATE	9.6E-11	2.3E-11	1.4E-10	6.2E-12	3.0E-11	5.9E-12	---	---
BENZO(A)PYRENE	7.8E-7	1.6E-7	2.2E-6	1.2E-7	2.2E-6	1.2E-7	---	---
ALDRIN	7.8E-6	1.8E-6	1.8E-4	2.8E-7	5.9E-4	1.1E-6	2.4E-4	9.6E-7
DIELDRIN	9.8E-6	2.3E-6	6.0E-4	2.3E-6	1.7E-4	4.1E-6	6.2E-4	6.9E-6
CHLORDANE	2.8E-6	6.1E-7	1.6E-5	5.7E-8	1.9E-4	3.8E-7	1.4E-5	4.4E-7
4,4'-DDT**	1.5E-8	3.0E-9	7.3E-7	3.2E-9	2.2E-7	1.8E-9	3.0E-7	7.0E-9
HEPTACHLOR**	7.1E-6	9.5E-7	6.8E-6	3.5E-7	2.2E-5	1.4E-7	2.6E-5	2.9E-7
2,3,7,8-TCDD***	---	---	8.0E-8	3.1E-6	1.1E-7	3.5E-9	---	---
TOTAL RISK ESTIMATE	2.9E-5	5.8E-6	8.1E-4	3.1E-6	9.8E-4	5.8E-6	9.0E-4	8.6E-6

* - All values are unit-less
** - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)
*** - Surface soils only

EI = exposure incidents (26/year);

AF = absorption factor (unitless, specific to exposure mode);

BW = body weight of most sensitive receptor (7-9 year old, 27.8 kg);

DY = days per year (365.25/year).

Upper and lower bound risks are estimated using maximum observed and geometric mean concentrations of the indicator chemicals in the surface soils. Table 23 is a tabulation of the NCRs estimated for each of the zones.

5.6.3 Summary of Potential Health Risks

The appropriate comparison criterion for potential cancer risks may be 10^{-5}, i.e. one additional cancer expected in an exposed population of 100,000 people over that of the unexposed group. This is the criterion used by the U.S. EPA Office of Drinking Water Safety (Federal Register, 1985) to set health goals for drinking water and by the U.S. EPA Office of Solid Waste to determine regulatory limits which define the toxicity parameter of a hazardous waste under RCRA (Federal Register, 1986).

Comparing the above criterion to the estimated potential cancer risks, the following describes the risks of each site zone:

- At lower bound (geometric mean soil concentrations) conditions, none of the zones exceed the above criterion.

- At the upper bound (maximum observed soil concentrations) conditions, all of the zones have associated risks that exceed the above criterion.

  - Zone I exceeds the criterion by 2.8 times due to possible exposure to aldrin (28 percent contribution to the total cancer risk estimate), dieldrin (35 percent), chlordane (10 percent) and heptachlor (25 percent).

  - Zone II total cancer risk exceeds the criterion by 81 times with almost all of the contribution from aldrin (22 percent) and dieldrin (74 percent).

TABLE 23
POTENTIAL NONCARCINOGENIC HEALTH RISKS
FROM INGESTION OF SURFACE SOILS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

INDICATOR CHEMICALS	QUADRANT I		QUADRANT II		QUADRANT III		QUADRANT IV	
	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND	UPPER BOUND	LOWER BOUND
BIS(2-ETHYLHEXYL) PHTHALATE	1.8E-5	1.7E-5	2.7E-5	4.7E-6	5.8E-6	4.5E-6	---	---
BENZO(A)PYRENE	4.3E-7	3.4E-7	1.2E-6	2.6E-7	1.2E-6	2.6E-7	---	---
ALDRIN	6.7E-2	5.6E-2	1.45	8.5E-3	4.52	3.3E-2	1.87	2.9E-2
DIELDRIN	2.9E-2	2.7E-2	1.77	2.7E-2	5.0E-1	4.9E-2	1.85	8.1E-2
CHLORDANE	1.7E-4	1.4E-4	9.0E-4	1.4E-5	1.0E-2	9.0E-5	8.5E-4	1.1E-4
4,4'-DDT**	2.3E-4	1.8E-4	1.1E-2	2.0E-4	3.0E-3	1.1E-4	5.0E-3	4.3E-4
HEPTACHLOR**	1.8E-1	9.9E-2	1.8E-1	3.7E-2	5.7E-1	1.5E-2	6.7E-1	3.0E-2
2,3,7,8-TCDD***	---	---	1.3E-2	1.4E-3	1.9E-2	2.0E-3	---	---
ENDRIN	1.2E-4	---	2.7E-3	8.3E-5	3.0E-3	8.4E-5	3.0E-3	2.5E-4
TOTAL RISK ESTIMATE	2.8E-1	1.8E-1	3.43	7.4E-2	5.63	9.9E-2	4.40	0.14

* - All values are unit-less
** - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)
*** - Surface soils only

- Zone III exceeds the criterion by 98 times with most of the contribution to total cancer risk attributed to aldrin (60 percent), dieldrin (17 percent), and chlordane (19 percent) due to an exceedingly high observed atypical concentration of 1,100 mg/kg.

- Zone IV exceeds the criterion by 90 times. Most of the risk is attributed to aldrin (27 percent) and dieldrin (69 percent).

Potential noncarcinogenic health risks (NCHR) do not exceed the criterion of less than unity for the total of the fractional RfDs in any of the zones where the geometric mean chemical concentrations were used to estimate risks. For the upper bound evaluation, the total NCHR exceeded the criterion in Zones II, III and IV:

- o Zone II: Total NCHR at 3.425 with 99 percent of the attribution to aldrin (42 percent), dieldrin (52 percent) and heptachlor (5 percent).

- o Zone III: Total NCHR at 5.633; aldrin, dieldrin and heptachlor providing 99 percent of the risk with aldrin/dieldrin at 80.9 percent and heptachlor at 10 percent, respectively.

- o Zone IV: Total NCHR at 4.402. All of the toxicity was associated with aldrin (42.5 percent), dieldrin (42 percent) and heptachlor (15.3 percent).

5.7 QUANTITATIVE RISK ASSESSMENT FOR INHALATION OF AIR PARTICULATES

The QRA for the air particulate inhalation pathway of exposure to the pesticides and 2,3,7,8-TCDD considers potential carcinogenic effects on the nearest receptor. Chronic toxicity is not considered on the basis that carcinogenic risk is the most sensitive parameter for risk characterization.

In order to determine the effective exposure dose, ambient air concentrations of air particulates, and thereby chemical concentrations, it must be assumed that the air particulates have the same chemical distribution as the affected soils. Emission rates were estimated using rapid assessment methods appearing in "Rapid Assessment of Exposure to Particulate Emissions From Surface Contamination Sites" (Cowherd, 1984) using the limited erosion potential model

(Cowherd, 1983). Using the total emissions estimated on the basis of surface area (for each quadrant) and a Gaussian Dispersion Model (Turner, 1970), air particulate concentrations were estimated.

The effective dose for inhalation of particulates in the surface soils were calculated by the following equation:

$$D_e = \frac{(C_i)\ (C_{ap})\ (IR)\ (K)\ YR)\ (AF)\ (WF)}{L\ (BW)} \qquad (5\text{-}5)$$

where:

D_e = effective dose (mg/kg/day);

C_i = concentration of chemical i in surface soils (mg/kg);

C_{ap} = concentration of air particulates at receptor location (mg/m^3 air);

IR = human inhalation rate (20 m^3 air/day);

K = conversion factor (1 kg soils/10^6 mg soils);

YR = number of years of exposure (70 years);

L = lifetime exposure (70 years);

BW = average body weight (70 kg adult);

WF = wind factor.

Upper- and lower-bound risk values are based on maximum observed and geometric mean concentrations of indicator chemicals in the surface soils. The cancer risk estimates are most likely overstated for both categories because:

- The exposure levels are assumed to be constant over a 70-year period, whereas the half-life in soils of the pesticides and 2,3,7,8-TCDD range from 3 to 12 years.
- The receptor is assumed to be exposed 24 hours/day when the wind is blowing in that direction.
- His behavior pattern (movements away from the exposure location, or the probability of his residing at the same location for a lifetime) are not considered.

TABLE 24
TOTAL POTENTIAL CANCER RISK
AT NEAREST RECEPTOR LOCATION*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

INDICATOR CHEMICALS	CANCER RISK QUADRANT I		CANCER RISK QUADRANT II		CANCER RISK QUADRANT III		CANCER RISK QUADRANT IV		RECEPTOR CANCER RISK TOTAL AT LOCATION	
	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.2E-14	2.1E-14	2.0E-14	3.7E-15	3.7E-15	2.9E-15	---	---	4.6E-14	2.7E-14
BENZO(A)PYRENE	2.0E-10	1.5E-10	3.5E-10	7.4E-11	1.8E-10	6.2E-11	---	---	7.3E-10	2.9E-10
ALDRIN	2.1E-9	1.7E-9	2.8E-8	1.7E-10	7.3E-8	5.3E-10	6.6E-8	1.0E-9	1.7E-7	3.4E-9
DIELDRIN	2.3E-9	2.1E-9	8.8E-8	1.4E-9	2.1E-8	2.0E-9	1.7E-7	7.4E-9	2.8E-7	1.3E-8
CHLORDANE	6.4E-10	5.3E-10	2.3E-9	3.4E-11	2.1E-8	1.8E-10	3.8E-9	4.8E-10	2.8E-8	1.2E-9
4,4'-DDT	1.7E-11	1.4E-11	5.4E-10	9.4E-12	1.3E-10	4.5E-12	4.1E-10	3.8E-11	1.1E-9	6.6E-11
HEPTACHLOR	1.7E-9	8.8E-10	1.0E-9	2.1E-10	2.7E-9	6.9E-11	7.1E-9	3.1E-10	1.3E-8	1.5E-8
2,3,7,8-TCDD	---	---	2.4E-9	2.4E-10	2.7E-9	3.4E-10	---	---	5.1E-9	5.8E-10
							TOTAL CANCER RISK		5.0E-7	3.3E-8

* - All values are unit-less

TABLE 25
INDICATOR CHEMICAL CONTRIBUTION
TO POTENTIAL CANCER RISK AND CHRONIC TOXICITY*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

INDICATOR CHEMICALS	QUADRANT I		QUADRANT II		QUADRANT III		QUADRANT IV	
	CANCER RISK	CHRONIC TOXICITY	CANCER RISK	CHRONIC TOXICITY	CANCER RISK	CHRONIC TOXICITY	CANCER RISK	CHRONIC TOXICITY
ALDRIN	28	---	22	42	60	80	27	42.5
DIELDRIN	35	---	74	52	17	9	69	42
CHLORDANE	10	---	2	0.026	19	0.18	1	---
HEPTACHLOR	25	---	0.008	5	2	10	3	15.3
2,3,7,8-TCDD	---	---	0.010	0.39	0.84	0.34	---	---
TOTAL PERCENT CONTRIBUTION (WITHIN QUADRANTS)	98	---	98	99	98	99	100	99.8

* - All values in percent

Table 24 presents the contribution to cancer risk from each of the zones and the total estimate of potential risk. At the postulated conditions, the risk would not exceed 10^{-6} (one additional cancer in a population of one million people over that in an unexposed population). Also, the estimated risks are most likely overestimated based on the extensive ground cover at the site.

5.8 SUMMARY OF THE RISK ASSESSMENT

The presence of aldrin, dieldrin, chlordane and heptachlor at high concentrations contributed to almost all of the potential excess lifetime cancer risk estimates. Table 25 tabulates the contribution of each of these indicator chemicals to the total potential cancer and chronic toxicity risk estimates. The remediation plan could focus on these indicator chemicals if clean-up is deemed necessary. However, the presence of 2,3,7,8-TCDD at concentrations above the recommended clean-up level of one microgram per kilogram (Kimbrough, 1983) by the Center for Disease Control (CDC) may dictate cleaning up affected soils. This clean-up level established by the CDC is based on residential soils where daily exposure could take place. A higher clean-up level may be more appropriate for the Riverdale site where access is limited by a fence that serves as a security barrier against trespass. Another aspect of the presence of 2,3,7,8-TCDD is the limitation on disposal alternatives due to its presence, although removal may be dictated by risks associated with aldrin/dieldrin, chlordane and heptachlor. Removal of aldrin/dieldrin could theoretically reduce the noncarcinogenic health risks to a value below the comparison criterion.

If the most reasonable (lower bound) risk estimates were deemed to be appropriate for this site, i.e., they do not exceed the selected criteria, a less rigorous remediation may be the most cost-effective solution that meets public health goals.

6.0 CONCLUSIONS

The following conclusions can be drawn as a result of the RI and PHE at the Riverdale Chemical Company site:

- Surface soils at the site are contaminated with BN/As, pesticides and 2,3,7,8-TCDD. The BN/As detected were primarily phthalates, PAHs, and phenols. The source of the BN/As appears to be the fly ash and cinders that constitute a majority of the fill at the site. The source of the pesticides and 2,3,7,8-TCDD appears to be the result of past pesticide formulation activities at the site.

- Subsurface soils (0 - 3 feet) at the site are contaminated with BN/As, pesticides, and 2,3,7,8-TCDD. The source of the contaminants are the same as for the surface soils.

- The classes of contaminants detected (phthalates, PAHs, phenols, pesticides, and 2,3,7,8-TCDD) generally have low water solubility rates, high soil adsorption coefficients, and low vapor pressure properties. Therefore, the contaminants detected will not be readily transported to surface/ground water or readily volatilize into the atmosphere.

- The primary mechanism of contaminant migration appears to be the physical transport of contaminated soil particles.

- The 2,3,7,8-TCDD contamination is limited to Quadrants II and III. The pesticide contamination is found throughout the site. The vertical extent of the 2,3,7,8-TCDD contamination appears to be limited to the surficial three feet of soil. The vertical extent of the pesticide contamination was not determined, however, due to the fact that the pesticides behave similar to 2,3,7,8-TCDD in terms of mobility in soils, the vertical extent of the pesticide contamination is expected to be similar to that of the 2,3,7,8-TCDD contamination.

- Potential exposure pathways include site trespassers who may ingest contaminated soils and persons residing downwind of the site who may inhale air particulates mobilized by wind erosion.

- For the site trespass/soil ingestion scenario, the health risk based on the lower bound geometric mean concentrations of pesticides does not exceed the

potential cancer risk criteria of 1×10^{-5}. The health risk based on the upper bound maximum observed concentrations for the pesticides exceed the potential cancer risk criteria of 1×10^{-5} in all site quadrants. The health risk based on the maximum observed concentration for 2,3,7,8-TCDD does not exceed the cancer risk criteria in any site quadrant.

- For the site trespass/soil ingestion scenario, the lower bound geometric mean concentrations of pesticides do not exceed the potential noncarcinogenic health risk criteria of less than unity. The upper bound maximum observed concentrations for pesticides exceed the NCHR criteria in Quadrants II, III, and IV.

- For the air particulate inhalation scenario, the potential cancer risk criteria is not exceeded by either the upper bound maximum observed or lower bound geometric mean concentrations.

- The upper bound concentrations of aldrin, dieldrin, chlordane and heptachlor contributed to almost all of the potential excess lifetime cancer risk. Remediation of these parameters could reduce the NCHR to values below the established criteria.

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APPENDIX
A

APPENDIX A

SCOPE OF WORK DOCUMENTS

APPENDIX A

SAMPLING PLAN

REMEDIAL INVESTIGATION/

FEASIBILITY STUDY

RIVERDALE CHEMICAL COMPANY

CHICAGO HEIGHTS, ILLINOIS

(Excerpted from the Quality Assurance Project Plan)

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1.0 INTRODUCTION

Remedial Investigation activities conducted by IT Corporation (IT) at the Riverdale Chemical Company's (Riverdale) plant will include the following activities noted below.

Nine soil borings will be drilled to a depth of 10-15 feet, or deeper if necessary. Approximately 100 soil samples will be collected from these borings. Initially, a total of 16 of these samples will be selected for testing of 2,3,7,8 tetrachlorodibenzo-p-dioxin (Dioxin) using rapid sample test turnaround time. Four of the 16 samples will be tested for Hazardous Substances List (HSL) organics and pesticides. Twenty surface soil samples will be collected at various on- and off-site locations. Fourteen samples will be tested for Dioxin and six composite samples will be tested for HSL organic and pesticide compounds.

Depending on the results of the initial testing, additional testing and sampling phases may need to be conducted in order to define the extent of contamination at the Riverdale site. This sampling plan details only the initial sampling and testing phase.

In the following sections of this sampling plan, information is presented on the proposed sampling locations and numbering system; drilling and sampling procedures; QA/QC sampling procedures; sample handling and analyses; decontamination procedures; field documentation procedures; organization, responsibilities, and training of the field team; and the schedule for field activities.

December 19, 1985

Project No. 850037

Dr. Michael J. Champion
Riverdale Chemical Company
220 East 17th Street
Chicago Heights, IL 60411

Proposed Scope of Work
Phase II Remedial Investigation
Riverdale Chemical Company
Chicago Heights, Illinois

Dear Dr. Champion:

International Technology Corporation (IT) is pleased to submit this proposed scope of work for the second phase of the Remedial Investigation at the Riverdale Chemical Company (Riverdale) site.

1.0 INTRODUCTION

IT Corporation was retained by Riverdale to conduct the Phase I Remedial Investigation in accordance with the consent decree entered into by Riverdale and U.S. EPA Region V. The field program was carried out in October of 1985 and involved collection of samples from soil boring and surface soil sampling locations. The samples were analyzed for 2,3,7,8-TCDD, Hazardous Substance List (HSL) organics and pesticides. The results of this investigation were presented to U.S. EPA Region V in the Phase I Remedial Investigation report dated December 11, 1985.

The findings of the report indicate that:

- 2,3,7,8-TCDD contamination is present off-site. Independent testing has confirmed its presence in soils immediately adjacent to Riverdale's western property boundary. It has also been detected in erosional drainage ways leaving the property to the south.

- The chlorinated pesticides, aldrin, dieldrin, chlordane, 4,4'-DDE, 4,4'-DDD, and heptachlor have been detected in high concentrations in composite soil sample SS-(08, 09, 10, 11), which is located near the front of the plant.

Based on these findings, IT had recommended that a second phase of sampling and soil analysis be conducted to define the off-site extent of 2,3,7,8-TCDD contaminated soils and to better define the extent of pesticide contaminated soils near the front of the plant. This information is needed to assess site hazards and to develop and evaluate remedial alternatives. The proposed scope of work is presented in the following sections.

2.0 INITIAL REMEDIAL MEASURES (IRM'S)

Because of the high visibility of this site, IT recommends that Riverdale take immediate steps to cover those areas where 2,3,7,8-TCDD has been detected in off-site soils. We specifically recommend the following IRM's:

2.1 WESTERN PROPERTY BOUNDARY AND ADJACENT (CHS) PROPERTY

Efforts should be made to cover the strip of barren soil over an area defined by the southwest corner of the Riverdale property (SS-16), north to a point approximately 25 feet north of sampling point SS-15, east approximately 30 feet and south to a line parallel to the southern property boundary running through sampling point SS-16. The approximate area is outlined on Figure 1.

This can be accomplished by laying down a geotextile fabric tarp similar to the one covering the tarped area east of the tank farm. As an alternative, crushed stone or gravel can be used to cover the exposed area. The advantage to using the tarp over the crushed stone is that the volume of potentially contaminated materials resulting from contact with the soil is greatly minimized. This will minimize the over volume of soil which may eventually have to be cleaned up, thereby minimizing the overall cost of mitigation.

2.2 SOUTHERN PROPERTY BOUNDARY AND EROSIONAL DRAINAGEWAYS

Efforts should be made to prevent additional sediment transport off the site via the erosional drainage ways emanating from the southern property boundary. Towards this end, IT recommends that straw be placed along the fence at the heads of these drainage ways. The straw will act as a sediment trap for potentially contaminated soil particles and will help to slow water velocity, thereby reducing potential for erosion during the spring runoff.

3.0 PHASE II SOIL SAMPLING

IT recommends that additional surface soil sampling be conducted on the adjacent properties to the south and west of the Riverdale site, and on the soils at the front of the plant. The specifics are presented below.

3.1 SAMPLING ON CHICAGO HEIGHTS STEEL PROPERTY

Surface soil samples will be collected along three east-west trending transects running perpendicular to the western property boundary. Samples will be collected at distances of 15, 30 and 45 feet from the fence. A maximum of nine samples will be collected. Tentative locations are shown in Figure 1.

At each location, a square approximately 8 X 8 inches will be inscribed on the ground surface. The soil will be scored and scraped to a depth of approximately one inch and placed in a stainless steel tray. All tools will be stainless steel to facilitate equipment decontamination. The soils will be thoroughly mixed and a portion will be placed in a labeled, specially cleaned 500 ml glass amber jar. Each location will be marked with a wooden or steel stake showing the location number.

Samples from the 15 and 30 foot distances (a total of six samples) will be submitted for analysis of 2,3,7,8-TCDD. If the samples collected from the 30-foot location indicate that dioxin is present, the samples from the 45-foot location will be submitted for analysis. This stepped approach is an economical way of bracketing the contaminated areas.

Analytical services will be provided by IT's analytical laboratory in Knoxville, Tennessee. Strict chain-of-custody procedures will be followed. Sample documentation will be in accordance with the Quality Assurance Project Plan (QAPP) previously approved for this site.

3.2 SAMPLING IN EROSIONAL DRAINAGE WAYS

Additional surface soil samples will be collected from the erosional drainage ways emanating from the southern property boundary. During the Phase I remedial investigation, three principle erosional channels were observed. The general location is indicated in Figure 1.

IT proposes to collect one surface soil sample from each drainage way. The sample will be taken from the furthest extent of barren soils at each location. Approximate locations are shown in Figure 1. Sample collection methodology, decontamination and documentation procedures will be identical to those described in Section 3.1.

4.0 ANALYTICAL TESTING

All analytical work will be conducted by IT's laboratory in Knoxville, Tennessee. This lab has been previously approved for analyses of 2,3,7,8-TCDD and HSL organics by U.S. EPA Region V. All work will be performed in accordance with Contract Lab Program protocols.

The following samples will be submitted for analysis:

- Nine soil samples (six from CHS property west of the site and three from erosional channels south of the site) plus one blank and one duplicate will be submitted for analysis of 2,3,7,8-TCDD.

- The four individual samples comprising composite sample SS-(08, 09, 10, 11) will each be submitted for analysis of pesticides.

- Surface soil sampling location SS-15 will be resampled, due to the difficulties encountered during analysis. If the same difficulties are encountered with similar results, the sample may be sent to a laboratory having a high resolution mass spectrometer (HRMS). (IT does not currently have HRMS capabilities.)

5.0 QUALITY ASSURANCE PROJECT PLAN

All QA/QC and health and safety procedures outlined in the QAPP written for the Riverdale Remedial Investigation will be observed during the Phase II RI. This document was approved by the Quality Assurance Office of U.S. EPA Region V on October 3, 1985, and is assumed to be valid for all additional phases of the RI, unless expressly stated by EPA. It is included here by reference.

6.0 SCHEDULE AND COST

It is estimated that the Phase II Remedial Investigation will take approximately eight weeks from notice to proceed to issuance of the Phase II RI report. The field program can be completed in a day. Analytical turnaround time is estimated to take four weeks.

The estimated cost of the Phase II RI is approximately $18,000. This work is considered to be an add-on to the original scope of work and is not covered by the original budget estimate.

IT is prepared to proceed with the Phase II RI within one week following notification to proceed. Authorization can be given by signing the attached copy of the work order and returning it to us at your earliest possible convenience. The terms and conditions of the work order are covered by the Master Services Agreement between Riverdale and IT Corporation.

I hope this proposed scope of work meets your needs at this time and look forward to providing additional work for you and your company. If you have any questions, please do not hesitate to call.

Sincerely,

Mark L. Hinchey
Project Hydrogeologist

MLH/lkp

:L17

CLIENT Riverdale Chemical Company

CONTACT Dr. Michael Champion

ADDRESS 210 E. 17th Street

Chicago Heights, IL 60411

CONTRACT NO. 850037

APPENDIX A

WORK ORDER NO. 2

This Appendix A is a work Order under the Master Services Agreement dated 2-25-85 by and between IT Corporation and CLIENT.

(1) The scope of work to be performed by IT is as described below, or in the documents referred to below which are by reference made a part hereof.

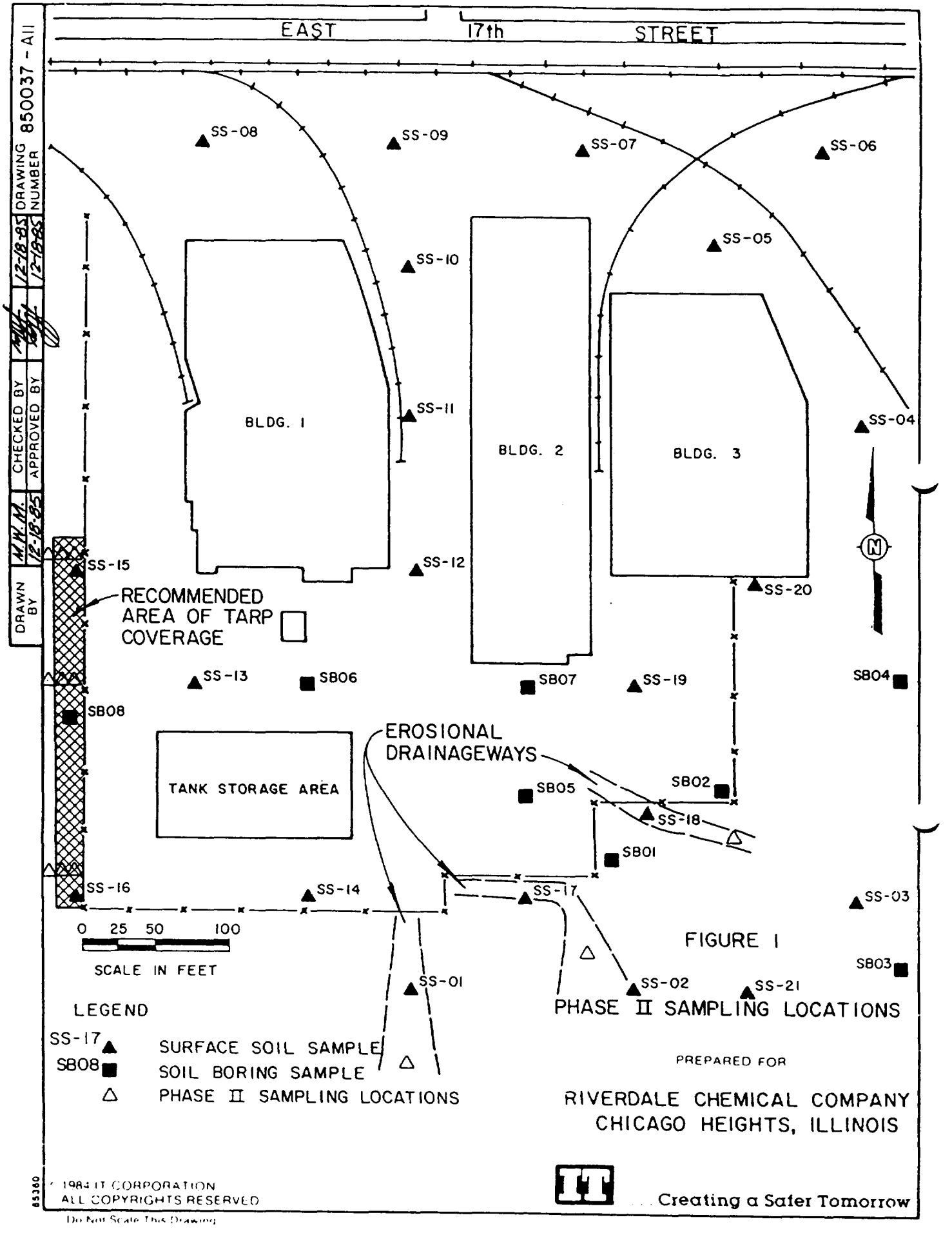
(2) Changes in or additions to the scope of work, including any special conditions applicable thereto, shall be described in separate documentation which references this Order. By mutual agreement, additions to the scope of work may include services wholly unrelated to the initial scope of work.

SCOPE OF WORK Perform soil sampling and analytical work as described in proposed scope of work: Phase II Remedial Investigation

OTHER SPECIAL PROVISIONS Cost not to exceed $20,000

ACCEPTANCE OF THE WORK ORDER

CLIENT	IT CORPORATION
By	By Michael J. Farrell
Title	Manager, Project Administration
Date	12/19/85


EAST 17th STREET
SS-08
SS-09
SS-07
SS-06
SS-05
SS-10
SS-11
SS-04
SS-12
SS-20
SS-15
SS-13
SS-19
SS-18
SS-16
SS-14
SS-17
SS-03
SS-01
SS-02
SS-21
BLDG. 1
BLDG. 2
BLDG. 3
TANK STORAGE AREA
RECOMMENDED AREA OF TARP COVERAGE
EROSIONAL DRAINAGEWAYS
SB06
SB07
SB04
SB08
SB05
SB02
SB01
SB03
N
0 25 50 100
SCALE IN FEET
LEGEND
SS-17 SURFACE SOIL SAMPLE
SB08 SOIL BORING SAMPLE
PHASE II SAMPLING LOCATIONS
FIGURE 1
PHASE II SAMPLING LOCATIONS
PREPARED FOR
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
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APPENDIX
B

APPENDIX B

CLIMATOLOGICAL DATA

CLIMATOGRAPHY OF THE UNITED STATES NO. 20

PARK FOREST, IL

PERIOD: 1951-80
ELEVATION: 710 FT

CLIMATOLOGICAL SUMMARY

	TEMPERATURE (F) MEANS			EXTREMES						MEAN NUMBER OF DAYS				DEGREE DAYS		PRECIPITATION TOTALS (INCHES)						SNOW			MEAN NUMBER OF DAYS		
										MAX		MIN															
	DAILY MAXIMUM *	DAILY MINIMUM *	MONTHLY *	RECORD HIGHEST	YEAR	DAY	RECORD LOWEST	YEAR	DAY	90 AND ABOVE	32 AND BELOW	32 AND BELOW	0 AND BELOW	HEATING BASE 65 *	COOLING BASE 65 *	MEAN *	GREATEST MONTHLY *	YEAR	GREATEST DAILY	YEAR	DAY	MEAN	MAXIMUM MONTHLY	YEAR	10 OR MORE	50 OR MORE	1.00 OR MORE
JAN	29.6	13.1	21.4	65+	67	24	-22+	77	17	0	17	29	7	1352	0	1.53	4.47	65	2.03	51	02	10.2	30.8	79	3	1	0
FEB	34.3	17.3	25.9	68+	76	28	-17+	79	5	0	11	26	3	1095	0	1.42	3.07	56	1.64	76	21	6.9	17.8	56	3	1	0
MAR	44.6	27.0	35.8	79	63	29	-5+	62	1	0	4	23	0	905	0	2.58	6.30	76	1.60	59	26	5.4	16.0	72	5	2	0
APR	59.0	38.3	48.7	89+	80	23	15+	72	8	0	0	8	0	489	0	4.07	7.07	67	2.18	76	25	1.1	9.1	70	8	3	1
MAY	70.5	48.2	59.4	93+	67	26	25+	66	10	1	0	1	0	223	49	3.66	6.97	74	3.30	51	10	.0	.0		7	2	1
JUN	80.6	58.2	69.4	101+	53	20	36+	72	11	5	0	0	0	37	169	4.33	8.29	57	4.25	74	06	.0	.0		7	3	1
JUL	83.9	62.9	73.4	100+	66	10	44	51	6	6	0	0	0	0	264	4.12	7.41	69	2.97	57	12	.0	.0		6	3	1
AUG	82.2	61.4	71.8	98+	64	3	42+	65	29	4	0	0	0	10	221	3.57	8.35	68	4.95	68	16	.0	.0		5	2	1
SEP	75.8	53.9	64.9	99+	53	2	32+	74	23	2	0	0	0	76	73	3.03	8.46	77	3.19	61	23	.0	.0		5	2	1
OCT	64.4	42.8	53.6	91+	63	6	17+	52	29	0	0	4	0	368	15	2.71	10.13	54	5.93	54	10	.2	3.7	67	5	2	0
NOV	48.2	30.7	39.5	77+	78	6	0+	58	30	0	2	18	0	765	0	2.18	5.59	79	1.80	68	28	2.2	14.0	51	5	1	0
DEC	35.2	19.7	27.5	66+	70	3	-16+	60	23	0	12	27	2	1163	0	2.04	6.75	71	2.77	71	10	8.2	30.6	51	4	1	0
YEAR	59.0	39.5	49.3	101	JUN 53	20	-22	JAN 77	17	18	46	136	12	6483	791	35.24	10.13	OCT 54	5.93	OCT 54	10	34.2	30.8	JAN 79	63	23	6

* FROM 1951-80 NORMALS

ESTIMATED VALUE BASED ON DATA FROM SURROUNDING STATIONS

+ ALSO ON EARLIER DATES

DEGREE DAYS TO SELECTED BASE TEMPERATURES (F)

BASE	HEATING DEGREE DAYS												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
[illegible]	1352	1095	905	489	223	37	0	10	76	368	765	1163	6483
[illegible]	1197	955	750	346	132	10	0	0	20	240	615	1008	5273
[illegible]	1104	871	657	265	87	0	0	0	7	179	525	915	4610
[illegible]	1042	815	601	216	62	0	0	0	0	145	465	853	4199
[illegible]	887	675	456	118	23	0	0	0	0	71	328	698	3256

BASE	COOLING DEGREE DAYS												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
[illegible]	0	0	6	27	198	432	570	521	301	101	0	0	2156
[illegible]	0	0	0	16	161	376	508	459	244	74	0	0	1838
[illegible]	0	0	0	7	113	292	415	366	167	42	0	0	1402
[illegible]	0	0	0	0	49	169	264	221	73	15	0	0	791
[illegible]	0	0	0	0	18	84	128	105	18	0	0	0	353

[illegible] 1951-80 NORMALS

PROBABILITY THAT THE MONTHLY PRECIPITATION WILL BE EQUAL TO OR LESS THAN THE INDICATED PRECIPITATION AMOUNT

MONTHLY PRECIPITATION (INCHES)

PROBABILITY LEVELS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.05	.36	.25	.66	1.57	1.44	1.39	1.66	.77	.46	48	.58	32
.10	.50	.38	.90	1.94	1.78	1.80	2.04	1.10	.71	72	78	[illegible]
.20	.72	.59	1.28	2.48	2.26	2.41	2.57	1.62	1.15	1.11	1.10	[illegible]
.30	.92	.78	1.61	2.93	2.66	2.92	3.01	2.10	1.57	1.48	1.38	[illegible]
.40	1.12	.98	1.93	3.36	3.03	3.42	3.43	2.57	2.00	1.86	1.65	[illegible]
.50	1.34	1.19	2.28	3.79	3.42	3.94	3.85	3.08	2.48	2.27	1.94	[illegible]
.60	1.58	1.43	2.66	4.26	3.83	4.51	4.31	3.65	3.03	2.74	2.25	[illegible]
.70	1.86	1.73	3.11	4.80	4.31	5.18	4.84	4.34	3.70	3.31	2.63	[illegible]
.80	2.23	2.12	3.71	5.49	4.91	6.03	5.51	5.24	4.59	4.06	3.12	[illegible]
.90	2.83	2.76	4.64	6.56	5.84	7.37	6.54	6.68	6.06	5.28	3.90	[illegible]
.95	3.39	3.36	5.52	7.52	6.69	8.60	7.47	8.04	7.46	6.44	4.62	[illegible]

THESE VALUES WERE DETERMINED FROM THE INCOMPLETE GAMMA DISTRIB[illegible]

116616 PARK FOREST, IL

LAT: DEG MIN 41 30N LONG: DEG MIN 87 41W

PERIOD: 1951-80

FREEZE DATA

PROBABILITY OF LATER DATE IN SPRING (THRU JULY 31) THAN INDICATED(*)

SPRING FREEZE DATES (MO/DAY)

TEMP (F)	.90	.80	.70	.60	.50	.40	.30	.20	.10
36	4/27	5/03	5/07	5/10	5/13	5/16	5/20	5/24	5/29
32	4/14	4/19	4/23	4/26	4/29	5/02	5/05	5/09	5/14
28	4/03	4/07	4/10	4/12	4/15	4/17	4/20	4/23	4/27
24	3/23	3/27	3/30	4/02	4/05	4/07	4/10	4/13	4/17
20	3/07	3/12	3/16	3/19	3/23	3/26	3/29	4/02	4/07
16	2/25	3/03	3/07	3/11	3/15	3/19	3/22	3/27	4/02

PROBABILITY OF EARLIER DATE IN FALL (BEGINNING AUG 1) THAN INDICATED(*)

FALL FREEZE DATES (MO/DAY)

TEMP (F)	.10	.20	.30	.40	.50	.60	.70	.80	.90
36	9/23	9/28	10/01	10/04	10/06	10/09	10/12	10/15	10/20
32	10/02	10/07	10/11	10/14	10/17	10/20	10/23	10/27	11/01
28	10/13	10/18	10/22	10/25	10/28	11/01	11/04	11/08	11/13
24	10/23	10/29	11/02	11/05	11/08	11/11	11/15	11/19	11/24
20	11/04	11/09	11/12	11/15	11/18	11/21	11/24	11/28	12/02
16	11/13	11/18	11/21	11/24	11/26	11/29	12/02	12/05	12/09

PROBABILITY OF LONGER THAN INDICATED FREEZE FREE PERIOD (DAYS)

FREEZE FREE PERIOD

TEMP (F)	.10	.20	.30	.40	.50	.60	.70	.80	.90
36	166	159	154	150	146	141	137	132	125
32	192	184	179	174	170	166	161	156	149
28	214	208	203	200	196	192	189	184	178
24	239	231	226	221	217	212	208	202	195
20	262	254	249	244	240	236	231	226	218
16	281	272	266	261	256	250	245	239	230

(*)PROBABILITY OF OBSERVING A TEMPERATURE AS COLD, OR COLDER, LATER IN THE SPRING OR EARLIER IN THE FALL THAN THE INDICATED DATE. 0/00 INDICATES THAT THE PROBABILITY OF OCCURRENCE OF THRESHOLD TEMPERATURE IS LESS THAN INDICATED PROBABILITY.

GROWING DEGREE UNITS TO SELECTED BASE TEMPERATURES (F)

GROWING DEGREE UNITS

BASE		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
40	M	6	11	74	291	608	889	1042	993	754	435	119	19	5241
	S	6	17	91	382	990	1879	2921	3914	4668	5103	5222	5241	
45	M	2	3	36	184	458	739	887	838	604	299	63	7	4120
	S	2	5	41	225	683	1422	2309	3147	3751	4050	4113	4120	
50	M	0	1	15	106	319	589	732	683	456	185	29	1	3116
	S	0	1	16	122	441	1030	1762	2445	2901	3086	3115	3116	
55	M	0	0	5	53	202	441	577	528	314	102	11	0	2233
	S	0	0	5	58	260	701	1278	1806	2120	2222	2233	2233	
60	M	0	0	1	22	114	300	422	375	192	49	3	0	1478
	S	0	0	1	23	137	437	859	1234	1426	1475	1478	1478	

M = MONTHLY DATA S = SUM OF MONTHLY DATA

GROWING DEGREE UNITS FOR CORN

CORN	M	3	6	45	171	369	579	708	669	473	258	66	10	3357
	S	3	9	54	225	594	1173	1881	2550	3023	3281	3347	3357	

NOTE: FOR CORN THE BASE IS 50, AND THE DEGREE UNITS ARE ADJUSTED FOR TEMPERATURES BELOW 50 AND ABOVE 86

OTHER CLIMATOLOGICAL DATA ARE AVAILABLE IN A VARIETY OF SUMMARIES AND FORMATS, SUCH AS THE CLIMATOGRAPHY OF THE UNITED STATES: NO. 60 - CLIMATE OF STATES: NO. 81 - MONTHLY NORMALS (AND SUPPLEMENTS: ANNUAL DEGREE DAYS TO SELECTED BASES DERIVED FROM THE 1951-80 NORMALS: AND MONTHLY PRECIPITATION PROBABILITIES, SELECTED PROBABILITY LEVELS DERIVED FROM THE 1951-80 NORMALS); NO 84 - DAILY NORMALS: NO. 85 - DIVISIONAL NORMALS. A VARIETY OF DATA IS AVAILABLE EITHER ON MAGNETIC TAPE, MICROFICHE, OR PAPER COPY.

TO OBTAIN INFORMATION ABOUT CLIMATOLOGICAL DATA AND RELATED PUBLICATIONS, CONTACT:

DIRECTOR
NATIONAL CLIMATIC DATA CENTER
FEDERAL BUILDING
ASHEVILLE, NC 28801-2696
(OR TELEPHONE: (704) 259-0682)

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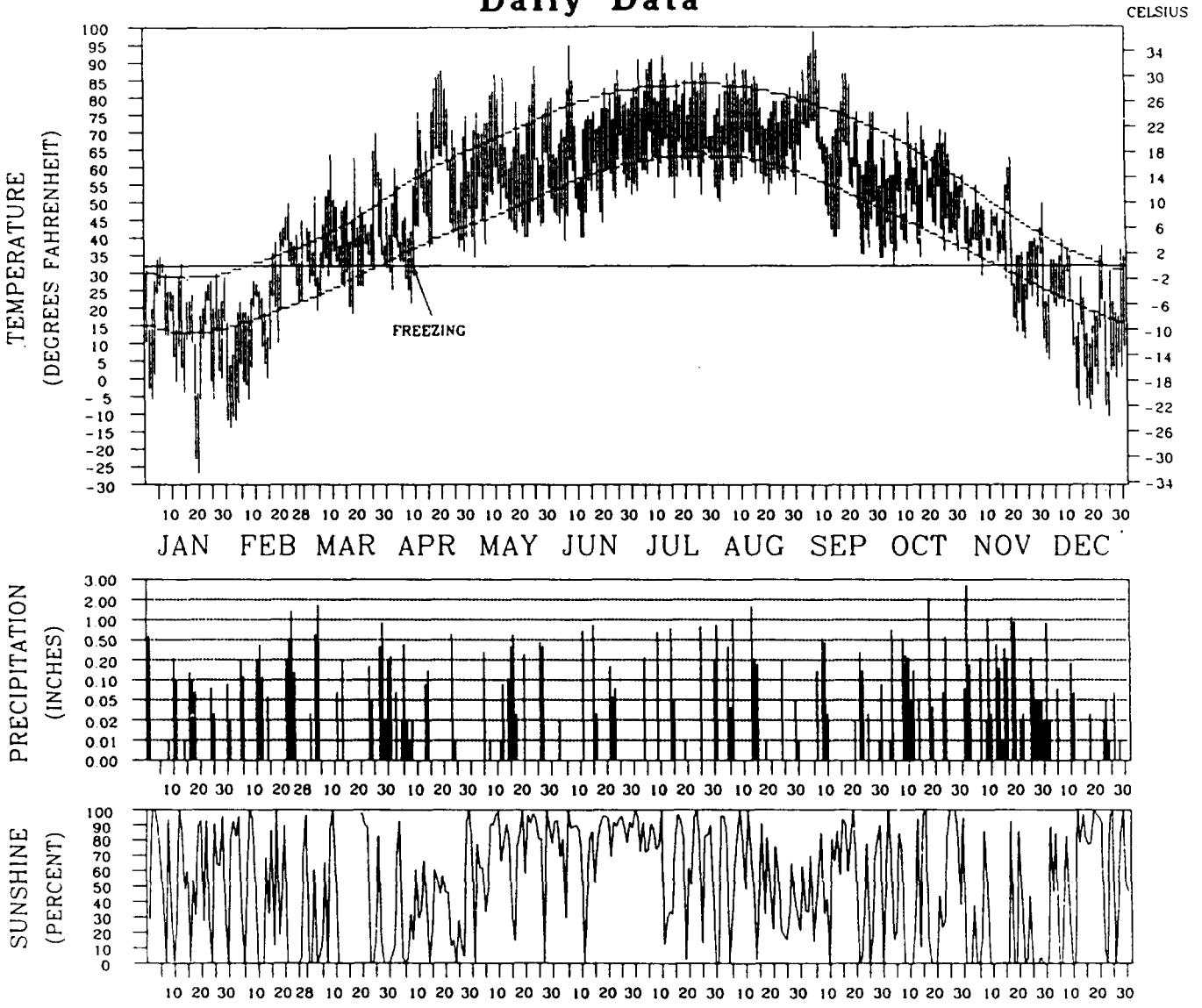
NATIONAL CLIMATIC DATA CENTER
ASHEVILLE, NC

USCOMM-NOAA-ASHEVILLE, NC 7/84/200

ISSN 0198-1846

1985 LOCAL CLIMATOLOGICAL DATA
ANNUAL SUMMARY WITH COMPARATIVE DATA
CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

Daily Data



TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)
PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR
SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

Kenneth D. Wadlow
DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE
NATIONAL CLIMATIC DATA CENTER ASHEVILLE NORTH CAROLINA

METEOROLOGICAL DATA FOR 1985

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

LATITUDE: 41°59' N LONGITUDE: 87°54' W ELEVATION: FT. GRND 658 BARO 692 TIME ZONE: CENTRAL WBAN: 94846

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:													
Averages													
-Daily Maximum	23.2	28.2	48.1	62.9	72.5	75.1	82.8	80.0	76.3	62.4	44.4	26.2	56.8
-Daily Minimum	5.6	12.5	30.6	42.2	47.8	52.0	59.9	58.4	54.5	42.5	31.1	7.8	37.1
-Monthly	14.4	20.4	39.4	52.6	60.2	63.6	71.4	69.2	65.4	52.5	37.8	17.0	47.0
-Monthly Dewpt.	8.0	15.3	29.3	41.8	46.2	49.8	59.2	59.7	54.7	42.4	32.2	9.1	37.3
Extremes													
-Highest	35	50	70	88	89	95	92	90	99	76	63	50	99
-Date	6	23	27	21	26	8	13	9	7	12	19	1	SEP 7
-Lowest	-27	-14	18	21	34	39	51	50	35	32	11	-11	-27
-Date	20	1	18	9	3	6	17	3	25	6	24	25	JAN 20
DEGREE DAYS BASE 65 °F:													
Heating	1563	1245	787	418	183	103	0	6	141	380	813	1480	7119
Cooling	0	0	0	53	42	71	204	142	158	0	0	0	670
% OF POSSIBLE SUNSHINE	55	44		38	73	80	65	54	52	47	16	58	
AVG. SKY COVER (tenths)													
Sunrise - Sunset	5.9	6.7	6.7	6.6	6.1	6.3	5.8	6.8	6.8	7.0	9.0	5.8	6.6
Midnight - Midnight	5.7	6.5	6.3	5.9	5.4	5.8	5.2	6.2	6.1	6.5	8.7	5.8	6.2
NUMBER OF DAYS:													
Sunrise to Sunset													
-Clear	11	6	6	5	10	3	9	5	4	8	2	10	79
-Partly Cloudy	5	6	9	10	6	16	10	8	12	4	3	7	96
-Cloudy	15	16	16	15	15	11	12	18	14	19	25	14	190
Precipitation .01 inches or more	12	10	12	10	11	7	8	10	10	13	21	11	135
Snow, Ice pellets 1.0 inches or more	9	5	0	0	0	0	0	0	0	0	0	2	16
Thunderstorms	0	2	2	3	5	4	4	4	4	5	2	0	35
Heavy Fog, visibility 1/4 mile or less	0	2	1	1	0	0	0	1	1	0	3	0	9
Temperature °F													
-Maximum													
90° and above	0	0	0	0	0	1	6	1	4	0	0	0	12
32° and below	27	17	1	0	0	0	0	0	0	0	2	19	66
-Minimum													
32° and below	31	25	21	6	0	0	0	0	0	1	13	31	128
0° and below	11	8	0	0	0	0	0	0	0	0	0	9	28
AVG. STATION PRESS. (mb)	992.2	995.3	992.2	990.2	988.5	990.2	991.2	993.9	994.9	994.6	993.9	993.2	992.6
RELATIVE HUMIDITY (%)													
Hour 00	76	83	75	80	73	72	82	85	79	78	81	74	78
Hour 06 (Local Time)	78	84	83	85	76	74	84	88	83	84	81	75	81
Hour 12	69	72	63	56	51	53	54	58	60	57	72	64	61
Hour 18	73	75	66	60	47	49	55	62	65	68	78	70	64
PRECIPITATION (inches):													
Water Equivalent													
-Total	1.48	3.46	4.73	1.48	2.79	1.97	3.75	3.90	1.82	4.98	8.22	1.49	40.07
-Greatest (24 hrs)	1.36	1.90	2.39	0.66	0.88	0.87	1.06	1.68	0.95	2.12	2.80	0.94	2.80
-Date	PM- 1	22-23	3- 4	23-24	26-27	15	30-31	13	8- 9	18-19	1- 2	1	NOV 1- 2
Snow, Ice pellets													
-Total	18.9	13.3	0.3	T	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	38.8
-Greatest (24 hrs)	7.5	6.0	0.3	T	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.4	7.5
-Date	PM- 1	10-11	3	8							21-22	1- 2	JAN PM- 1
WIND:													
Resultant													
-Direction (!!!)	281	272	253	236	225	328	246	198	196	176	003	261	257
-Speed (mph)	7.9	5.6	1.7	3.0	1.7	0.7	1.8	0.7	3.8	1.4	2.0	7.2	2.5
Average Speed (mph)	12.6	11.7	12.3	10.9	10.4	9.3	8.5	7.1	9.5	9.7	10.5	10.6	10.3
Fastest Obs. 1 Min.													
-Direction (!!!)	33	29	26	03	01	27	30	28	20	19	26	24	26
-Speed (mph)	33	30	37	28	33	22	26	28	24	33	30	29	37
-Date	25	18	4	16	16	22	9	24	23	8	16	1	MAR 4
Peak Gust													
-Direction (!!!)	NW	N	W	NE	W	W	S		SW	S	W	SW	
-Speed (mph)	49	43	52	35	51	46	31		36	46	44	40	
-Date	25	12	4	16	31	22	4		23	8	16	1	

(!!!) See Reference Notes on Page 68

NORMALS, MEANS, AND EXTREMES

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

LATITUDE: 41°59'N LONGITUDE: 87°54' W ELEVATION: FT. GRND 658 BARO 692 TIME ZONE: CENTRAL WBAN: 94846

	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:														
Normals														
-Daily Maximum		29.2	33.9	44.3	58.8	70.0	79.4	83.3	82.1	75.5	64.1	48.2	35.0	58.7
-Daily Minimum		13.6	18.1	27.6	38.8	48.1	57.7	62.7	61.7	53.9	42.9	31.4	20.3	39.7
-Monthly		21.4	26.0	36.0	48.8	59.0	68.6	73.0	71.9	64.7	53.5	39.8	27.6	49.2
Extremes														
-Record Highest	27	61	71	87	91	93	99	102	99	99	91	78	71	102
-Year		1967	1976	1981	1980	1977	1983	1980	1983	1985	1963	1978	1982	JUL 1980
-Record Lowest	27	-27	-17	-8	7	24	36	40	41	28	17	1	-25	-27
-Year		1985	1967	1962	1982	1966	1972	1965	1965	1974	1981	1976	1983	JAN 1985
NORMAL DEGREE DAYS:														
Heating (base 65°F)		1352	1092	899	486	224	38	0	9	75	368	756	1156	6455
Cooling (base 65°F)		0	0	0	0	41	146	252	223	66	12	0	0	740
% OF POSSIBLE SUNSHINE	5	45	44	50	47	60	69	68	64	57	49	33	43	52
MEAN SKY COVER (tenths)														
Sunrise - Sunset	27	6.8	6.8	7.3	6.8	6.3	6.0	5.5	5.7	5.8	6.0	7.2	7.2	6.5
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	27	7.0	6.1	4.7	6.2	7.1	7.1	8.8	8.9	8.8	8.5	5.8	5.8	84.9
-Partly Cloudy	27	5.9	6.3	8.7	7.7	9.8	11.5	12.9	11.3	9.8	9.0	6.4	6.0	105.4
-Cloudy	27	18.0	15.9	17.6	16.1	14.0	11.3	9.3	10.7	11.4	13.4	17.9	19.1	175.0
Precipitation .01 inches or more	27	11.3	9.6	12.7	12.6	11.0	10.2	9.8	9.1	9.6	9.2	10.2	11.6	127.0
Snow, Ice pellets 1.0 inches or more	27	3.4	2.5	2.2	0.5	0.0	0.0	0.0	0.0	0.0	0.1	0.7	2.7	12.1
Thunderstorms	27	0.3	0.4	2.1	4.4	4.8	6.6	6.1	5.7	4.6	1.7	1.1	0.7	38.6
Heavy Fog Visibility 1/4 mile or less	27	1.4	1.9	2.3	0.9	1.4	0.6	0.6	0.8	0.5	1.0	1.6	2.2	15.2
Temperature °F														
-Maximum														
90° and above	27	0.0	0.0	0.0	0.*	0.9	3.3	5.9	4.3	1.9	0.1	0.0	0.0	16.4
32° and below	27	19.1	13.3	4.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.0	12.1	51.1
-Minimum														
32° and below	27	29.1	25.0	21.5	7.8	1.0	0.0	0.0	0.0	0.3	4.7	17.0	26.5	132.7
0° and below	27	7.4	3.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	14.0
AVG. STATION PRESS. (mb)	13	993.4	993.4	990.4	990.2	989.5	989.9	991.4	992.6	993.2	993.4	992.5	992.9	991.9
RELATIVE HUMIDITY (%)														
Hour 00	27	75	75	76	72	73	75	79	81	81	76	77	78	77
Hour 06 (Local Time)	27	76	77	79	77	77	78	81	85	85	81	81	80	80
Hour 12	27	67	66	61	55	54	55	57	57	58	56	64	70	60
Hour 18	27	71	69	65	58	54	55	57	62	63	64	70	71	63
PRECIPITATION (inches):														
Water Equivalent														
-Normal		1.60	1.31	2.59	3.66	3.15	4.08	3.63	3.53	3.35	2.28	2.06	2.10	33.34
-Maximum Monthly	27	4.11	3.46	5.91	7.69	7.14	7.94	8.33	8.54	11.44	6.55	8.22	8.56	11.44
-Year		1965	1985	1976	1983	1970	1967	1982	1980	1961	1969	1985	1982	SEP 1961
-Minimum Monthly	27	0.10	0.12	0.63	0.97	1.61	1.56	1.18	0.51	0.02	0.16	0.65	0.23	0.02
-Year		1981	1969	1981	1971	1967	1982	1977	1969	1979	1964	1976	1962	SEP 1979
-Maximum in 24 hrs	27	2.00	1.90	2.39	2.78	3.45	3.09	2.89	3.56	3.00	4.62	2.80	4.53	4.62
-Year		1960	1985	1985	1983	1981	1967	1962	1975	1978	1969	1985	1982	OCT 1969
Snow, Ice pellets														
-Maximum Monthly	27	34.3	21.5	24.7	11.1	1.6				T	6.6	10.4	35.3	35.3
-Year		1979	1967	1965	1975	1966				1967	1967	1959	1978	DEC 1978
-Maximum in 24 hrs	27	18.1	9.7	10.6	10.9	1.6				T	6.6	5.8	11.0	18.1
-Year		1967	1981	1970	1975	1966				1967	1967	1975	1969	JAN 1967
WIND:														
Mean Speed (mph)	27	11.6	11.4	11.8	12.0	10.5	9.1	8.1	8.0	8.6	9.9	10.9	10.9	10.3
Prevailing Direction														
Fastest Obs. 1 Min.														
-Direction (!!!)	27	28	25	01	24	34	24	36	32	23	20	23	26	23
-Speed (MPH)	27	47	45	54	54	52	41	55	46	58	48	51	46	58
-Year		1971	1967	1964	1965	1962	1970	1980	1960	1959	1971	1958	1970	SEP 1959
Peak Gust														
-Direction (!!!)	2	NW	N	W	S	W	W	NE	W	W	S	W	W	S
-Speed (mph)	2	49	52	52	69	51	46	54	24	37	46	44	52	69
-Date		1985	1984	1985	1984	1985	1985	1984	1984	1984	1985	1985	1984	APR 1984

(!!!) See Reference Notes on Page 6B.

PRECIPITATION (inches)

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1958											1.85	0.72	
1959	1.91	1.66	3.39	2.24	3.44	1.68	5.18	2.03	1.91	4.04	2.57	1.99	32.04
1960	3.07	2.70	1.17	3.02	2.46	4.06	4.27	3.46	1.39	1.33	0.81	0.46	28.20
1961	0.27	0.88	4.01	2.47	2.03	4.20	3.69	1.34	11.44	3.34	1.76	1.35	36.78
1962	2.39	1.18	1.33	1.14	3.38	2.13	5.27	1.62	1.50	0.89	0.71	0.23	21.77
1963	0.84	0.36	2.26	4.88	1.92	2.30	4.09	2.73	2.88	0.28	2.00	0.73	25.27
1964	0.72	0.52	3.45	5.22	2.26	2.86	4.23	1.95	3.96	0.16	2.90	1.51	29.74
1965	4.11	1.18	3.06	3.48	2.36	3.44	3.66	6.40	5.03	1.57	1.47	3.32	39.08
1966	1.09	1.75	2.64	6.28	4.77	2.95	2.19	1.00	0.55	2.16	4.74	1.88	32.00
1967	2.22	1.82	2.30	3.97	1.61	7.94	1.87	2.60	2.45	3.89	2.19	2.41	35.27
1968	1.77	0.87	0.90	2.31	2.99	4.15	2.03	5.32	3.88	1.04	3.70	2.77	31.73
1969	1.62	0.12	1.93	4.02	3.17	7.76	3.43	0.51	3.01	6.55	1.11	1.18	34.41
1970	0.82	0.59	2.12	4.29	7.14	7.14	4.08	1.50	8.69	2.48	2.78	1.77	43.40
1971	0.93	1.94	1.54	0.97	2.23	2.62	3.57	3.97	2.39	0.72	1.32	5.37	27.57
1972	1.01	0.73	3.45	4.77	3.02	3.55	4.97	6.97	8.14	2.92	3.05	2.89	45.47
1973	1.24	1.38	3.91	4.99	3.69	2.87	5.27	0.67	6.01	2.86	1.50	3.71	38.10
1974	3.29	2.11	2.40	4.27	5.09	4.69	2.96	2.60	1.47	1.88	2.47	2.12	35.35
1975	3.69	2.48	2.02	5.50	3.02	5.07	2.19	7.37	0.80	1.90	2.53	3.05	39.62
1976	0.85	1.87	5.91	4.05	4.03	2.93	1.44	1.29	1.49	1.41	0.65	0.64	26.56
1977	0.55	0.71	3.67	2.62	1.88	5.12	1.18	5.39	6.07	1.36	2.05	1.96	32.56
1978	1.48	0.43	1.16	3.94	2.80	6.36	4.61	1.96	6.88	1.08	2.24	4.41	37.35
1979	2.81	1.02	4.49	4.92	2.58	4.63	2.19	7.57	0.02	1.49	2.80	2.58	37.10
1980	1.04	1.24	1.96	3.41	3.22	3.42	3.56	8.54	5.65	2.09	1.10	3.43	38.66
1981	0.10	2.35	0.63	6.14	5.85	4.46	4.50	6.60	3.25	1.80	2.46	1.05	39.19
1982	2.90	0.41	4.15	2.78	2.08	1.56	8.33	3.93	1.15	1.88	6.95	8.56	44.68
1983	0.66	2.06	3.56	7.69	6.26	4.11	4.25	2.08	5.41	4.41	5.87	2.99	49.35
1984	1.15	1.39	3.00	4.11	4.49	2.02	3.19	2.10	3.84	3.15	2.64	2.92	34.00
1985	1.48	3.46	4.73	1.48	2.79	1.97	3.75	3.90	1.82	4.98	8.22	1.49	40.07
Record Mean	1.63	1.38	2.78	3.89	3.35	3.93	3.70	3.53	3.74	2.28	2.66	2.41	35.30

See Reference Notes on Page 6B.

AVERAGE TEMPERATURE (deg. F)

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1958											41.4	20.5	
1959	16.2	24.3	35.8	47.5	64.8	71.1	73.3	77.3	67.3	50.1	31.8	34.4	49.5
1960	26.8	24.6	24.4	52.1	57.7	66.6	72.1	73.7	68.4	54.0	41.7	23.5	48.5
1961	20.3	31.4	38.0	43.3	54.8	67.4	71.1	70.9	65.6	53.6	39.9	25.3	48.5
1962	16.8	24.4	33.5	48.8	65.0	67.9	69.2	71.8	60.7	55.8	40.1	23.2	48.1
1963	11.5	16.9	39.8	50.9	56.3	69.0	72.1	68.5	64.8	60.5	41.9	13.3	47.1
1964	27.7	26.6	33.7	49.1	62.7	69.0	72.1	67.7	63.3	48.0	41.4	24.7	48.9
1965	21.4	24.3	26.6	46.6	61.7	64.9	69.4	68.0	63.8	53.2	40.3	35.3	47.9
1966	16.3	26.1	39.6	45.2	53.4	68.5	74.5	69.6	62.5	51.4	42.5	27.1	48.1
1967	27.7	19.8	36.5	48.4	53.8	69.8	68.4	66.2	61.7	52.9	37.3	30.3	47.7
1968	23.8	23.6	42.7	52.3	57.0	70.2	72.0	73.7	65.5	54.7	40.0	27.8	50.3
1969	21.1	29.9	34.4	50.8	60.4	64.3	73.0	73.9	65.3	51.8	38.3	28.0	49.3
1970	16.3	26.1	34.8	51.7	61.9	69.4	74.7	72.9	65.2	55.4	40.7	30.8	50.0
1971	18.9	28.2	35.0	48.6	57.2	73.5	71.5	72.0	69.7	61.7	41.7	34.2	51.0
1972	19.6	23.6	34.0	44.8	61.0	65.7	73.6	73.8	63.5	49.3	37.7	23.9	47.6
1973	28.2	28.7	44.0	48.1	54.8	71.1	74.7	74.6	66.0	57.9	41.9	28.1	51.5
1974	24.8	27.4	38.6	52.3	56.8	65.5	73.6	70.0	60.5	52.8	40.6	30.2	49.4
1975	27.3	26.2	34.1	43.3	62.3	70.5	75.5	76.3	61.4	55.8	47.2	31.5	50.9
1976	19.9	35.2	42.8	52.3	55.9	70.1	74.0	70.8	62.7	48.3	32.4	19.4	48.6
1977	10.7	26.9	44.9	55.0	67.2	69.3	77.5	71.9	66.0	51.5	40.0	24.2	50.4
1978	15.7	16.8	31.9	47.5	58.3	67.6	72.0	72.4	68.8	51.4	40.8	25.8	47.4
1979	12.5	16.2	36.4	45.5	59.3	69.2	72.0	71.0	66.1	53.3	40.6	33.7	48.0
1980	23.4	21.5	32.6	46.5	59.7	65.3	75.7	75.7	66.0	48.4	39.9	28.0	48.6
1981	22.6	28.0	37.6	51.8	55.3	69.8	72.5	71.2	61.7	49.1	40.8	24.9	48.8
1982	12.2	21.5	35.1	44.5	64.3	62.1	74.1	68.8	62.1	53.2	39.1	36.0	47.8
1983	26.3	30.5	37.4	43.4	53.2	69.7	76.7	77.3	64.6	52.8	41.1	14.3	49.0
1984	17.1	33.9	29.5	45.8	55.5	70.3	70.3	72.8	61.1	54.7	37.9	31.0	48.3
1985	14.4	20.4	39.4	52.6	60.2	63.6	71.4	69.2	65.4	52.5	37.8	17.0	47.0
Record Mean	20.0	25.3	36.0	48.5	58.9	68.2	72.9	71.9	64.4	53.0	39.9	26.6	48.8
Max	27.9	33.2	44.5	58.4	69.9	79.2	83.3	82.1	74.9	63.5	48.2	34.1	58.3
Min	12.0	17.3	27.6	38.5	47.9	57.2	62.4	61.7	53.9	42.6	31.6	19.2	39.3

See Reference Notes on Page 6B.

HEATING DEGREE DAYS Base 65 deg. F

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1958-59					701	1375	1509	1131	897	523	133	25	
1959-60	2	0	85	454	988	941	1175	1164	1247	407	243	53	6759
1960-61	2	3	54	346	691	1282	1377	935	830	640	332	53	6545
1961-62	15	11	126	360	747	1223	1489	1128	970	504	147	50	6770
1962-63	6	1	179	310	740	1291	1655	1339	776	425	281	59	7062
1963-64	16	24	86	176	684	1598	1149	1106	963	479	139	63	6483
1964-65	10	52	148	521	699	1240	1345	1134	1185	545	157	77	7113
1965-66	12	53	110	370	733	915	1502	1079	782	587	371	53	6567
1966-67	1	12	127	420	669	1170	1148	1257	878	491	362	19	6554
1967-68	39	53	160	395	827	1068	1274	1192	682	376	257	28	6351
1968-69	14	12	59	355	740	1146	1355	976	941	419	204	124	6345
1969-70	4	0	75	423	794	1138	1506	1086	929	418	168	44	6585
1970-71	2	0	85	302	725	1055	1422	1026	923	484	262	14	6300
1971-72	7	3	64	154	693	948	1405	1197	954	602	178	80	6285
1972-73	15	10	109	481	811	1269	1135	1012	645	503	311	0	6301
1973-74	0	0	72	244	687	1139	1240	1046	812	383	266	63	5952
1974-75	0	1	176	384	724	1072	1160	1078	951	643	152	30	6371
1975-76	1	0	147	303	531	1033	1392	859	681	411	285	17	5660
1976-77	0	9	119	522	973	1408	1679	1060	616	332	115	41	6874
1977-78	0	8	42	413	741	1254	1521	1346	1020	518	264	46	7173
1978-79	1	4	59	418	718	1206	1622	1360	879	580	233	30	7110
1979-80	16	19	62	382	722	967	1281	1254	995	558	198	83	6537
1980-81	0	3	71	511	746	1140	1308	1031	846	397	313	6	6372
1981-82	8	6	135	489	719	1236	1632	1213	922	608	93	118	7179
1982-83	7	37	152	372	772	891	1194	961	847	643	364	38	6278
1983-84	16	0	125	383	714	1568	1479	894	1095	575	300	18	7167
1984-85	19	1	189	320	807	1046	1563	1245	787	418	183	103	6681
1985-86	0	6	141	380	813	1480							

See Reference Notes on Page 6B.

COOLING DEGREE DAYS Base 65 deg. F

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1971	0	0	0	0	27	275	213	228	213	59	0	0	1015
1972	0	0	0	0	64	106	289	289	72	0	0	0	820
1973	0	0	0	5	3	189	308	301	108	32	0	0	946
1974	0	0	0	10	21	83	274	162	48	12	0	0	610
1975	0	0	0	0	76	203	332	358	46	24	1	0	1040
1976	0	0	0	36	6	178	286	196	56	8	0	0	766
1977	0	0	0	39	191	178	395	229	76	0	0	0	1108
1978	0	0	0	0	60	132	227	243	181	2	0	0	845
1979	0	0	0	2	61	164	241	213	99	26	0	0	806
1980	0	0	0	10	43	101	338	342	107	2	0	0	943
1981	0	0	0	9	20	157	248	204	44	0	0	0	682
1982	0	0	0	0	79	38	295	161	69	14	0	0	656
1983	0	0	1	0	4	189	385	388	122	10	0	0	1099
1984	0	0	0	5	11	184	190	254	77	8	0	0	729
1985	0	0	0	53	42	71	204	142	158	0	0	0	670

See Reference Notes on Page 6B.

SNOWFALL (inches)

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1958-59					0.4	10.7	15.6	2.2	2.9	0.6	0.0	0.0	
1959-60	0.0	0.0	0.0	0.3	10.4	6.9	3.5	17.3	13.3	T	T	0.0	51.7
1960-61	0.0	0.0	0.0	0.0	0.1	4.2	3.0	6.5	2.4	6.9	0.0	0.0	23.1
1961-62	0.0	0.0	0.0	T	2.0	10.7	18.6	10.0	5.7	0.7	0.0	0.0	47.7
1962-63	0.0	0.0	0.0	T	0.3	2.3	16.8	8.4	7.5	T	0.0	0.0	35.3
1963-64	0.0	0.0	0.0	0.0	T	8.9	1.6	5.9	19.8	T	0.0	0.0	36.2
1964-65	0.0	0.0	0.0	0.0	2.3	11.1	11.7	11.5	24.7	T	0.0	0.0	61.3
1965-66	0.0	0.0	0.0	T	0.2	6.6	15.5	4.3	0.7	T	1.6	0.0	28.9
1966-67	0.0	0.0	0.0	T	0.5	8.4	25.1	21.5	8.8	3.4	T	0.0	67.7
1967-68	0.0	0.0	T	6.6	2.4	2.9	10.4	3.8	1.5	0.1	0.0	0.0	27.7
1968-69	0.0	0.0	0.0	0.0	0.7	10.9	3.7	2.3	4.7	0.0	T	0.0	22.3
1969-70	0.0	0.0	0.0	0.0	2.0	19.3	9.5	6.3	11.8	7.2	0.0	0.0	56.1
1970-71	0.0	0.0	0.0	0.0	0.2	2.7	10.0	1.4	8.0	0.8	T	0.0	23.1
1971-72	0.0	0.0	0.0	0.0	1.3	0.2	7.6	7.7	16.8	3.3	0.0	0.0	36.9
1972-73	0.0	0.0	0.0	0.1	0.9	11.2	0.5	9.3	3.4	0.2	T	0.0	25.6
1973-74	0.0	0.0	0.0	0.0	T	18.8	7.4	9.6	1.4	T	0.0	0.0	37.2
1974-75	0.0	0.0	0.0	0.0	1.0	9.4	3.5	8.2	4.5	11.1	0.0	0.0	37.7
1975-76	0.0	0.0	0.0	0.0	6.4	6.8	10.0	1.6	1.9	0.8	T	0.0	27.5
1976-77	0.0	0.0	0.0	1.6	0.5	6.5	7.2	4.0	4.9	T	0.0	0.0	24.7
1977-78	0.0	0.0	0.0	0.0	5.2	12.7	21.9	7.9	4.5	0.2	0.0	0.0	52.4
1978-79	0.0	0.0	0.0	0.0	5.2	35.3	34.3	6.8	2.0	0.1	0.0	0.0	83.7
1979-80	0.0	0.0	0.0	0.0	4.0	0.9	6.2	14.7	11.6	4.2	0.0	0.0	41.6
1980-81	0.0	0.0	0.0	T	5.1	9.7	2.0	15.9	2.3	0.0	0.0	0.0	35.0
1981-82	0.0	0.0	0.0	T	3.6	4.9	21.1	4.8	14.3	10.6	0.0	0.0	59.3
1982-83	0.0	0.0	0.0	0.0	0.4	2.1	5.0	8.9	9.0	1.2	0.0	0.0	26.6
1983-84	0.0	0.0	0.0	0.0	1.0	16.5	17.2	1.9	9.7	2.7	0.0	0.0	49.0
1984-85	0.0	0.0	0.0	0.0	T	6.6	18.9	13.3	0.3	T	0.0	0.0	39.1
1985-86	0.0	0.0	0.0	0.0	1.1	5.2							
Record Mean	0.0	0.0	T	0.3	2.0	9.0	11.4	8.0	7.3	2.0	0.1	0.0	40.2

See Reference Notes on Page 6B.

REFERENCE NOTES

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

GENERAL
T - TRACE AMOUNT.
BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.
# INDICATES A STATION OR INSTRUMENT RELOCATION.
SEE STATION LOCATION TABLE ON PAGE 8.

SPECIFIC
PAGE 2
PM - INCLUDES LAST DAY OF PREVIOUS MONTH

PAGE 3
(a) - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.
* LESS THAN .05
NORMALS - BASED ON THE 1951-1980 RECORD PERIOD.
EXTREMES - DATES ARE THE MOST RECENT OCCURRENCE
WIND DIR - NUMERALS SHOW TENS OF DEGRESS CLOCKWISE FROM TRUE NORTH. "00" INDICATES CALM.
RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES.

EXCEPTIONS

PAGES 4A, 4B, 6A
RECORD MEANS ARE THROUGH THE CURRENT YEAR,
BEGINNING IN 1958 FOR TEMPERATURE
1958 FOR PRECIPITATION
1958 FOR SNOWFALL

CHICAGO, OHARE INTERNATIONAL AIRPORT, ILLINOIS

Chicago is located along the southwest shore of Lake Michigan and occupies a plain which, for the most part, is only some tens of feet above the lake. Lake Michigan averages 579 feet above sea level. Natural water drainage over most of the city would be into Lake Michigan, and from areas west of the city is into the Mississippi River System. But actual drainage over most of the city is artificially channeled also into the Mississippi system. Topography does not significantly affect air flow in or near the city except that lesser frictional drag over Lake Michigan causes winds to be frequently stronger along the lakeshore, and often permits air masses moving from the north to reach shore areas an hour or more before affecting western parts of the city.

Chicago is in a region of frequently changeable weather. The climate is predominately continental, ranging from relatively warm in summer to relatively cold in winter. However, the continentality is partially modified by Lake Michigan, and to a lesser extent by other Great Lakes. In late autumn and winter, air masses that are initially very cold often reach the city only after being tempered by passage over one or more of the lakes. Similarly, in late spring and summer, air masses reaching the city from the north, northeast, or east are cooler because of movement over the Great Lakes. Very low winter temperatures most often occur in air that flows southward to the west of Lake Superior before reaching the Chicago area. In summer the higher temperatures are with south or southwest flow and are therefore not influenced by the lakes, the only modifying effect being a local lake breeze. Strong south or southwest flow may overcome the lake breeze and cause high temperatures to extend over the entire city.

During the warm season, when the lake is cold relative to land, there is frequently a lake breeze that reduces daytime temperature near the shore, sometimes by 10 degrees or more below temperatures farther inland. When the breeze off the lake is light this effect usually reaches inland only a mile or two, but with stronger on-shore winds the whole city is cooled. On the other hand, temperatures at night are warmer near the lake so that 24-hour averages on the whole are only slightly different in various parts of the city and suburbs.

At the OHare International Airport temperatures of 96 degrees or higher occur in about half the summers, while about half the winters have a minimum as low as -15 degrees. The average occurrence of the first temperature as low as 32 degrees in the fall is mid-October and the average occurrence of the last temperature as low as 32 degrees in the spring is late April.

Precipitation falls mostly from air that has passed over the Gulf of Mexico. But in winter there is sometimes snowfall, light inland but locally heavy near the lakeshore, with Lake Michigan as the principal moisture source. The heavy lakeshore snow occurs when initially colder air moves from the north with a long trajectory over Lake Michigan and impinges on the Chicago lakeshore. In this situation the air mass is warmed and its moisture content increased up to a height of several thousand feet. Snowfall is produced by upward currents that become stronger, because of frictional effects, when the air moves from the lake onto land. This type of snowfall therefore tends to be heavier and to extend farther inland in south-shore areas of the city and in Indiana suburbs, where the angle between wind-flow and shoreline is greatest. The effect of Lake Michigan, both on winter temperatures and lake-produced snowfall, is enhanced by non-freezing of much of the lake during the winter, even though areas and harbors are often ice-choked.

Summer thunderstorms are often locally heavy and variable, parts of the city may receive substantial rainfall and other parts none. Longer periods of continuous precipitation are mostly in autumn, winter, and spring. About one-half the precipitation in winter, and about 10 percent of the yearly total precipitation, falls as snow. Snowfall from month to month and year to year is greatly variable. There is a 50 percent likelihood that the first and last 1-inch snowfall of a season will occur by December 5 and March 20, respectively.

Channeling of winds between tall buildings often causes locally stronger gusts in the central business area. However, the nickname, windy city, is a misnomer as the average wind speed is not greater than in many other parts of the U.S.

STATION LOCATION

CHICAGO, ILLINOIS
O'HARE INTERNATIONAL AIRPORT

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Longitude West	Elevation above Sea level: Ground at temperature site	Elevation above Ground: Wind instruments	Extreme thermometers	Psychrometer	Sunshine Switch	Tipping bucket rain gage	Weighing rain gage	8" rain gage	Hygrothermometer	Automatic Observing Equipment *	Remarks
UNIVERSITY OF CHICAGO																
Rosenwald Hall 58th Street and University Avenue	1/01/16	3/31/62		41° 47'	87° 36'	594	131	7	7		3	3	3			Chicago Observatory 1/1/26 through 6/30/42, otherwise climatological observations.
5730 S Woodlawn Avenue	4/01/62	Present	825' NE	41° 47'	87° 36'	594		6				4	3			Climatological observations.
AIRPORT (MIDWAY)																
National Airtransport Hangar, 5940 South Cicero Avenue	2/13/28	11/03/32		41° 47'	87° 45'	610	54	43	43				41			
South Terminal Building Midway Airport 6200 South Cicero Avenue	11/03/32	1/16/80	5/16 mi. S	41° 47'	87° 45'	e607	b20	c6	c5	%27	a26	a26	26	d4	NA M	Chicago Observatory beginning 7/1/42, ending 1/16/80. a - Added 7/1/42. b - 36 feet to 7/20/49; 18 feet to 4/14/58; 48 feet to 4/24/62. c - 21 feet to 5/15/41. Standby status after 8/1/63. Discontinued 11/25/70. d - Commissioned 5000 feet WNW of station 8/1/63. e - 610 feet to 8/1/63. % - Commissioned 1967. M - Ramos 1/14/80 to Present.
AIRPORT (O'HARE)																
International Terminal Building	10/30/58	3/7/85	NA	41° 59'	87° 54'	658	65 g20'	41 i39 m39	40 i39	NA p53	NA p39	NA h38 i39 k39	36 i38 n39	NA f4 j4	NA	f - Commissioned 3300' SW of office 12/1/60. g - Effective 12/8/60. h - Commissioned 6/4/62. i - Moved 1200' E 4/12/63. j - Type change 8/24/65. k - Type change 12/5/69. m - Minor adjustment 9/15/71. n - Minor adjustment 7/1/80. p - Installed 7/1/80.
Hardstand Operational Bldg.	3/7/85	Present	about 1/2 mi SE	41° 59'	87° 54'	658	q20	q39	q39	q53	q39	q39	q39	q4	NA	Chicago Observatory beginning 1/16/80. q - Instruments not moved 3/7/85.

* Type
M = AMOS
T = AUTOB

CITY OFFICE LOCATIONS FROM 1870-1970 ARE AVAILABLE ON THE 1979 AND PREVIOUS LCD ANNUALS PUBLISHED FOR CHICAGO, MIDWAY AIRPORT.

SUBSCRIPTION:
Price and ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801

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Site Investigation of Potential Particulate Emissions
at Riverdale Chemical, Chicago Heights, Illinois

James A. Dewey
Environmental Engineer

Steve Rothblatt, Chief
Air and Radiation Branch

THRU: William L. MacDowell, Chief
Control Technology Unit

Joseph Paisie, Chief
Technical Analysis Section

On October 2, 1985 I visited the Riverdale Chemical Company plant in Chicago Heights to determine the potential for entrainment and transport of dioxin-contaminated ~~laden~~ particulate beyond the site boundaries and to discuss the plant's operational history with the facility management. Both objectives were satisfied.

Immediately prior to and during my site inspection, Dr. Michael Champion explained to me the operating history of Riverdale Chemical. He described the specific origin and nature of their dioxin problem and the corrective actions implemented (and planned) to eliminate it.

Inspection showed the site to be well-controlled against the potential of dioxin-laden particulate entrainment. The most contaminated area was covered by a large groundcover tarp. This tarp was made of a synthetic material that is permeable to water and insensitive to ultraviolet light. It was in excellent condition and well secured with bricks to avoid wind-lift.

All plant areas where ground sampling has shown any toxics content are protected from contaminated particulate entrainment by either of two mechanisms: dense vegetative cover or gravel cover. The vegetative cover protects unused plant areas and is so dense and thickly matted that additional treatment is superfluous. The gravel covering trafficked portions of the site is well packed, generally unrutted, and appears to be at least 6" thick. Their gravel roadbed is in good shape but the large vehicles (tractor-trailers) using it will pulverize the gravel over time, increasing the potential for fugitive emissions. Close inspection shows that the pulverization of the roadbed has already begun.

While at the site, I discussed with both Michael and James Champion the advantages of dust suppressant application as a contol measure that could both prolong the life of their gravel roadbed and substantially decrease potential dust generation. They expressed interest in suppressant usage if they could find one that USEPA has given a clean bill of health-(both are understandably concerned about any additional toxic residue problem). I have sent them all of the product information I have on dust suppressants (at their request).

bcc: Neil Meldgin

5AMD:ARB:TAS:CTU:DEWEY:DISK#5:sr:10/7/85

RAD 10/9/85
WLM 10/9/85
JP 10/9/85

APPENDIX C

SAMPLING PLAN

APPENDIX A

SAMPLING PLAN

REMEDIAL INVESTIGATION/

FEASIBILITY STUDY

RIVERDALE CHEMICAL COMPANY

CHICAGO HEIGHTS, ILLINOIS

(Excerpted from the Quality Assurance Project Plan)

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1.0 INTRODUCTION

Remedial Investigation activities conducted by IT Corporation (IT) at the Riverdale Chemical Company's (Riverdale) plant will include the following activities noted below.

Nine soil borings will be drilled to a depth of 10-15 feet, or deeper if necessary. Approximately 100 soil samples will be collected from these borings. Initially, a total of 16 of these samples will be selected for testing of 2,3,7,8 tetrachlorodibenzo-p-dioxin (Dioxin) using rapid sample test turnaround time. Four of the 16 samples will be tested for Hazardous Substances List (HSL) organics and pesticides. Twenty surface soil samples will be collected at various on- and off-site locations. Fourteen samples will be tested for Dioxin and six composite samples will be tested for HSL organic and pesticide compounds.

Depending on the results of the initial testing, additional testing and sampling phases may need to be conducted in order to define the extent of contamination at the Riverdale site. This sampling plan details only the initial sampling and testing phase.

In the following sections of this sampling plan, information is presented on the proposed sampling locations and numbering system; drilling and sampling procedures; QA/QC sampling procedures; sample handling and analyses; decontamination procedures; field documentation procedures; organization, responsibilities, and training of the field team; and the schedule for field activities.

2.0 SAMPLING LOCATIONS, LABELING AND NUMBERING SYSTEMS

2.1 LOCATIONS

Tentative boring and surface soil sampling locations are shown in Figure 1. Exact boring and surface sampling locations will be determined in the field by either the Project Manager, the Project Hydrogeologist/Engineer or both. Selection of locations will be made in conjunction with suggestions by plant personnel.

2.2 LABELING

The sample containers will be labeled prior to being filled with soil at the sampling site. The sample label for surface and subsurface soil samples will show the project number, sample number, sample location and depth, date, time of sampling, and sampler's initials. The label will be filled out with waterproof ink or marker.

2.3 SAMPLE NUMBERING SYSTEM

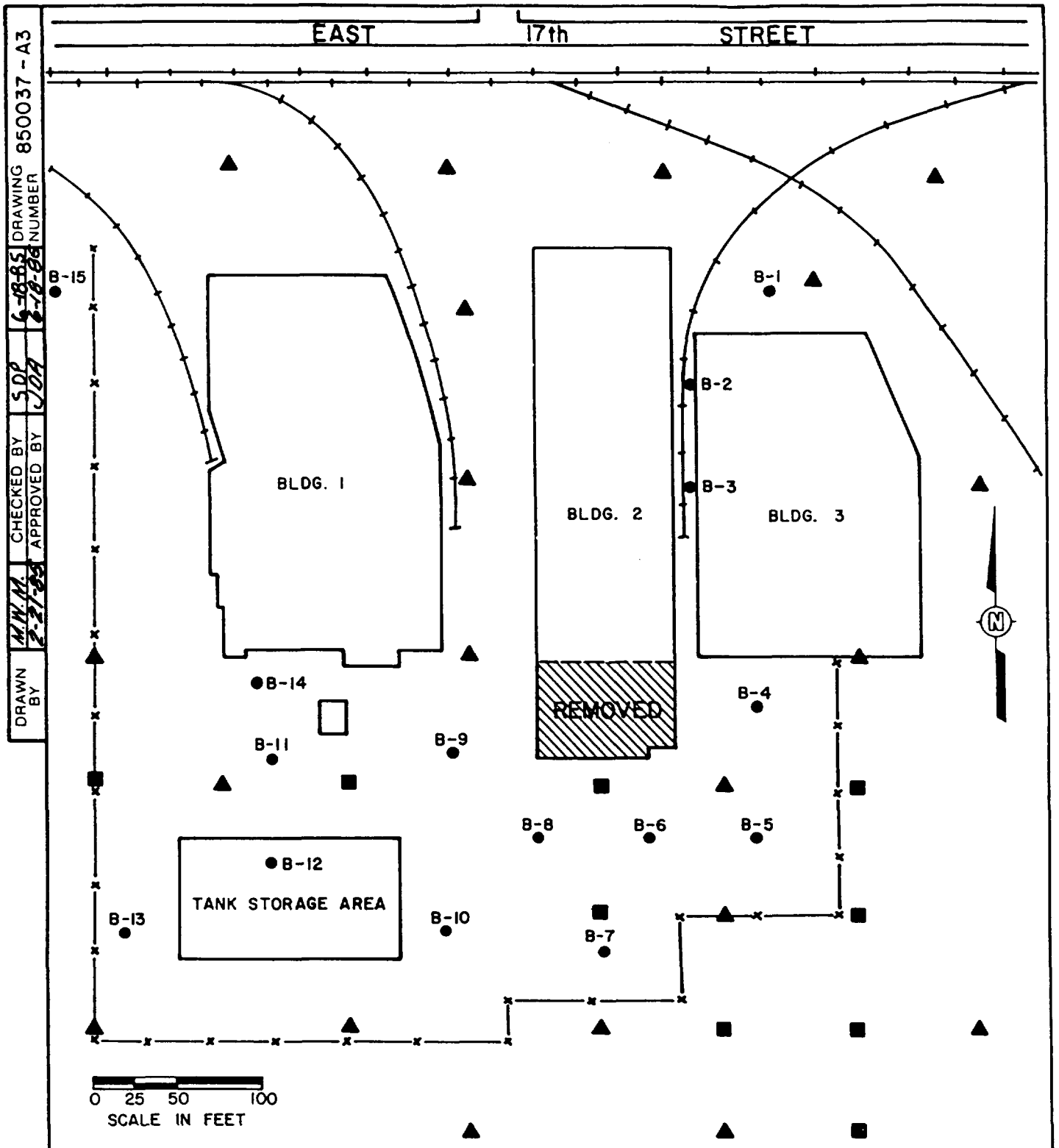
A sample numbering system will be used to identify each sample taken during the Riverdale sampling program. This numbering system will provide a tracking procedure to allow retrieval of information about a particular sample and provide each sample with a unique number. The sample identification numbering system is described below:

- A three letter designation will be used to identify the site where the samples are collected. For this project, it will be RIV, which stands for Riverdale

- Each sample type collected during the sampling program will be identified by a 2-digit code:
  - SB - Soil, Boring
  - SS - Soil, Surface

- A 2-digit number will be used to indicate boring and surface sample locations. Soil samples from borings will be identified as to the depth at which they were taken. The number will specify the deepest depth at which the sample was taken. Composite samples will be indicated by parentheses

- A 1-digit number will be used to consecutively number sequential samples taken at a sampling site.



LEGEND

B-11● SAMPLE LOCATION BY OTHERS

■ PROPOSED BORING LOCATION

▲ PROPOSED SURFACE SAMPLING LOCATION

RAILROAD

FENCE LINE

FIGURE 1

SAMPLING LOCATIONS

PREPARED FOR

RIVERDALE CHEMICAL COMPANY

CHICAGO HEIGHTS, ILLINOIS

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DRAWING NUMBER 850037 - A3

DRAWN BY H.W.M. 2-21-85

CHECKED BY S.D.P. 6-18-85

APPROVED BY J.D.A. 6-19-85

85360

Examples of sample numbers are:

- RIV-SB-01-4.5-1 - soil boring sample from boring 1, sample interval from 3 to 4.5 feet depth, sample 1
- RIV-SS-01-1 - Surface soil sample, location 01, sample 1
- RIV-SS-(01-05)-1 - Surface soil sample, composite of locations 01 through 05, sample 1

3.0 DRILLING AND SAMPLING PROCEDURES

The purpose of this task is to characterize the near surface site geology and the horizontal and vertical extent of contamination at the site. The exploration is planned to consist of nine soil borings across the site and collection of 20 surface soil samples. A qualified engineer or hydrogeologist will develop boring logs from the drilling and coordinate all field activities.

3.1 SOIL BORINGS

The nine soil borings will be drilled to a depth of 10-15 feet, or as necessary to define the near surface geology. The final depth of the borings will be determined in the field. Consideration will be given to the existence of coarse grained soils or fractured fine grained soils (which could act as migration pathways for contaminants) and the homogeneity and continuity of the site stratigraphy. Proposed boring locations are shown in Figure 1.

The boreholes will be advanced with hollow stem augers. Samples will be collected with a 3-inch diameter split-barrel sampler on 1.5 foot intervals to a depth of 15 feet. If the borings are advanced deeper than this, the sample interval will be increased to 2.5 feet. At the completion of drilling, each boring will be completely grouted with a cement/bentonite slurry to the ground surface to prevent possible migration of contaminants. (See Section 3.6).

Each boring will be logged by the Project Hydrogeologist/Engineer. This individual will also provide continuous inspection of all drilling activities. The boring log will include:

- Heading information. Included will be the project number, boring number, personnel responsible for logging the hole, ground elevation and coordinates, and date started and completed

- Depths recorded in feet and tenths of feet

- Detailed soil descriptions including:
  - major soil component
  - secondary components and estimated percentages
  - classification
  - unified soil classification symbol

- color
- consistency or density
- moisture content, listed as an adjective (e.g., dry, moist, wet)
- texture
- depositional origin

o Depth/elevation interval

o Depth/elevation of strata changes

o Water-table information and method of determination, if applicable

o Sample drive and recovery

o Blow counts, hammerweight, and length of fall

o Equipment details

o Drilling sequence and comments

o Problems encountered.

After logging a sample, the hydrogeologist or sampling engineer will transfer it to a pre-labeled jar.

Jarred samples will be kept in a cooler at 4°C until they can be transferred to a more permanent storage location.

A total of approximately 100 investigative samples will be collected for possible physical and chemical analysis during the drilling program.

Decontamination procedures for the equipment utilized in the subsurface investigation are outlined in Section 3.3.

3.2 SURFACE SOIL SAMPLING

The purpose of the surface sampling is to define the horizontal extent of contamination on the site and define the boundaries of contamination. It is anticipated that 20 surface samples will be collected. Proposed sampling locations are shown on Figure 1. The off-site samples will be collected if access to the property can be obtained. Copies of letters to property owners, requesting permission to sample, will be submitted to the U.S. EPA as verification of Riverdale's effort to obtain such access.

Samples will be collected from the upper 6-inches at each location using a shovel and stainless steel spoon or a stainless steel scoop. After collecting each sample, the sampling team will record the location, sample number, date, time, sampling personnel, and weather conditions in the field log. Decontamination of sampling equipment will be required between sampling locations and consist of the procedures detailed in Section 3.3.

3.3 DECONTAMINATION PROCEDURES

The drilling rig and associated tools will be decontaminated prior to entering the site and will be cleaned between borings. All sampling equipment will be decontaminated between samples to prevent cross contamination between borings and samples. Specific decontamination procedures are presented below:

The drilling rig should be recently painted with no surface areas showing rust. In addition, the rig will be thoroughly cleaned prior to its use. This will be accomplished by a detergent wash and scrub of the drilling rig, the augers, the tools, the bit, and anything else that will either come in contact with the soil or with the tools and augers themselves. Following the detergent wash, the equipment will be rinsed with clean water and then washed with a methanol, acetone or isopropyl alcohol solution followed by steam cleaning with potable water. A sample of the final potable water rinse may be collected for analysis as it drains from the drilling augers. The cleaned augers, tools and other drilling equipment will be placed on a clean truck bed for transportation to the drilling site.

The drill rig will also be inspected for any leakage of hydraulic fluid, oil, transmission fluid or other organic compound which could possibly contaminate the soils. The rig will be filled with gasoline or diesel fuel prior to being brought to the drilling site. Once the drill rig is brought to the site, it will be assumed that the surface soils are contaminated and no equipment will be set down on the ground where it could be contaminated. Clean plastic sheeting, aluminum foil, or cardboard will be placed on the ground to provide a work surface for each hole. The drilling rig will be steam cleaned each time it is moved to a new boring location.

The materials that will enter the borehole (augers, rods, etc.) will be carefully cleaned by an initial detergent wash with trisodium phosphate detergent (TSP), followed with a clean water rinse, a methanol, acetone or isopropyl alcohol rinse, and finally a steam cleaning using potable water.

The sample split spoons will be decontaminated after each sampling drive using the following procedure:

- Scrub with long-handled-brush in TSP and water
- Rinse in water
- Rinse in acetone, methanol or isopropyl alcohol
- Air dry
- Rinse in distilled water.

Several spoons will be used so that the solvents on the spoon can evaporate before the spoon is used again.

All surface sampling equipment will be decontaminated following the above described procedure after each sample is collected.

Drilling personnel will wear appropriate protective clothing as required by the Health and Safety Plan (see Appendix B). These measures will not only protect the driller, but will also protect the hole from cross-contamination. All protective equipment (gloves, boots, etc.) will be decontaminated prior to reuse or disposal, utilizing the procedure outlined earlier.

The drill rig, tools and other drilling equipment will be cleaned before leaving the site. A sample of the final rinse water may be collected to ascertain that the rig will not transport contaminants off the site.

3.4 LOCATING AND SAMPLING UTILITY LINES

This section outlines the provisions IT will use for identifying and locating utility lines, buried pipe and miscellaneous equipment which may be contaminated, and for determining the extent of contamination.

To locate the placement of utilities, sewers and other various buried objects on plant grounds, the plant foreman or superintendent will be contacted to

review the plant's as-built drawings. The foreman will also assist IT personnel to stake, mark or otherwise identify the underground objects near the proposed soil boring locations. This will be done to minimize accidental uncovering or damage to the utilities during drilling operations. In addition, the local public works department and utility companies will be contacted to ascertain the location of existing municipal utilities, electric, gas, and telephone lines that may be buried in the area. This information would be applicable to both on-site and off-site plant grounds. If it is necessary to expose portions of these utilities during drilling, a representative of the particular utility company will be requested to be present. The representative will witness the location and condition of the uncovered utility, as well as providing for a positive identification. The locations of buried utilities and other objects will be presented in the remedial investigation report.

To determine the extent of contamination near any buried objects, soils that are in direct contact with the objects will be sampled. The scope of work for the initial sampling phase, though, is limited to surface and near surface soil sampling, and not near buried objects. If results of the initial sample analysis indicate a need for sampling near buried objects, additional sampling will be conducted during a later phase.

3.5 DISPOSAL OF CONTAMINATED SOIL AND WATER

It is not anticipated that water will be used in the drilling process. Therefore, disposal of contaminated recirculation water is not of concern during this phase of the project.

During the drilling and sampling operations, contaminated soil, disposable health and safety gear, and water from decontamination efforts will be generated. The total amount of contaminated material produced is expected to be relatively small. The cuttings will be moved to and covered by the tarped area on the southern portion of the site. Water from the decontamination processes will be discarded near the point where the boreholes are drilled. Since no impermeable cap exists on-site, this method of disposal will not increase any potential contamination in the soils already present. Disposable

safety equipment (i.e., booties, gloves, outer coverings) will be decontaminated and disposed with other solid wastes generated by the plant.

3.6 HOLE ABANDONMENT PROCEDURES

Upon reaching the maximum depth of the boring and completion of the soil sampling, the borehole shall be abandoned using the following procedure:

- Remove the plug from the hollow stem auger
- Prepare a bentonite/cement slurry that contains at least 25 percent bentonite
- Assemble tremie rods and place in the borehole so that the discharge valve is approximately one foot above the bottom of the boring
- Back the hollow stem augers out of the hole while simultaneously pumping the bentonite/cement slurry into the hole
- After removing the augers and tremieing rods from the hole, finish off the bentonite/cement slurry at the ground surface.

4.0 QA/QC SAMPLING PROCEDURES

Duplicate and blank samples will be collected during the sampling program. In general, one duplicate will be collected for every 20 samples collected and one blank will be obtained for every 20 samples that are taken.

Duplicate soil samples will be obtained by simultaneously filling two sets of sample bottles using standard sampling equipment and procedures. These will then be treated as separate samples for labeling and shipping. Duplicate samples will be logged in the field log book.

Blank samples will be prepared using diatomaceous earth for all soil samples by filling the appropriate sample containers. Standard sampling equipment and procedures will be used for blank sampling. Soil blanks will be placed in a decontaminated stainless steel scoop prior to being placed in sample containers. Blank samples will be treated as separate samples during identification, logging, and shipping procedures.

Performance Evaluation samples from EMSL-LV will be provide by U.S. EPA Region V. The samples will consist of one spiked sample and one blank sample.

5.0 SAMPLE PROCESSING

The soil samples will be processed according to the procedures summarized in Table 1. All samples are anticipated to be low or medium concentration samples.

All soil samples collected from borings will be initially screened prior to shipping using the guidelines summarized below:

- Headspace analysis - the headspace in each container collected for organic analysis will be sampled using an HNu/OVA. The cap of each sample will be loosened and lifted only enough to allow the insertion of the intake probe of the instrument. The sample numbers and instrument readings will be recorded. Samples with relatively high or otherwise anomalous readings may be selected for analysis.

- Suspicious appearance - a visual appraisal will be made when possible and samples which exhibit unusual or anomalous appearances may be selected for analysis.

- Lithology - in some cases it may be pertinent to trace contamination along a specific horizon, and a sample may be selected based upon lithology or stratigraphic position.

- Spatial distribution - all other criteria being equal, samples will be selected to provide spatial distribution.

The initial screening may affect the selection of samples for analyses outlined in Section 6.0.

Initially, it is anticipated that a total of 30 soil samples will be collected (16 from soil borings and 14 from surface locations) for Dioxin analyses; 10 samples will be submitted (4 from soil borings and 6 from surface locations) for HSL organics and pesticides analysis. Two duplicates and two blanks will be collected for Dioxin testing and one duplicate and one blank will be collected for the HSL compound analyses.

While awaiting shipping, all low concentration samples will be stored on ice in coolers. All samples will be preserved on the same day that they are

TABLE 1
BOTTLES, PRESERVATION, SHIPPING AND PACKING REQUIREMENTS FOR CLP SAMPLES
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

ANALYSIS	BOTTLES AND JARS	PRESERVATION	HOLDING TIME	VOLUME OF SAMPLE	SHIPPING	NORMAL PACKAGING
SOILS						
Low Concentration (Organics)						
Acid extractables, base/neutral extractables, pesticides/PCB's, Dioxin	One 8-oz. wide-mouth glass jar	Iced to 4°C	Not established	Fill 3/4 full	Federal Express Priority 1	Foam Liner No. 3
Volatiles	Two 120-ml wide-mouth glass jar	Iced to 4°C	Not established	Fill completely no headspace	Federal Express Priority 1	Foam Liner No. 3
Medium Concentration (Organics)						
Acid extractables, base/neutral extractables, pesticide/PCB's, Dioxin	One 8-oz. wide-mouth glass jar	None	Not established	Fill 3/4 full	Federal Express Priority 1 w/attached shipper's certification for restricted articles	In metal paint cans vermiculite
Volatiles	Two 120-ml wide-mouth glass jars	None	Not established	Fill completely no headspace	See Above	In metal paint cans vermiculite

collected. If samples cannot be shipped on a particular day, packaging will be delayed until the following morning so that the samples can be shipped with a full load of ice. These samples will be stored on ice in coolers, and kept in a secure area. Medium concentration samples do not require ice preservation.

Coolers will be shipped via Federal Express to the IT Environmental Analytical Laboratory in Knoxville, Tennessee. Notification of shipment, including airbill number, will be phoned to the Laboratory either by close of business of the day that the samples are shipped, or if a late shipment is made, by 9:00 a.m. the following day.

A chain-of-custody record will accompany the samples from time of collection to receipt in the laboratory. A copy of IT's chain-of-custody record form is included with the QAPP.

6.0 SAMPLE ANALYSES

6.1 SOIL BORING ANALYSES

The analytical testing program will define the vertical extent of contamination on the site and define the boundaries of no contamination. This will be accomplished by a tiered effective analysis of samples. Initially, a total of 16 samples will be tested using rapid sample turnaround. If the results show significant contamination, additional testing may be accomplished within the sample hold times. The proposed initial testing will be conducted in the order listed below:

- Three samples will be tested from each of two borings to define the vertical migration of contamination. It is anticipated that the samples to be tested will be collected from depths of six inches, two feet and five feet. The depth interval may be changed in the field depending on the sample processing procedures outlined in Section 5.0 or in the laboratory depending on the results of early lab tests. The two borings will be located in the areas of highest previously recorded contamination.

- Two samples will be tested from each of three borings at depths of six inches and two feet. The two feet depth may be changed depending on the results of the initial testing.

- One sample from each of four borings will be tested at a depth of two feet to define the boundary of no contamination. The two foot depth may be changed as described above.

All of the samples will be tested for Dioxin. Additionally, four samples will be composited from the 16 samples and will be tested for HSL organics and pesticides. A list of the parameters to be tested is presented in Table 2. If the results of this testing show significant contamination, the testing program can be expanded.

6.2 SURFACE SOIL ANALYSES

All of the surface samples collected south of Buildings 1 and 3 will be tested for Dioxin. The eight samples collected from the northern area will be composited into two samples which will be tested for Dioxin. The 20 surface

samples will be composited into six samples to be tested for the HSL pollutants. Table 2 contains the list of parameters to be analyzed.

TABLE 2
PARAMETERS TO BE ANALYZED
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

VOLATILES
Chloromethane
Bromoethane
Vinyl Chloride
Chloroethane
Methylene Chloride
Acetone
Carbon Disulfide
1,1-Dichloroethene
1,1-Dichloroethane
trans-1,2-Dichloroethene
Chloroform
1,2-Dichloroethane
2-Butanone
1,1,1-Trichloroethane
Carbon Tetrachloride
Vinyl Acetate
Bromodichloromethane
1,1,2,2-Tetrachloroethane
1,2-Dichloropropane
trans-1,3-Dichloropropene
Trichloroethene
Dibromochloromethane
1,1,2-Trichloroethane
Benzene
cis-1,3-Dichloropropene
2-Chloroethyl Vinyl Ether
Bromoform
2-Hexanone
4-Methyl-2-pentanone
Tetrachloroethene
Toluene
Chlorobenzene
Ethyl Benzene
Styrene
Total Xylenes

SEMI-VOLATILES
N-Nitrosodimethylamine
Phenol
Aniline
bis(2-Chloroethyl) ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl) ether
4-Methylphenol
N-Nitroso-Dipropylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol
Benzoic Acid
bis(2-Chloroethoxy) methane
2,4-Dichlorophenol
1,2,4-Trichlorobenzene
Naphthalene
4-Chloroaniline
Hexachlorobutadiene
4-Chloro-3-methylphenol
(para-chloro-meta-cresol)
2-Methylnaphthalene
Hexachlorocyclopentadiene
2,4,6-Trichlorophenol
2,4,5-Trichlorophenol
2-Chloronaphthalene

SEMI-VOLATILES
2-Nitroaniline
Dimethyl Phthalate
Acenaphthylene
3-Nitroaniline
Acenaphthene
2,4-Dinitrophenol
4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diethylphthalate
4-Chlorophenyl Phenyl ether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-nitrosodiphenylamine
4-Bromophenyl Phenyl ether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
Di-n-butylphthalate
Fluoranthene
Benzidine
Pyrene
Butyl Benzyl Phthalate
3,3'-Dichlorobenzidine
Benzo(a)anthracene
bis(2-ethylhexyl)phthalate
Chrysene
Di-n-octyl Phthalate
Benzo(b)fluoranthene
Benzo(k) fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenz(a,h)anthracene
Benzo(g,h,i)perylene

PESTICIDES
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor Epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endrin Aldehyde
Endosulfan Sulfate
4,4'-DDT
Endrin Ketone
Methoxychlor
Chlrodane
Toxaphene
AROCLOR-1016
AROCLOR-1221
AROCLOR-1232
AROCLOR-1242
AROCLOR-1248
AROCLOR-1254
AROCLOR-1260

DIOXIN
2,2,7,8-TCDD

7.0 FIELD DOCUMENTATION PROCEDURES

7.1 SITE LOCATION PROCEDURE

Following identification of boring and surface soil sampling sites, a wooden stake (approximately 2" x 2" x 24") will be driven into the ground, allowing approximately 8 to 10 inches of the stake to remain visible above ground. The top portion of the stake will be painted orange and labeled for identification. The label will contain the sample location number and type. The location of each stake may be recorded by use of a transit and stadia rod.

7.2 PHOTOGRAPHS

Photographs will be taken of each sampling site with respect to the surrounding area and relative to objects used to locate the site. The picture number and roll number (if more than one roll of film is used) will be logged in the field notebook to identify which sampling site is depicted in the photograph. The film roll will be identified by taking a photograph of an informational sign on the first frame of the roll. This sign will have the job and film roll numbers written on it so as to identify the pictures contained on the roll.

For example: Riverdale
Roll Number 1
Frame Number 1 of 36
July 1, 1985 - (Photographer's name)

7.3 FIELD NOTEBOOKS

Field notebooks will provide the means of recording data collection activities performed at the site. As such, entries will be described in as much detail as possible so that the situation can be reconstructed without reliance upon memory.

Notebooks will be assigned to field personnel, but will be stored in IT's Milwaukee office when not in use. Each notebook will be identified by the project-specific document number.

The cover of each notebook will contain:

Person and Organization to whom the book is assigned
Book Number
Project Name
Start Date
End Date

Entries into the notebook will contain a variety of information. At the beginning of each entry, the date, start time, weather, all field personnel present, level of personal protection being used on-site, and the signature of the person making the entry will be entered. The names of visitors to the site and the purpose of their visit will be recorded in the field notebook.

All measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Wherever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The film roll number and number of photographs taken of the station will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the procedures documented in this plan. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample is collected, and the volume and number of containers into which the sample is placed in the field. Sample numbers will be assigned prior to going on-site. Significant field notebook entries shall be countersigned by another member of the project team.

A log of personnel and visitors on site will be maintained, including entry and exit times. This log may be a separate "sign-in" field notebook. Major activities being performed or other items pertinent to the history of the investigation will also be noted.

8.0 FIELD TEAM ORGANIZATION, RESPONSIBILITIES, AND TRAINING

8.1 ORGANIZATION

The field sampling team will be organized according to the sampling activity. For on-site sampling work, the actual team makeup will consist of a combination of the following:

- Project Manager
- Sampling Team Leader
- Site Safety Officer
- Hydrogeologist/Engineer
- Sampling Engineer
- Preparation Area Technician.

One person may assume more than one of the roles listed above.

Specific responsibilities and assignments of sampling team members are described below.

8.2 PROJECT MANAGER

The Project Manager (PM) will conduct the initial site briefing and be responsible for task assignments and supplying all safety equipment.

8.3 SAMPLING TEAM LEADER

The Sampling Team Leader (STL) will be responsible for the coordination of all sampling efforts, will provide for the availability and maintenance of all sampling equipment and materials, and will provide the necessary shipping and packing materials. The STL will supervise the completion of all chain-of-custody records; supervise the proper handling and shipping of the samples collected; be responsible for the accurate completion of the field notebook; and provide close coordination with the Project Manager.

8.4 SITE SAFETY OFFICE

The Site Safety Officer (SSO) will be responsible for the adherence to all site safety requirements by team members. The SSO will assist the PM in conducting the site briefing meeting. The SSO will also assist in the various sampling activities and will perform the final safety check.

Additional responsibilities will include:

- Updating equipment or procedures based upon new information gathered during the site inspection
- Upgrading or degrading the levels of protection based upon site observations
- Enforcing the "buddy system"
- Determining and posting locations and routes to medical facilities, including poison control centers; arranging for emergency transportation to medical facilities
- Notifying local public emergency officers, i.e., police and fire departments, of the nature of the team's operations and posting emergency telephone numbers
- Entering the exclusion area in emergencies when at least one other member of the field team is available to stay behind and notify emergency services; or after he/she has notified emergency services
- Examining work party members for symptoms of exposure of stress
- Providing emergency medical care and first aid as necessary on-site.

The SSO has the ultimate responsibility to stop any operation that threatens the health or safety of the team or surrounding populace.

8.5 HYDROGEOLOGIST/ENGINEER

The Hydrogeologist/Engineer will supervise drilling operations and will be responsible for ensuring that the logging requirements are met. He will also be part of the sample collection team.

8.6 SAMPLING ENGINEER

The Sampling Engineer (SE) will assist the STL in collecting surface soil and boring samples and in decontaminating all field equipment.

8.7 PREPARATION AREA TECHNICIAN

The Preparation Area Technician (PAT) will remain in the decontaminated area and will assume custody of samples from the sampling team. The PAT will be responsible for the completion of all chain-of-custody forms. The PAT will also be responsible for maintaining communications with on-site personnel.

8.8 AGENCY ROLE

It is assumed that personnel from the U.S. EPA and IEPA, if present, will be acting as observers only and will not participate directly in field sampling and related activities.

9.0 SAMPLING ACTIVITY SCHEDULE

The sampling program described in this sampling plan is expected to take two to three weeks to complete. The subsequent analyses will require a turnaround time of approximately three to four weeks. Based on the results, either the Site Assessment may be undertaken or the scope of work will be expanded and additional sampling will have to be conducted. If an additional sampling phase is deemed necessary, details pertaining to the scope of work for that phase will then be provided. The following project activities will be implemented by the milestone dates shown below:

Activity	Number of Days After Approval of QAPP
Initiate Field Activities	25
Submit Results of Phase I Analyis to U.S. EPA	70
Submit Phase II Scope of Work (if necessary) to U.S. EPA	80

APPENDIX
D

APPENDIX D

BORING LOGS

FIELD BORING LOGS

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE		
BORING NUMBER: SB01	COORDINATES:	DATE: 10/15/85	
ELEVATION: 684.55	GWL: Depth Ø Date/Time	DATE STARTED: 10/15/85	
ENGINEER/GEOLOGIST: MLH	Depth Date/Time	DATE COMPLETED: 10/15/85	
DRILLING METHODS: 4 IN I.D. HSA		PAGE 1 OF 1	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (0.5 FT)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
							Bkgd HNu: 20-3.0 ppm
				Soft, Black silt topsoil organic 0.5	PT		
1.5	01	1 1 1	17	Fill; cinders, ash, brick fragments in a ~~sat~~ silty sand soil matrix	hf		t: 0945 HNu: Bkgd
3.0	02	1 2 2	14	Fill. cinders, ash, rock & brick fragments; moist 2.9	hf		t: 0958 HNu: Bkgd
				~~tig~~ loose light brown silty sand. wet 3.1	sm		
4.5	03	1 14	6	loose; dark brownish grey to black very fine sandy silt. moist 4.3	sm		t: 10:05 HNu: Bkgd
				~~Dark grey silt, soft moist~~			
5		OVER DRILL 4.5 - 5.0					
6.5	04	1 2 5	12	medium stiff to stiff greenish grey silty clay. yellowish brown to orange mottles? slightly moist			t: 10:12 HNu: Bkgd
8.0	05	6 10 13	12	Stiff to very stiff greenish grey mottled yellow brown silty clay. moist			t: 10:30 HNu: Bkgd
9.5	06	6 10 13	18	As above			t: 10:50 HNu: Bkgd
11.0	07	4 10 16	18	very stiff to hard yellowish brown to grey mottled silty clay very slightly moist			t: 11:00 HNu: B
12.5	08	7 13 27	0	No Recovery			t: 11:21 HNu: B Bkgd
14	09	16 23 26	18	Very stiff to hard yellow brown mottled grey silty clay. w/ light grey fine sand, dry 14.0 EOB			t: 11:40 HNu: Bkgd

NOTES: CME 550 ATV MOUNTED. 3" ∅ SPLIT BBL SAMPLER; MOTE FREEFALLING HAMMER FALLING 30 INCHES; 2 WRAPS ON CATHEAD

DRILLER: JIM REEH
ASSISTANT: JIM WADE } EII
SAMPLE TECH: RICK RANDISH
DESIGN TECH: MIKE WU } IT

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE	
BORING NUMBER: SB02	COORDINATES:	DATE: 10/15/85
ELEVATION: 681.74	GWL: Depth ∅ Date/Time	DATE STARTED: 10/15/85
ENGINEER/GEOLOGIST: MLH	Depth Date/Time	DATE COMPLETED: 10/15/85
DRILLING METHODS: 4" ID HSA		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 10 CM	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (Bkgd HNu = 2.0-3.0 ppm)
0	01	1 1 1	14	Soft, Black silt, highly organic very moist. some brick fragment, 1.0	PT		t: 15:12 HNu: Bkgd
1.5	02	1 3 6	12	Soft yellow brown to grey silty clay mottled, moist.	ml-cl	▽ 2	t: 15:16 HNu: Bkgd
3.0	03	2 5 4	16	4.0			t: 15:21 HNu: Bkgd
4.5				loose grey to yellow silty med grained sand, some gravel; very moist 4.5	SM		
5	04	3 8 13	18	Very stiff to hard yellowish brown silty clay. mottled grey; dry	cl		t: 15:26 HNu: B
6.0	05	4 18 23	18	Hard yellow brow silty clay dry occ pebble.	cl		t: 15:38 HNu: B
7.5	06	8 18 30	18	Hard yellow brown silty clay dry. - Grades to -	cl		t: 15:47 HNu: Bkgd
9.0	07	5 9 15	15	medium stiff to stiff grayish brown silty clay: less mottled; moist - Grades to -	cl-ml		t: 15:57 HNu: Bkgd
10.5	08	9 22 33	18	Very hard medium grey clay some silt. occ. pebble; occ mottles, dry	cl-ch		t: 16:19 HNu: Bkgd
12	09	5 14 18	18		cl-ch		t: 16:31 HNu: Bkgd
13.5				13.5 EOB			
15							

NOTES: 140 lb HAMMER; 2" ∅ SPLIT BBL SAMPLER. FALLING 30 INCHES. JUMARS ON CME HEAD. CME 550 ATV MOUNTED RIG.

DRILLER: JIM REECH
ASSISTANT: JIM WADE } IT
SAFETY TECH: RICK DAWSEH } IT CORP.
CLERK: MIKE WILL

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE CHEMICAL		
BORING NUMBER: SB-03	COORDINATES:		DATE: 10/16/85
ELEVATION: 682.65	GWL: Depth	Date/Time	DATE STARTED: 10/16/85
ENGINEER/GEOLOGIST: MLH	Depth	Date/Time	DATE COMPLETED: 10/16/85
DRILLING METHODS:			PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 10 CM	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0							Bucket HNu = Not functional
1.5	01	5 8 10	18	Fill material; crushed stone; cinders in an organic black silty loam top soil Some plant fragment & organic matter. 1.5'	hf		t=14:12
3.0	02	4 8 12	18	Medium stiff, yellowish grey clayey silt to silty clay. Friable; dry 2.9'	cl-ml		t=14:46
				loose fine brown sand, dry 3.2'	sm		
4.5	03	4 7 8	6	Medium stiff dark brown. silt, dry some organic matter.	ml		t=14:53
6.0	04	4 6 8	17	Stiff, yellowish brown to grey silty clay mottled; moist; trace gravel	cl		t=15:01 2" pebble in shoe
7.5	05	3 6 8	16	stiff yellowish brown to gray silty clay; mottled; moist Grades to	cl-ml		softer than above and more moist t=15:12
9.0	06	8 17 19	18	stiff yellowish brown clayey silt Grades to	ml		t=15:19
10.5	07	8 13 19	18	Hard, light greyish brown silty clay; less mottled; dry	cl		t=15:27
12	08	8 15 24	18	Hard, light brown silty clay dry	cl		t=15:34
13.5	09	5 13 23	18	Hard light brown silty clay dry 13.5 EOB	cl		t=15:50

NOTES: CME 550 ATV MOUNTED; 3" ⌀ SPLIT BBL SAMPLER DRIVEN 18 inches 140 lb FREE HAMMER HAMMER FALLING 30 inches; 2 WRAPS ON CATHEAD

DRILLER : JIM RECH } ETI
ASSISTANT : JIM WADE
SAMPLE TECH : RICK PARROSH } IT
DECON TECH : MIKE WILL

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE CHEMICAL	
BORING NUMBER: SB-04	COORDINATES:	DATE: 10/16/85
ELEVATION: 681.33	GWL: Depth Date/Time	DATE STARTED: 10/16/85
ENGINEER/GEOLOGIST: MLH	Depth Date/Time	DATE COMPLETED: 10/16/85
DRILLING METHODS: 4" Ø HSA		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 10 SFT	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0							HNu not functioning
	01	3 9 13	18	loose dark brown to black silt loam topsoil 1.0			t = 10:05
1.5				stiff, light yellowish grey silty clay dry	cl		
	02	12 15 16	6	very stiff light yellowish brown to grey silty clay trace gravel. some organic matter dry.	cl		t = 10:08
3.0							
	03	1 7 10	9	very stiff yellowish brown to grey silty clay; dry. mottled	cl		t = 10:21
4.5							
5	04	5 13 17	18	Hard, yellowish brown to grey mottled silty clay. dry. trace gravel	cl		t = 10:32
6.0							
	05	8 19 34	18	Hard yellow brown to grey silty clay; dry, mottled.	cl		t = 10:44
7.5							
	06	10 21 31	18	Hard yellow brown to grey silty clay dry. mottled	cl		t = 10:51
9.0							
10	07	9 18 25	18	Hard yellow brown silty clay. dry	cl		"4" sand inclusion t=10:57 (moist) less grey
10.5							
	08	4 14 23	18	Hard yellow brown to grey silty clay dry; mottled			t = 11:10
12.							
	09	8 20 31	18	Hard ~~yo~~ grey to yellowish brown silty clay. dry.			t = 11:37
13.5							
15							

NOTES: DRILL RIG: ATV MOUNTED CME550; 3" Ø SPLIT BBL SAMPLER. DRIVEN 18 BLOWS BY ~~FATT~~ 140 lb HAMMER: 2 WRAPS ON CAT HEAD

DRILLER: JIM RECH } ETI
ASSISTANT: JIM WADE }
SAMPLE TECH: RICK PANOSH } IT
DECON TECH: MIKE WU }

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE		
BORING NUMBER: SB-05	COORDINATES:		DATE: 10/21/85
ELEVATION: 686.30	GWL: Depth	Date/Time	DATE STARTED: 10/21/85
ENGINEER/GEOLOGIST: NLH	Depth	Date/Time	DATE COMPLETED: 10/21/85
DRILLING METHODS: 4" ID HSA			PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (0.5 FT)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS HNu = 2.0-4.0 PPM Bkgd
0				Brownish Grey clay soil 0.5'			
1.5	01	2 4/4	18	Fill. Bricks, crushed rock stones in a brown to dark grey silt loam soil	hf		t=0842 HNu=4.0
3.0	02	4 5 6	10	As above · Brick fragments moist	hf		t=0853 HNu=3.0 ppm
4.5	03	9 8 3	10	Fill: Dark brown to black silty sandy gravel, wet in lot 6 inch 4.8'	hf		t=0902 HNu=2.0 ppm
5 6.0	04	2 3 7	16	SOFT YELLOWISH BROWN TO GREY SILTY CLAY; MOIST; STICKY	cl		t=0911 HNu=Bkgd
7.5	05	3 5 16	12	STIFF TO HARD YELLOW BROWN SILTY CLAY. STICKY MOIST	cl		t=0924 HNu=Bkgd
9.0	06	7 17 23	18	HARD YELLOW BROWN TO GREY SILTY CLAY; MOTTLED DRY	cl		t=0933 HNu=Bkgd
10 10.5	07	10 17 28	18	HARD YELLOW BROWN TO GREY SILTY CLAY, MOTTLED, DRY	cl		t=0942 HNu=Bkgd
12.	08	6 18 27	18	HARD YELLOW BROWN TO GREY SILTY CLAY; MOTTLED; DRY	cl		t=0953 HNu=Bkgd
13.5	09	11 22 44	18	HARD YELLOW BROWN TO GREY SILTY CLAY, MOTTLED; DRY 13.5'	cl		t=10:11 HNu=Bkgd
				EOB			

NOTES: DRILL RIG ATV MOUNTED CME 550: 3" Ø SPLIT BBL SAMPLER DRIVEN 18 INCHES BY A 140LB HAMMER FALLING 30 INCHES: 2 WRAPS ON CAT HEAD.

DRILLER: JIM RECH } ETI
ASSISTANT: JIM WADE

SAMPLE TECH: RICK PARRISH } ITC

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE CHEMICAL	
BORING NUMBER: SB-06	COORDINATES:	DATE: 10/17/85
ELEVATION: 688.33	GWL: Depth Date/Time	DATE STARTED: 10/17/85
ENGINEER/GEOLOGIST: MLH	Depth Date/Time	DATE COMPLETED: 10/18/85
DRILLING METHODS:		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS OVA Bkgd: 10ppm
1.5	01	2 6 3	18	FILL; Brick fragments rocks etc in cinders and soil.	hf		t=15:27 OVA: Bkgd
3.0	02	1 2 2	18	Fill; cinders w/ soil bricks very stoney sandy gravel. 3.2.	hf		t=15:37 OVA: Bkgd
	03	1 3 23/3"	12	Soft to medium stiff blue grey clayey silt w/ organic matter / natural MOIST 4.2 REFUSAL	hf		t: 15:45 OVA= 120ppm SPOONDARK Auger refusal at 4.2'
5.0				OVER DRILL			END SHIFT 16:00 10/17/85 BEGIN SHIFT 0830 10/18/85
6.5	04	6 14 24	6	VERY STIFF YELLOW BROWN TO GREY SILTY CLAY; BECOMING STIFFER AND DRIER W/ DEPTH	cl		t: 0841 OVA=20ppm
8.0	05	5 15 27	18	HARD YELLOW BROWN TO GREY CLAY SOME SILT; DRY	cl		t: 0854 OVA: Bkgd
9.5	06	7 13 20	18	HARD YELLOW BROWN TO GREY SILTY CLAY ; DRY	cl		t: 0906 OVA: Bkgd
11.0	07	7 18 28	18	HARD YELLOW BROWN TO GREY SILTY CLAY DRY	cl		t: 0915 OVA: Bkgd
12.5	08	4 16 26	18	AS ABOVE	cl		t: 0924 OVA: Bkgd
14.	09	5 16 24	18	AS ABOVE 14.0 EOB	cl		t: 0937 OVA: Bkgd

NOTES: Drilled into concrete in first foot. moved back five feet spoon and auger refusal at 4.2'. Feels like large rock or concrete OVA pegs. pull out move back and auger down to 5.0' foot OVA pegs again in hole and reads 80ppm on cuttings shut down operation and call MIKE to discuss going to LEVEL B.

DRILL RIG: ATV MOUNTED CME 550; 3" ø SPLIT BBL SAMPLER DRIVEN 18 INCHES BY 140lb HAMMER FALLING 30 INCHES: 3 HOLES ON CATHEAD.

DRILLER: JIM REGIN (EI) SAMPLE TECH: RICK RANDISH

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE CHEMICAL	
BORING NUMBER: SB-07	COORDINATES:	DATE: 10/17/85
ELEVATION: 686.29	GWL: Depth Date/Time	DATE STARTED: 10/17/85
ENGINEER/GEOLOGIST: MLH	Depth Date/Time	DATE COMPLETED: 10/17/85
DRILLING METHODS: 4" ID HSA		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 0.5 FT	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS (OVA Bkgd = 80ppm)
1.5	01	8 13 12	16	Fill. Brick and rock fragments cinders in dark brown to black silty clay matrix.	hf		t - 11:05 OVA = Bkgd
3.0	02	5 50/6 –	11	Fill. yellow brown silty clay. rock fragments. 2.7			Refusal at 2.5' OVA = t - 11:15 feels like wood. Bks
4.5	03	3 2 5	17	Soft yellow brown to grey silty clay mottled; very moist.	cl		t = 11:30 OVA = Bkgd
6.0	04	2 6 10	17	medium stiff yellow brown to grey silty clay mottled; moist.	cl		t = 1137 OVA = 10ppm BREAK FOR LUNCH BEGIN AGAIN 13:00
7.5	05	3 14 21	18	Hard yellow brown to grey mottled silty clay; dry.	cl		t = 13:15 OVA = 12 ppm
9.0	06	6 16 25	18	Hard yellow brown to grey mottled silty clay; dry.	cl		t - 1320 OVA = Bkgd
10.5	07	5 15 22	18	Hard yellow brown to grey mottled silty clay. dry	cl		t = 1327 somewhat fractured but fractures filled with grey-white clay
12	08	5 15 23	18	Hard yellow brown to grey mottled silty clay; dry	cl		t = 13:35 OVA = Bkgd
13.5	09	7 12 22	18	Hard yellow brown to grey mottled silty clay; dry. 13.5 EOB	cl		t = 1350 OVA = Bkgd

NOTES: DRILL RIG AMI ATV MOUNTED CME 550; 3"Ø SPLIT BARREL SAMPLER DRIVEN 18 INCHES BY 140 LB HAMMER FALLING 30 INCHES. 2 WRAPS ON CATHEAD

DRILLER: JIM RECH } ETI
ASSISTANT: JIM WALK }
SAMPLE TECH: RICK ANDOSH } IT CORP.
DECON TECH: MIN WU }

IT CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 850037	PROJECT NAME: RIVERDALE CHEMICAL	
BORING NUMBER: SB-08	COORDINATES:	DATE: 10/17/85
ELEVATION: 689.22	GWL: Depth Date/Time	DATE STARTED: 10/17/85
ENGINEER/GEOLOGIST: NLH	Depth Date/Time	DATE COMPLETED: 10/17/85
DRILLING METHODS: 4" ID HSA		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (0.5 FT)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0							OVA Bkgd-8ppm
				medium stiff dark brown clay loam topsoil 0.75	hf		
1.5	01	1 3 7	18	Medium stiff yellow brown silty clay mottled grey; slightly moist			t = 0830 OVA: Bkgd
3.0	02	6 10 18	18	Stiff yellow brown grey silty clay very slightly moist; mottled	cl		t = 0836 OVA: Bkgd
4.5	03	6 17 25	18	Hard, yellowish brown to grey mottled silty clay; dry	cl		t = 0845 OVA: Bkgd
5	04	4 5 6	18	5.0 loose brown silty sand trace gravel moist grades into 5.5	cl / sm		t = 0847 OVA: Bkgd
6.0				soft blue grey silty clay-some sand very moist 6.0	ml		
7.5	05	1 2 3	4	soft to medium stiff yellow brown to grey silty clay mottled; moist	cl		t = 0852 OVA: Bkgd sampler wet
9.0	06	2 4 12	18	soft to medium stiff yellow brown to grey silty clay slightly moist — Grades to —	cl		t = 0859 OVA: Bkgd
10.	07	5 16 25	18	Hard light brown silty clay yellow grey. dry to slightly moist	cl		t = 0911 OVA: Bkgd
12.0	08	4 14 24	18	Hard light brown clay; trace to some silt. dry. fractured	cl		t = 0920 OVA: Bkgd
13.5	09	5 17 26	18	Hard light brown clay trace to some silt. dry. fractured 13.5 EOB	cl		t = 0925 OVA: Bkgd
5							

NOTES: DRILL RIG AN ATV MOUNTED CME 550; 3" ø SPLIT BBL SAMPLER DRIVEN 18 INCHES BY A 140 LB HAMMER FALLING 30 INCHES; 2 WRAPS ON CATHEAD

DRILLER: JIM RECH } ETI
ASSISTANT: JIM WADE
SAMPLE TECH: RICK PANCH } IT CORP.
DECON TECH: MIN WU

EDITED BORING LOGS

DATE BEGAN: 10/15/85
DATE FINISHED: 10/15/85
GROUND SURFACE EL: 664.55

BORING NO. SB01

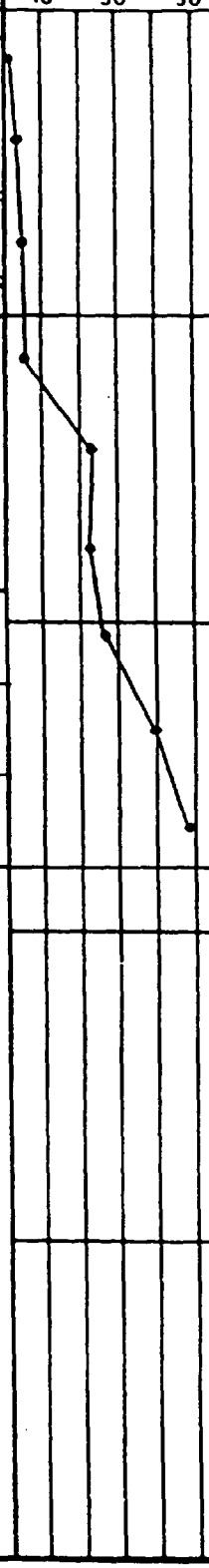
N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
				Soft black silt, organic 0.5	pt
		01		Fill, silty sand with cinders, ash, and rock and brick fragments dry to moist	hf
	2.5	02		2.9	
		03		Loose light brown silty sand, wet 3.1	sm
	5.0			Loose dark brown gray to black very fine sandy silt, moist 4.3	sm
		04		Soft dark gray silt, moist 4.5	ml
				No sample 5.0	
	7.5	05		Medium stiff to very stiff green gray silty clay, with yellow brown to orange mottles, moist	cl
		06		9.5	
	10.0	07		Very stiff to hard gray silty clay, with yellow brown mottles, moist 11.0	cl
	12.5	08		No Recovery	
670.55	14.0	09		Very stiff to hard gray silty clay, with yellow brown mottles and light gray fractures, fillings, dry 14.0	cl
				Bottom of Boring	

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTENT (PERCENT) 20 40



PROJECT NO. 850037

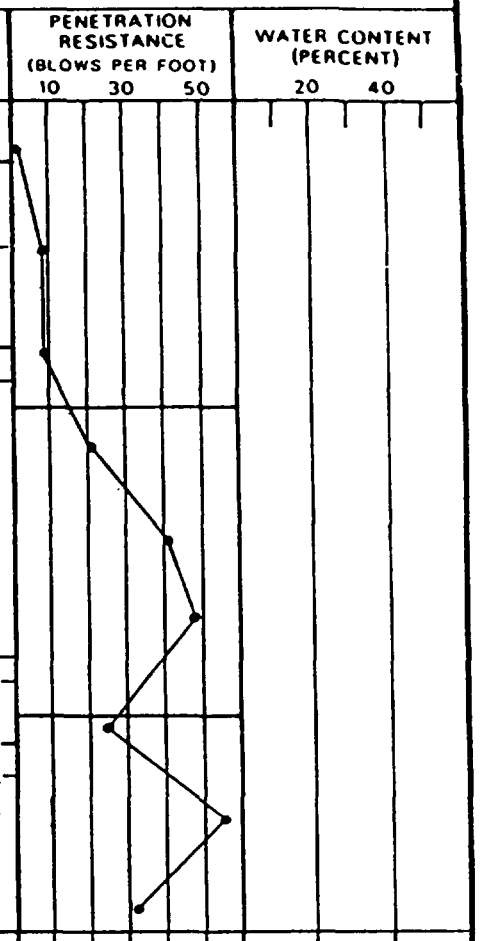
DATE BEGAN: 10/15/85
DATE FINISHED: 10/15/85
GROUND SURFACE EL: 665.74

BORING NO. SB02

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Soft black silt, highly organic, some brick fragments, moist 1.0	pt
	2.5	02		Soft yellow brown to gray silty clay, mottled, moist 4.0	ml-cl
		03		Loose gray to yellow silty medium grained sand, some gravel, moist 4.5	sm
	5.0	04		Very stiff to hard yellow brown silty clay, occasional gravel, pieces, mottled, dry 9.0	cl
	7.5	05			
		06			
	10.0	07		Medium stiff to stiff gray brown silty clay, mottled, moist	cl-ml
		08		Very hard medium gray clay, some silt, occasional gravel pieces, occasional mottling, dry 13.5	cl-ch
	12.5	09			
668.2	13.5				
				Bottom of Boring	



PROJECT NO. 850037

DATE BEGAN: 10/16/85
DATE FINISHED: 10/16/85
GROUND SURFACE EL: 665.65

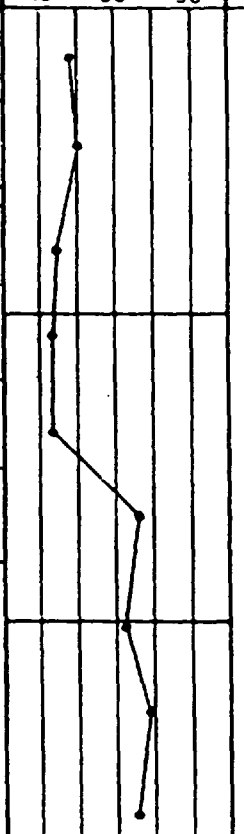
BORING NO. SB03

N N/A E N/A

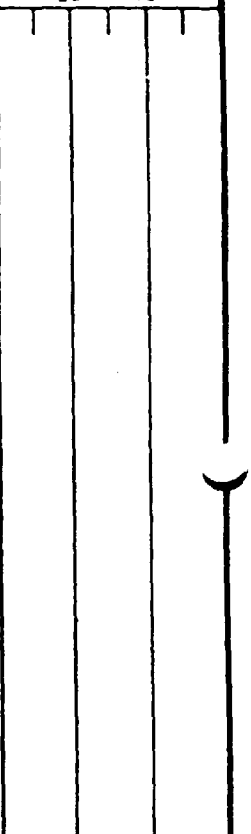
FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Fill - Black silty loam, with crushed stone, cinders, plant fragments, organic matter 1.5	hf
	2.5	02		Medium stiff yellow gray clayey silt to silty clay, friable, dry 2.9	cl-ml
		03		Loose brown fine sand, dry 3.2	sm
				Medium stiff dark brown silt, some organic matter, dry 4.5	ml
	5.0	04		Stiff yellow brown to gray silty clay, trace gravel, mottled, moist 6.0	cl
	7.5	05		Stiff yellow brown to gray silty clay, mottled, moist 7.5	cl-ml
		06		Stiff yellow brown clayey silt 9.0	ml
	10.0	07			
		08		Hard light gray brown to light brown silty clay, dry	cl
	12.5				
669.15	13.5	09		13.5	
				Bottom of Boring	

PENETRATION RESISTANCE (BLOWS PER FOOT)



WATER CONTENT (PERCENT)



PROJECT NO. 850037

DATE BEGAN: 10/16/85

DATE FINISHED: 10/16/85

GROUND SURFACE EL: 665.33

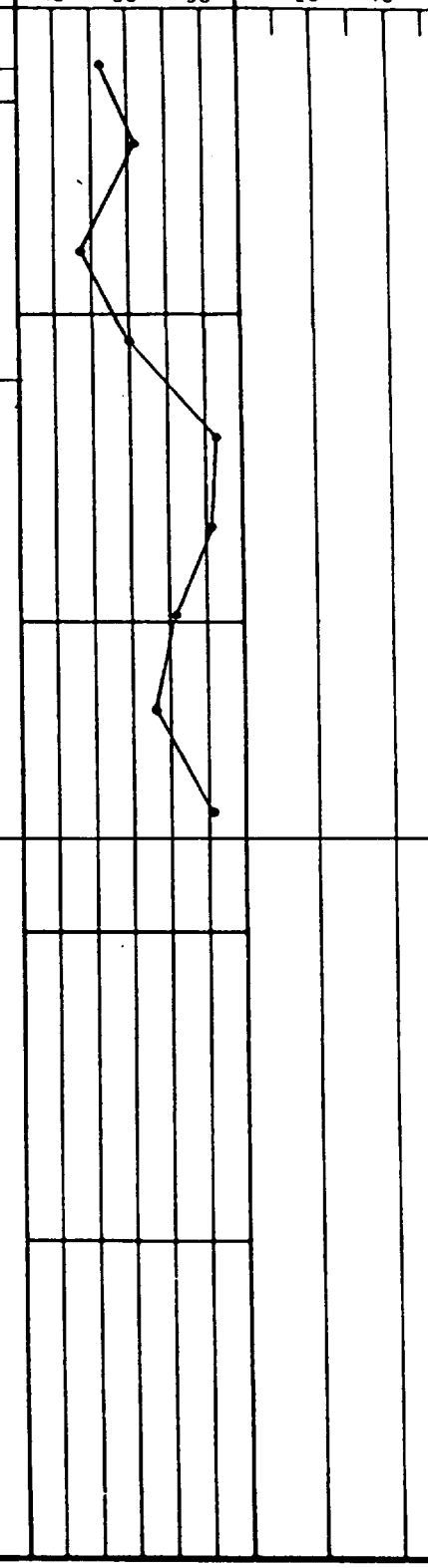
BORING NO. SB04

N N/A E N/A

FIELD ENGINEER: M. Hinchey

CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Loose dark brown to black silt 1.0	ml
				Stiff light yellow gray silty clay, dry 1.5	cl
	2.5	02			
		03		Very stiff light yellow brown to gray silty clay, some organic matter, trace gravel, mottled, dry	cl
	5.0	04		6.0	
	7.5	05		Hard yellow brown to gray silty clay, mottled, ¼ inch snad inclusion at approximately 9.0 feet, dry	cl
		06			
	10.0	07			
		08			
	12.5	09			
667.83	13.5			13.5	
				Bottom of Boring	



PROJECT NO. 850037

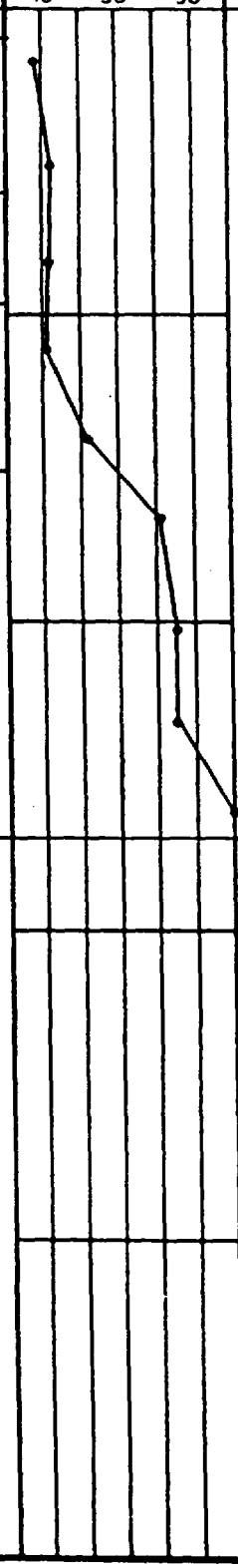
DATE BEGAN: 10/21/85
DATE FINISHED: 10/21/85
GROUND SURFACE EL.: 669.30

BORING NO. SB05

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
				Fill, brown gray clay 0.5	hf
		01		Fill, brown to dark gray silt with brick fragments, crushed rock, stone, dry to moist 3.0	hf
	2.5	02			
		03		Fill, dark brown to black silty sandy gravel, moist to wet 4.8	hf
	5.0				
		04		Soft to hard yellow brown to gray silty clay, moist 7.5	cl
	7.5	05			
		06		Hard yellow brown to gray silty clay, mottled, dry 13.5	cl
	10.0	07			
		08			
	12.5				
672.8	13.5	09			
				Bottom of Boring	



PROJECT NO. 850037

DATE BEGAN: 10/17/85

DATE FINISHED: 10/18/85

GROUND SURFACE EL: 671.33

BORING NO. SB06

N N/A E N/A

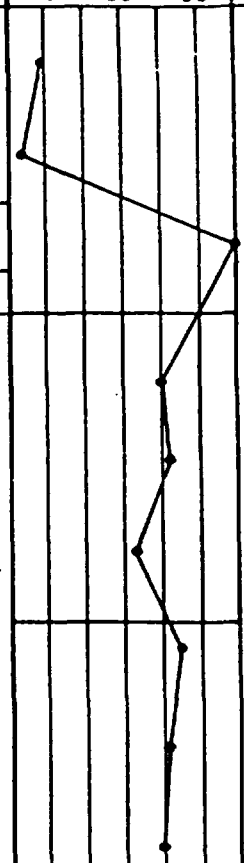
FIELD ENGINEER: M. Hinchey

CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Fill, sandy gravel with brick fragments, rocks and cinders, wet	hf
	2.5	02			
				3.2	
		03		Soft to meduim stiff blue gray clayey silt, some organic matter, moist	hf
				4.3	
	5.0			No sample	
				5.0	
		04			
		05			
	7.5				
		06		Very stiff to hard yellow brown to gray silty clay to clay, some silt, dry	cl
	10.0	07			
		08			
	12.5				
		09			
674.33	14.0			14.0	
				Bottom of Boring	

NOTE: Boring was offset twice due to auger refusal at 1.0 and 5.0 feet.

High OVA readings were noted at 5.0 feet



PROJECT NO. 850037

DATE BEGAN: 10/17/85
DATE FINISHED: 10/17/85
GROUND SURFACE EL: 669.89

BORING NO. SB07

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
		01		Fill, yellow brown to black silty clay with brick and rock fragments, cinders, dry	hf		
	2.5	02		2.7		55/12	
		03		Soft to medium stiff yellow brown to gray silty clay, mottled, moist	cl		
	5.0	04		6.0			
	7.5	05					
		06		Hard yellow brown to gray silty clay, mottled, dry	cl		
	10.0	07					
		08					
	12.5						
672.79	13.5	09		13.5			
				Bottom of Boring			

PROJECT NO. 850037

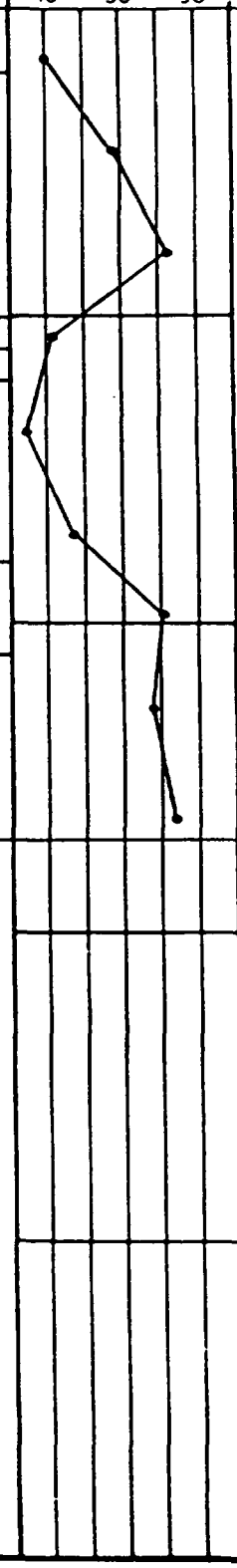
DATE BEGAN: 10/17/85
DATE FINISHED: 10/17/85
GROUND SURFACE EL: 672.22

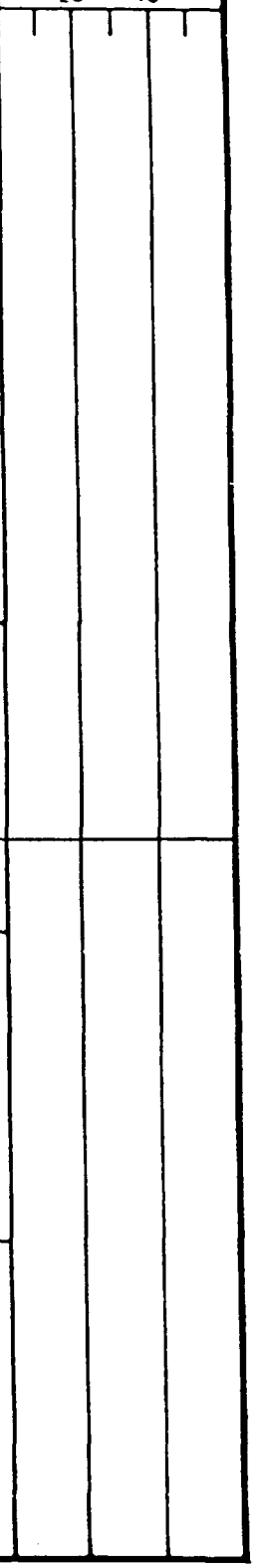
BORING NO. SB08

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Medium stiff dark brown clay loam, dry 1.0	hf
	2.5	02		Medium stiff to hard yellow brown to gray silty clay, mottled, dry 5.0	cl
		03			
	5.0	04		Loose brown silty sand, trace gravel, moist 5.5	sm
				Grades to	
	7.5	05		Soft blue gray silty clay, some clay, moist 6.0	ml
		06		Soft to medium stiff yellow brown to gray silty clay, mottled, moist 9.0	cl
				Grades to	
	10.0	07		Hard light brown to yellow gray silty clay, dry 10.5	cl
		08		Hard light brown clay, trace to some silt, fractured, dry	cl
	12.5				
675.72	13.5	09		13.5	
				Bottom of Boring	





PROJECT NO. 850037

APPENDIX
E

APPENDIX E

PRELIMINARY ASSESSMENT, PHASE I RI

PRELIMINARY ASSESSMENT

PHASE I REMEDIAL INVESTIGATION

prepared for

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

by

IT CORPORATION

Mark L. Hinchey
Project Manager

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1.0 INTRODUCTION

IT Corporation (IT) was retained by Riverdale Chemical Company (Riverdale) to conduct a Remedial Investigation/Feasibility Study (RI/FS) at Riverdale's pesticide formulation facility in Chicago Heights, Illinois. The RI/FS is being conducted in compliance with the consent agreement entered into by U.S. EPA Region V and Riverdale. The site location and vicinity diagrams are presented in Figures 1 and 2, respectively.

The purpose of the Remedial Investigation is to define the extent of dioxin and pesticide contaminated soils on and adjacent to Riverdale property. The investigation is being conducted in a phased approach, as outlined in the QAPP. The first phase (the results of which are presented herein) consisted of collecting twenty-one surface soil samples and augering eight soil borings. The original work plan called for twenty surface soil samples and nine borings. However, due to unexpectedly high water conditions in a low-lying area to the east and south of the plant, one of the boring locations was inaccessible to the drilling equipment. A revised sampling program, agreed to by the EPA on site coordinator, Neil Meldgin, substituted a surface soil sample for the soil boring collected in the same general vicinity. A Phase II sampling program would be implemented should the findings of the Phase I investigation warrant it.

The Quality Assurance Project Plan for the Remedial Investigation was approved by the Region V Quality Assurance Office on October 3, 1985. IT mobilized for the Phase I investigation on October 14, 1985 and completed the field program on October 21, 1985. The methodologies employed and the specific findings of the investigation are presented in the following sections.

Drilling services were subcontracted to Exploration Technology Incorporated, a geotechnical drilling firm experienced in hazardous waste investigations. Analytical services were provided by IT Analytical Services of Knoxville, Tennessee.

All drilling and soil sampling were supervised by an experienced IT hydrogeologist and under the observation of Dr. Michael Champion of Riverdale.

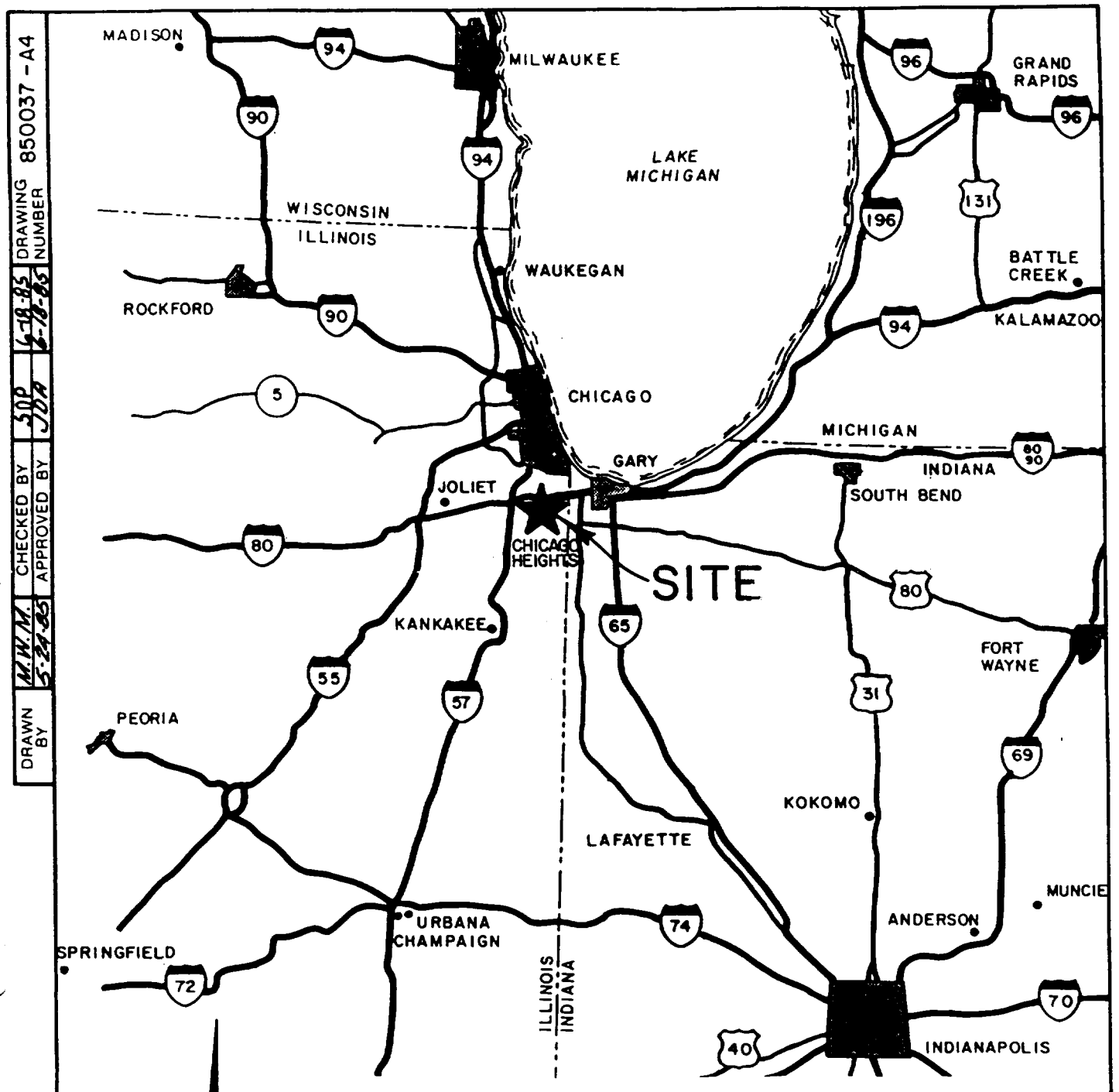

FIGURE I

LOCATION MAP

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWN BY	M.W.M. 5-24-85	CHECKED BY	SDP 6-19-85	DRAWING NUMBER	850037-A4
		APPROVED BY	JDA 6-18-85		

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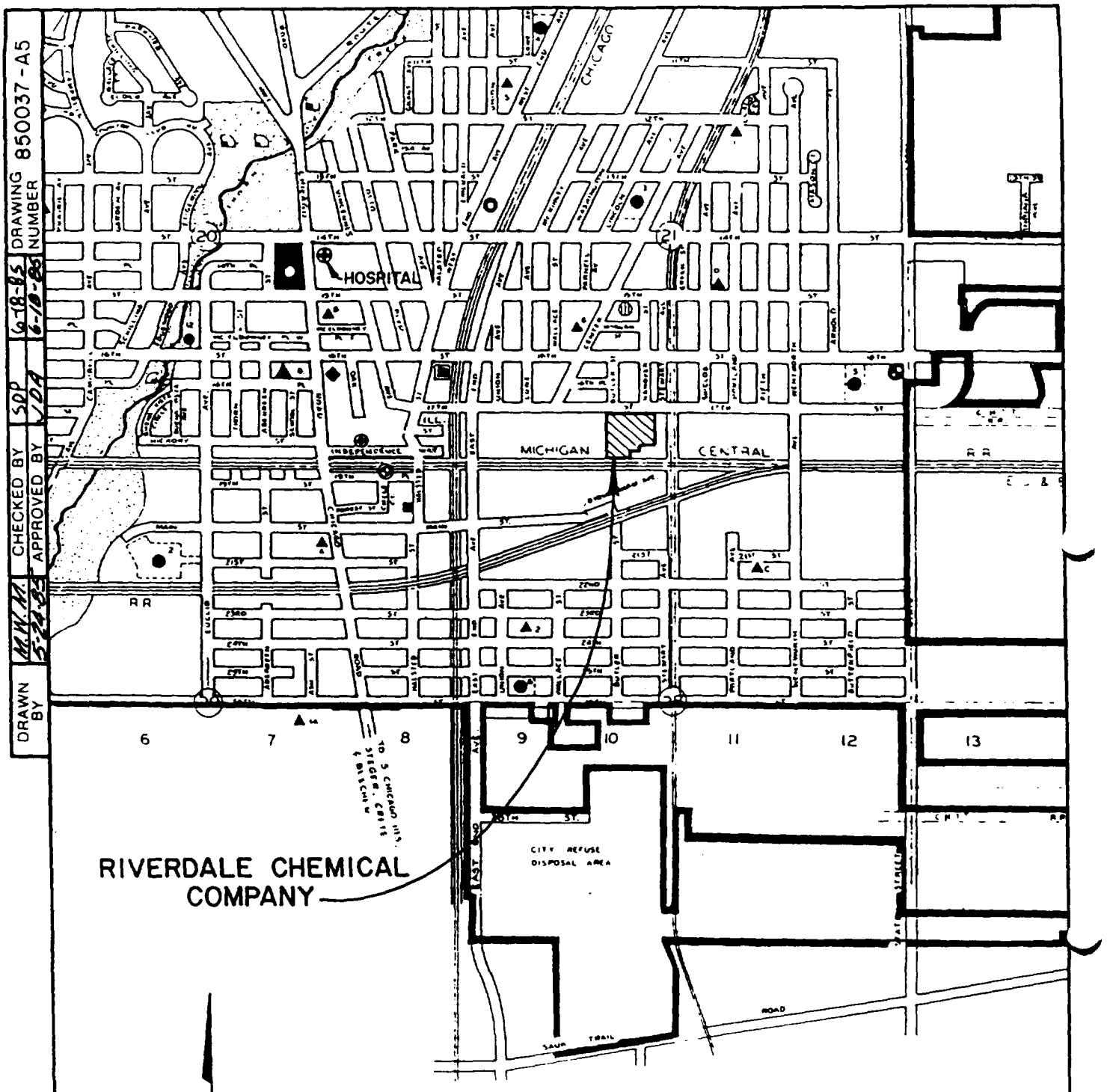

FIGURE 2

VICINITY MAP

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWN BY M.W.H. 5-24-85
CHECKED BY SDP 6-18-85
APPROVED BY VDA 6-18-85
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2.0 FIELD INVESTIGATION

The Phase I field investigation consisted of collecting soil samples from borings and selected surface locations on and adjacent to the Riverdale site. The distribution of borings and surface soil sampling locations was designed to provide comprehensive coverage of the site and to determine, as a first cut, the horizontal and vertical extent of soil contamination. The specific methodologies used during the investigation are discussed in the following sections.

2.1 SOIL BORING AND SAMPLING

A total of eight augered bore holes were drilled during the Phase I field program. Locations are shown in Figure 3. All bore holes were advanced using 6-inch outside diameter (3-1/4 inch inside diameter) hollow stem augers. A CME550 drill rig was used. Each boring was sampled continuously (at 1.5 foot intervals) using a 3-inch outside diameter split barrel sampler. The sampler was driven a total of 18 inches by a 140 pound hammer freely falling over a distance of 30 inches. Blow counts were recorded for each 6-inch interval. The sample spoon was opened by an IT technician and emptied into a stainless steel tray. The core was split open and scanned by a HNu photoionizing organic vapor analyzer. The reading and time were recorded. The sample was then described by the supervising hydrogeologist using the Unified Soil Classification System. The sample was composited in the tray and a portion was placed into a labeled 500 ml amber glass jar with a teflon-lined lid. The remaining sample was discarded in a spoils pile. The jar was subsequently decontaminated, placed in a ziploc plastic bag and placed in a cooler until being shipped to the laboratory. Stringent chain-of-custody procedures were observed.

The split barrel samplers, stainless steel trays, and stainless steel sampling tools were thoroughly decontaminated in a trisodium phosphate/tap water wash followed by a tap water rinse. The equipment was then sprayed with pesticide grade methanol, followed by a purified water spray rinse and was allowed to air dry before being used again. The augers and all tools that entered the bore hole were steam cleaned between each bore hole to minimize the chances of cross contamination.

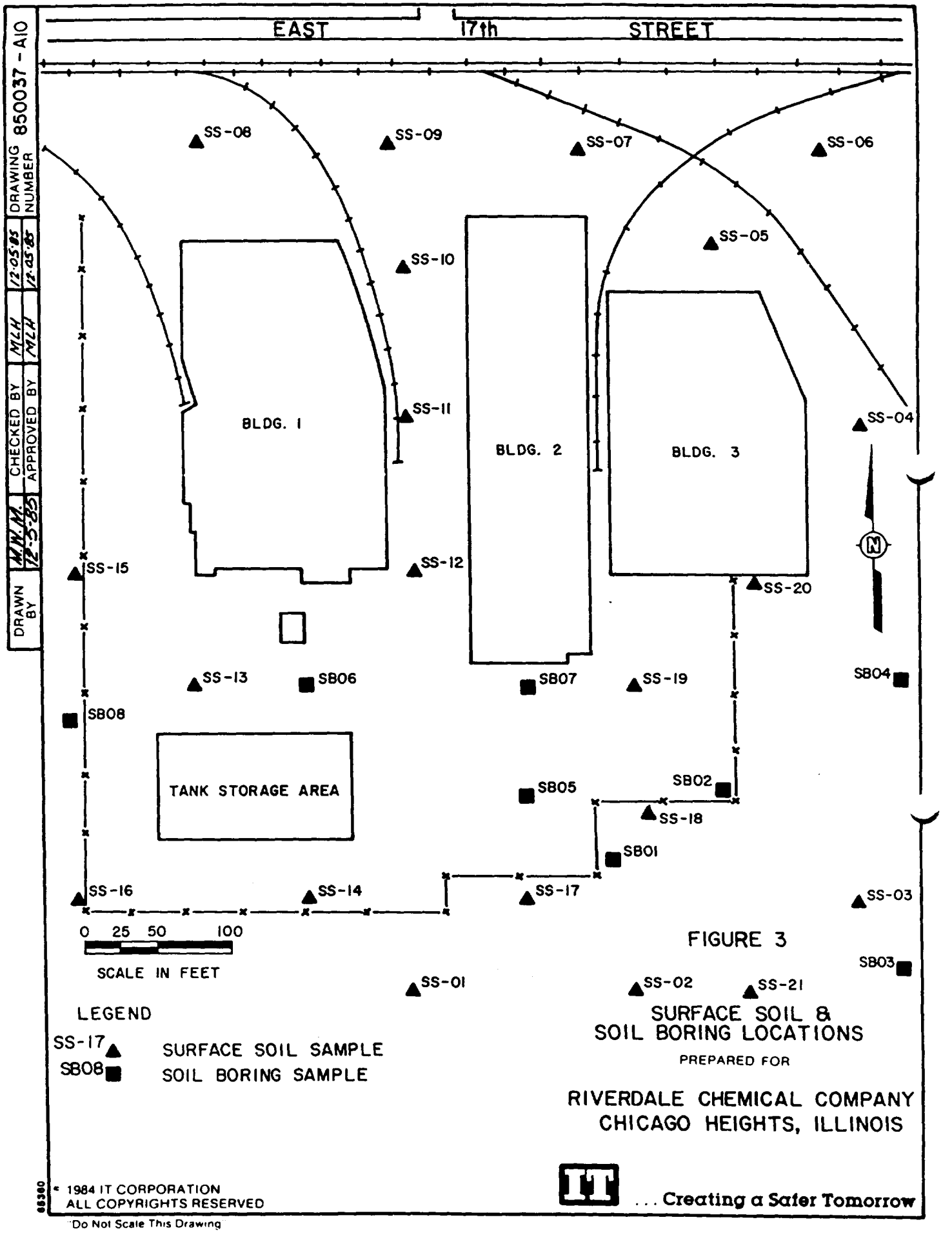

FIGURE 3

SURFACE SOIL & SOIL BORING LOCATIONS

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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All spoils and cuttings generated from on-site borings were collected to a central location (the tarped area), and were covered with visqueen and secured with bricks. Each boring was grouted from the bottom up with an expanding bentonite/cement grout via tremie pipe. Each location was marked with a wooden stake showing the boring number. Photo documentation of all field activities was provided by Dr. Champion.

2.2 SURFACE SOIL SAMPLING

Surface soil samples were collected from 21 locations on and adjacent to the Riverdale property. Locations are shown in Figure 3. At each location a square approximately 8 X 8 inches was inscribed on the ground surface. The soil within this square was scored with a stainless steel knife into a grid comprised of approximately one inch squares. The soil within each one inch square area was scraped up with a stainless steel spoon to a depth of approximately one inch and thoroughly composited in a stainless steel tray. The contents of the tray were placed in labeled 500 ml amber glass jars with teflon-lined lids. Each location was marked with a wooden or metal stake showing the location number. The decontamination procedures followed were identical to those followed for soil boring sampling. Sample custody was maintained by the IT sampling team.

2.3 SAMPLE SELECTION

As stated in the QAPP, an estimated 80 to 100 samples would be collected from the soil borings and 20 samples would be collected from surface soil locations. Selected samples were to be shipped for analysis of 2,3,7,8-TCDD and hazardous substance list (HSL) organics and pesticides according the the following schedule.

- The eight surface soil samples collected from the front part of the plant grounds would be composited into two samples and analyzed for 2,3,7,8-TCDD.
- The remaining twelve (actually thirteen) would be analyzed individually for 2,3,7,8-TCDD.
- Sixteen soil boring samples would be analyzed for 2,3,7,8-TCDD.

- The twenty (actually 21) surface soil samples would be composited into six samples and submitted for analysis of HSL organics and pesticides.

- Samples from the nine soil borings (actually eight) would be composited into four samples and submitted for analysis of HSL organics.

- Two quality control samples provided by U.S. EPA would be submitted for analysis of 2,3,7,8-TCDD.

A total of 36 samples were submitted for analysis of 2,3,7,8-TCDD. This included one duplicate and one blank. Two of the samples were composite surface soil samples as described above. Twelve soil samples were submitted for analysis of HSL organics and pesticides. This included one blank and one duplicate.

The selection of composite samples was designed to provide coverage of different zones of the site. The zones were very roughly defined on the basis of areal coverage of the property and where areas of contamination were expected based on past studies and personal conversations with plant personnel. For example, composite sample SS-(15,16) was designed to cover the western boundary of the property. Samples SS-(04, 05, 06, 07) and SS-(08, 09, 10, 11) were designed to cover the front part of the plant where contamination was expected to be at a minimum.

Composite sample SB-(05, 06) was selected based on areas of suspected high concentrations. Composite sample SB-(07, 08) was selected based on areas which were expected to have low concentrations. These zones are roughly delineated for surface soils and soil boring soils in Figures 4 and 5, respectively. Table 1 lists surface and soil boring samples submitted for analysis of 2,3,7,8-TCDD and HSL organics and pesticides.

Selection of boring samples was based on zones of visual contamination and readings of the HNu. In general, a sample was selected from the upper one and one-half feet of each boring, with the rationale being that this is the zone in which the highest levels of contamination would be expected. In those instances where recovery was poor, a sample was collected from the next lowest interval. Similarly, a sample was selected from the first interval of natural

TABLE 1 - SAMPLES SUBMITTED FOR ANALYSIS

2,3,7,8-TCDD

SURFACE SOIL SAMPLES	SOIL BORING SAMPLES
RIV-(SS01)-1	RIV-SB01-1.5-1
RIV-(SS02)-1	RIV-SB01-6.5-1
RIV-(SS03)-1	RIV-SB02-1.5-1
RIV-(SS12)-1	RIV-SB02-6.0-1
RIV-(SS13)-1	RIV-SB03-1.5-1
RIV-(SS14)-1	RIV-SB03-6.0-1
RIV-(SS15)-1	RIV-SB04-1.5-1
RIV-(SS16)-1	RIV-SB04-6.0-1
RIV-(SS17)-1	RIV-SB05-3.0-1
RIV-(SS18)-1	RIV-SB05-7.5-1
RIV-(SS19)-1	RIV-SB06-3.0-1
RIV-(SS20)-1	RIV-SB06-8.0-1
RIV-(SS21)-1	RIV-SB07-1.5-1
RIV-(SS22)-1[1]	RIV-SB07-6.0-1
RDC-1[2]	RIV-SB08-1.5-1
RDC-2[2]	RIV-SB08-4.5-1
Composites	RIV-SB09-0.0-1[3]
RIV-SS-(04, 05, 06, 07)-1	RIV-SB10-0.0-1[5]
RIV-SS-(08, 09, 10, 11)-1	

HSL ORGANICS

SURFACE SOIL SAMPLES	SOIL BORING SAMPLES
RIV-SS-(04, 05, 06, 07)-1	RIV-SB-(01-02)-1
RIV-SS-(08, 09, 10, 11)-1	Composite of SB01-1.5-1 and SB02-1.5-1
RIV-SS-(01, 02, 17, 18)-1	RIV-SB-(03, 04)-1
RIV-SS-(03, 19, 20, 21)-1	Composite of SB03-1.5-1 and SB04-1.5-1
RIV-SS-(12, 13, 14)-1	RIV-SB-(05, 06)-1
RIV-SS-(15, 16)-1	Composite of SB05-3.0-1 and SB06-3.0-1
RIV-SS-(22, 23, 24, 25)-1[4]	RIV-SB-(07, 08)-1
RIV-SS-(23)-1[5]	Composite of SB07-1.5-1 and SB08-1.5-1

Notes

(1) Duplicate of SS13
(2) QA samples provided by U.S. EPA.
(3) Duplicate of SB04-6.0-1.
(4) Duplicate of SS-(04, 05, 06, 07)-1
(5) Blank

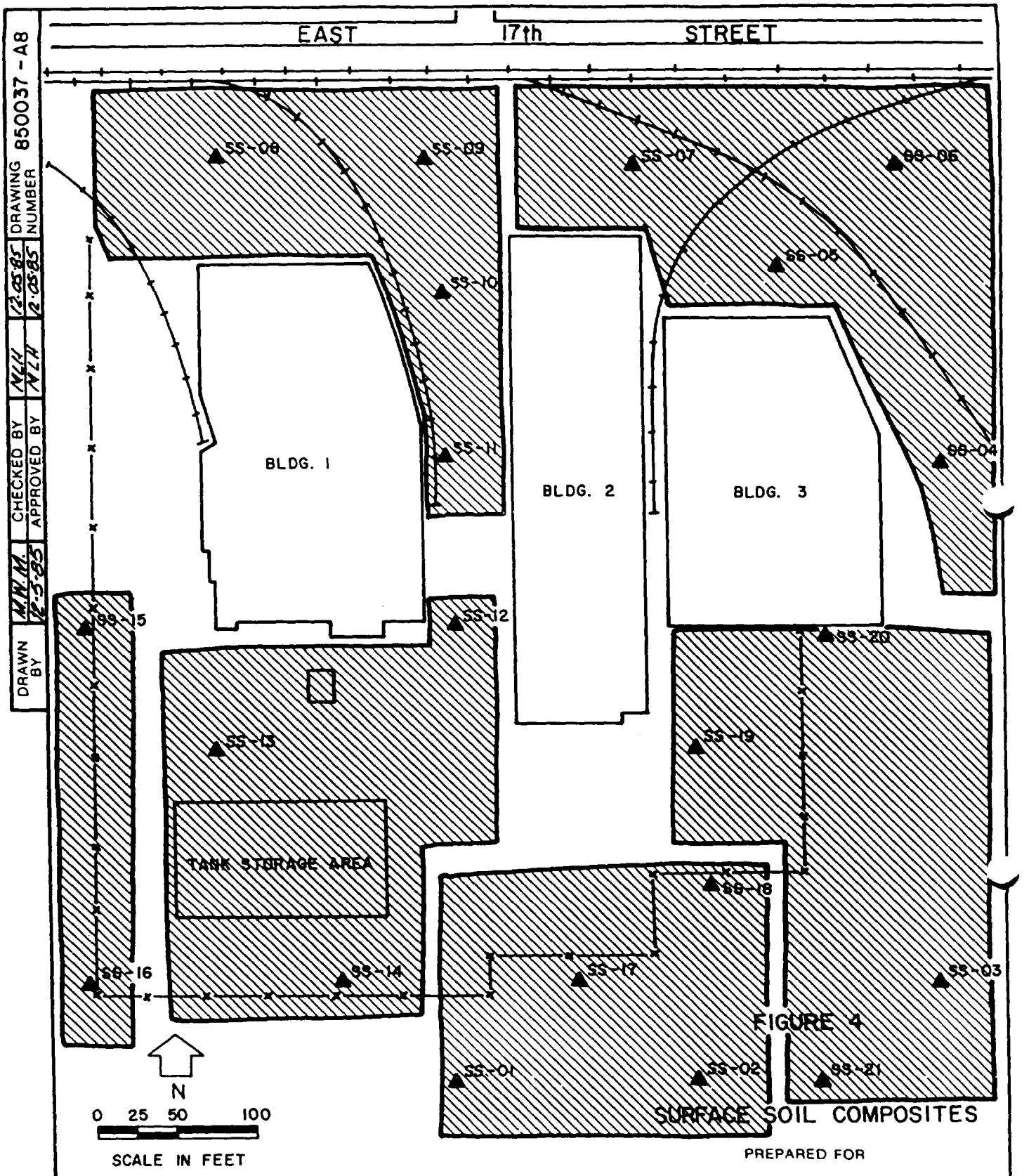

FIGURE 4

SURFACE SOIL COMPOSITES

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWING NUMBER 850037 - A8
CHECKED BY MLH 12-05-85
APPROVED BY MLH 12-05-85
DRAWN BY M.W.M. 12-5-85

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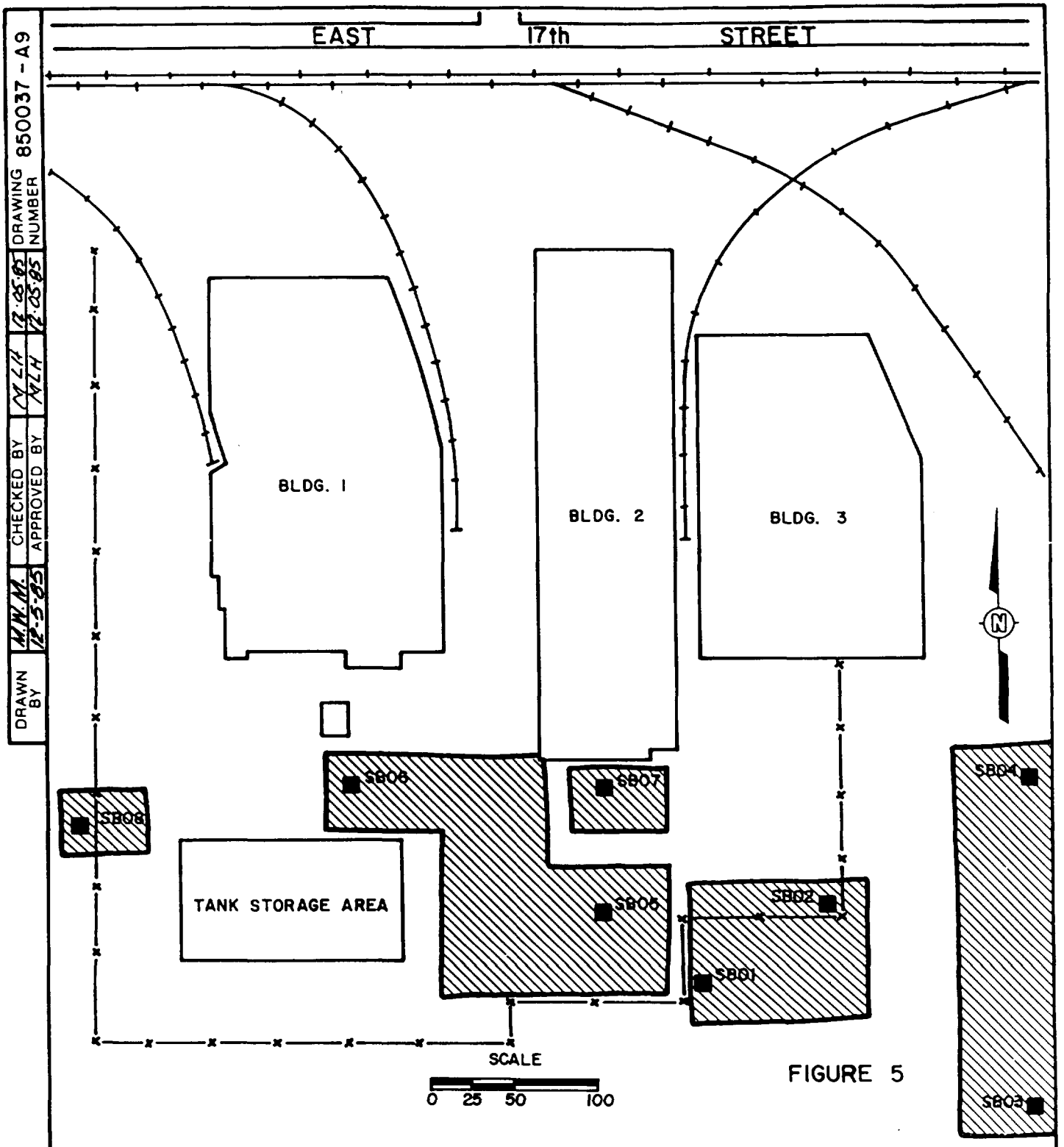

FIGURE 5

SOIL BORING COMPOSITES

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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CHECKED BY	CLH 12-05-85
APPROVED BY	MLH 12-05-85
DRAWING NUMBER	850037 - A9

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soil in each boring which was visually free of contamination, with the rationale being that dioxin would only migrate to the extent of the observed contaminant front due to its hydrophobic nature. All soil boring composite samples were comprised of the first (0.0-1.5) foot of each boring except where recovery was poor, in which case the composite was made up of soils in the 1.3-3.0 foot interval.

2.4 SAMPLE ANALYSIS

All samples were analyzed by IT Analytical Services of Knoxville, Tennessee. U.S. EPA Contract Laboratory Program protocols were followed for all analytical work.

The samples and blank were spiked prior to extraction with an internal standard/surrogate solution containing 50 ng ^{13}C-2,3,7,8-TCDD and 10 ng ^{37}Cl-2,3,7,8-TCDD. The samples were extracted and cleaned up using the EPA reference method described in "The Determination of 2,3,7,8-TCDD From Soil and Sediment," revised September 1983. Extracts were analyzed by GC/MS operating in the selected ion monitoring mode for enhanced sensitivity.

A ten (10) gram aliquot of each soil and 10 g sodium sulfate (a blank) were weighed into separate jars. The samples and blank were spiked with the internal standard/surrogate mixture and allowed to stand overnight for equilibration, followed by an extraction with a methanol/hexane mixture for three hours using a platform shaker. The resulting extracts were filtered into a KD flask and the volume reduced to approximately 1 ml.

To aid in the removal of chemical interferences, the samples and blank were first treated using separatory funnel techniques found in Option C of "The Determination of 2,3,7,8-TCDD in Soil and Sediment," September 1983 revision. Extracts were washed with 20% KOH and distilled water followed by three concentrated H_2SO_4 washes. Further cleanup consisted of two steps of column chromatography. The first step involved a neutral alumina column while the second was a dual column system utilizing acid-modified silica gel followed by neutral alumina. Final extracts were concentrated near dryness and raised to 50 ul with a solution containing 11 ng ^{13}C-2,3,7,8-TCDF.

GC/MS Analysis

The sample extracts were analyzed using HRGC/LRMS scanning in the selected ion monitoring mode for enhanced sensitivity. The column used for this isomer specific analysis was a 60 m SP2331 fused silica column. Before acquisition of the samples, a seven isomer performance mixture containing the six most closely eluting TCDD isomers was run. In addition, a five point calibration plot was run in triplicate. The shift standard, analyzed on the same day as the samples, produced a response factor within 10% of the fifteen point. Percent recovery is reported by comparing ^{13}C-TCDD to ^{13}C-TCDF. Accuracy of the method is obtained by the recovery of ^{37}Cl-TCDD versus ^{13}C-TCDD.

The results are reported in ppb. A detection limit is calculated from 2.5 times the signal in the area of the elution of ^{13}C-TCDD whenever a sample contains no detectable TCDD.

QA/QC results are presented in a separate document along with the raw data package. In all cases, precision and accuracy are within the limits established for acceptance of dioxin/dibenzofuran

TABLE 2
DIOXIN CONCENTRATION ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

SAMPLE I.D. NUMBER	2,3,7,8-TCDD CONC. (PPB)
SS01	1.6
SS02	ND
SS03	ND
SS(04,05,06,07)	ND
SS(08,09,10,11)	ND
SS12	ND
SS13	3.6
SS14	7.7
SS15	197
SS16	1.1
SS17	9.6
SS18	10.5
SS19	5.1
SS20	ND
SS21	ND
SS22 (1)	3.8
SB01-1.5	ND
SB01-6.5	ND
SB02-1.5	ND
SB02-6.0	ND
SB03-1.5	ND
SB03-6.0	ND
SB04-1.5	ND
SB04-6.0	ND
SB05-3.0	26.0
SB05-7.5	ND
SB06-3.0	33.7
SB06-8.0	0.80
SB07-1.5	1.4
SB07-6.0	ND
SB08-1.5	ND
SB08-4.5	ND
SB09-0.0 (2)	ND
SB10-0.0 (3)	ND
RDC-1 (4)	ND
RDC-2 (4)	4.8

SS=SURFACE SOIL SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED IN PARENTHESES.
SB=SOIL BORING SAMPLE. NUMBER SUCCEEDING HYPHEN IS DEPTH FROM WHICH SAMPLE WAS COLLECTED.
ND=INDICATES COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
(1)=SAMPLE IS DUPLICATE OF SS13.
(2)=SAMPLE IS DUPLICATE OF SB04-6.0.
(3)=SAMPLE IS A TRAVEL BLANK.
(4)=QC SAMPLE PROVIDED BY U.S. EPA.

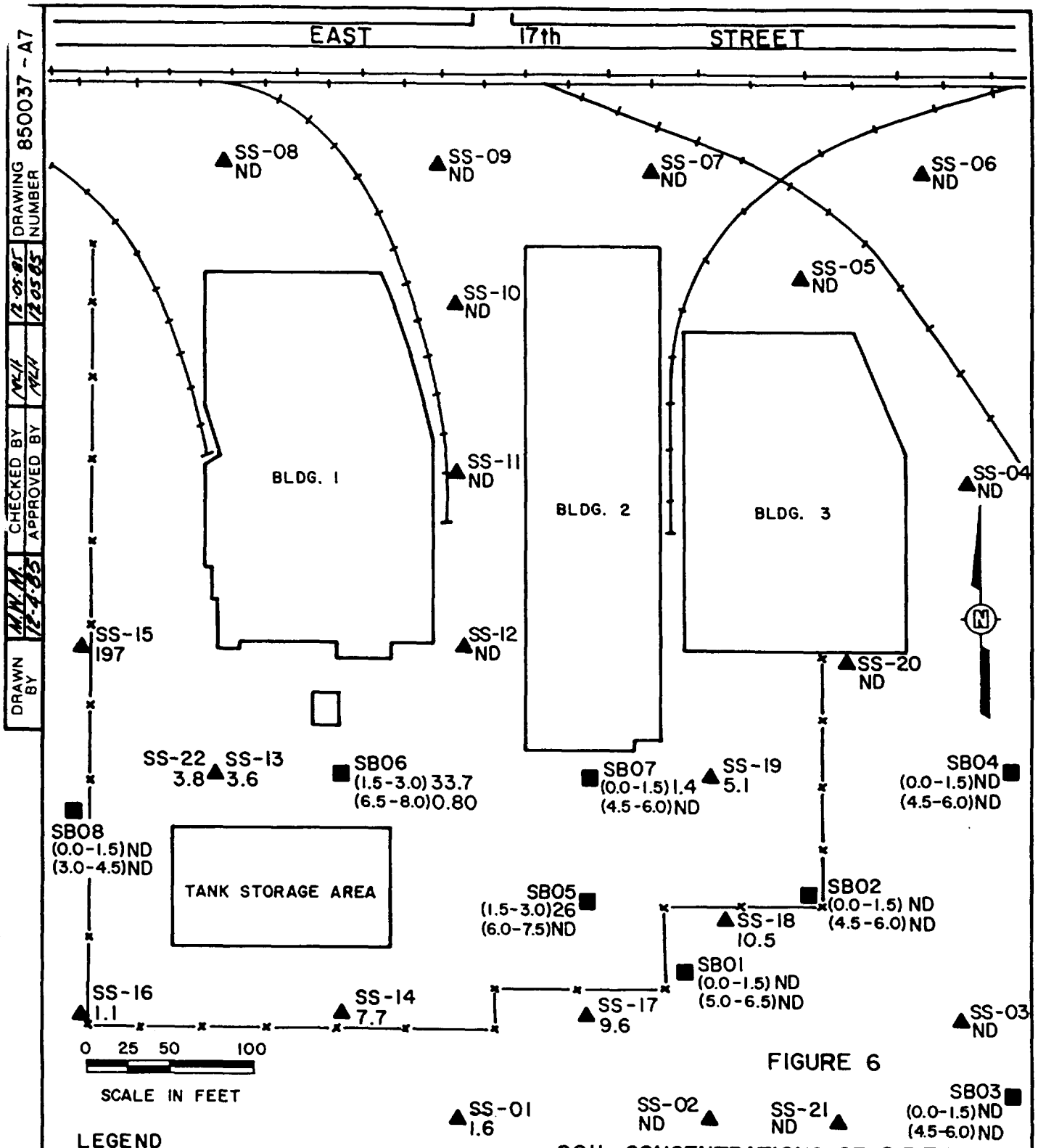

FIGURE 6

SOIL CONCENTRATIONS OF 2,3,7,8-TCDD

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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Of the soil boring samples submitted for analysis, borings SB05 and SB06 exhibit the highest levels of contamination. These borings show high levels of 2,3,7,8-TCDD in the upper three feet of the profile. Because of poor recovery in the 0.0-1.5 interval, a sample from the 1.5-3.0 foot interval was submitted. The level of dioxin drops to 0.80 ppb in the interval 6.5-8.0 feet in boring SB06 and is not detected in the range 6.0-7.5 in boring SB05. The soils at boring SB-06 were very moist to wet in the upper three to four feet. This created some problems with soil sloshing into the bore hole and getting inside the hollow stem augers. Because of this, there may have been some residual soil contamination on the split barrel sampler as it was driven from 6.5 to 8.0 feet. Therefore, it is possible that the 0.80 ppb value of dioxin detected may be the result of in-bore hole contamination and may not be representative of the actual concentration in soils of this interval. The analytical results, therefore, indicate that 2,3,7,8-TCDD contamination is confined to the upper few feet of soil or fill and does not appear to be migrating downward.

3.2.2 HSL Organics and Pesticides

The results of HSL organic and pesticide analyses are presented in Table 3. Volatile organic compounds are generally absent with the exception of methylene chloride and 2-butanone which, because they show up in the method blank, are considered to be the result of laboratory contamination.

Base/neutral and acid extractable compounds are generally absent with the exception of phthalates and polynucleated aromatic hydrocarbons (PAHs). The phthalate compounds are present in the method blank and are considered to be the result of laboratory contamination. The source of the PAH compounds is probably the cinders and ash which constitute a major portion of the fill on the plant property.

High concentrations of chlorinated pesticides were detected in several of the surface soil composite samples. The only surface soil sample which did not exhibit high concentrations of pesticides was sample SS(03, 19, 20, 21), which was collected from areas of anticipated low concentrations.

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
VOLATILES (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	2.1 J	ND	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	2.0 J	ND	ND	ND	2.9 J	ND
METHYLENE CHLORIDE	55 B	33 B	16 B	58 B	20 B	91 B	28 B	70 B
CHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BROMOFORM	ND	ND	ND	ND	ND	ND	ND	ND
BROMODICHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
DIBROMOCHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	3.9 J	ND	ND	ND	ND
TOLUENE	ND	ND	ND	1.6 J	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
VINYL CHLORIDE	ND	ND	1.4 J,B	ND	ND	ND	ND	ND
ACETONE	68	ND	ND	ND	ND	ND	ND	160
2-BUTANONE	21 B	13 B	13 B	8.7 J,B	9.8 J,B	10 B	10 B	28 J,B
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND
2-HEXANONE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND
VINYL ACETATE	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL XYLENES	11	ND	24	ND	ND	ND	39	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
VOLATILES (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
BENZENE	ND	ND	ND	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND
CHLOROBENZENE	ND	3.5 J	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND
CHLOROETHANE	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND
TRANS-1,2-DICHLOROETHENE	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND
METHYLENE CHLORIDE	34 B	83 B	52 B	68 B
CHLOROMETHANE	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND
BROMOFORM	ND	ND	ND	ND
BROMODICHLOROMETHANE	ND	ND	ND	ND
DIBROMOCHLOROMETHANE	ND	ND	ND	ND
TETRACHLOROETHENE	1.8 J	4.3 J	ND	1.6 J
TOLUENE	4.0 J	14	ND	4.3 J
TRICHLOROETHENE	ND	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND	ND
ACETONE	ND	ND	ND	ND
2-BUTANONE	11 B	10 B	9.0 J,B	8.9 J,B
CARBON DISULFIDE	ND	ND	ND	ND
2-HEXANONE	ND	ND	ND	ND
4-METHYL-2-PENTANONE	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND
VINYL ACETATE	ND	ND	ND	ND
TOTAL XYLENES	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
SEMI-VOLATILES (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
2,4,6-TRICHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	ND	ND	470	ND	ND	ND	520	ND
2,4-DIMETHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2-NITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
4-NITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
4,6-DINITRO-2-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	210
PHENOL	ND	ND	ND	ND	ND	ND	ND	ND
BENZOIC ACID	ND	ND	ND	ND	ND	ND	ND	800
2-METHYLPHENOL	ND	ND	300 J	ND	ND	ND	310 J	ND
4-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TRICHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
ACENAPHTHENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZIDINE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROETHYL)ETHER	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	ND	ND	ND	ND	ND	ND	ND	ND
4-CHLORO-3-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
FLUORANTHENE	5000 J	3600	930	1700 J	4800	4600 J	600	ND
4-CHLOROPHENYL PHENYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
SEMI-VOLATILES CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
2,4,6-TRICHLOROPHENOL	ND	ND	ND	ND
2-CHLOROPHENOL	ND	ND	ND	ND
2,4-DICHLOROPHENOL	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	ND	ND	ND	ND
2-NITROPHENOL	ND	ND	ND	ND
4-NITROPHENOL	ND	ND	ND	ND
2,4-DINITROPHENOL	ND	ND	ND	ND
4,6-DINITRO-2-METHYLPHENOL	ND	ND	ND	ND
PENTACHLOROPHENOL	ND	ND	ND	ND
PHENOL	ND	ND	ND	ND
BENZOIC ACID	ND	ND	ND	ND
2-METHYLPHENOL	ND	ND	ND	ND
4-METHYLPHENOL	ND	ND	ND	ND
2,4,5-TRICHLOROPHENOL	ND	ND	ND	ND
ACENAPHTHENE	ND	ND	ND	150 J
BENZIDINE	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND
HEXACHLOROBENZENE	ND	ND	ND	ND
HEXACHLOROETHANE	ND	ND	ND	ND
BIS(2-CHLOROETHYL)ETHER	ND	ND	ND	ND
2-CHLORONAPHTHALENE	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	ND	ND	ND	ND
2,4-DINITROTOLUENE	ND	ND	ND	ND
2,6-DINITROTOLUENE	ND	ND	ND	ND
4-CHLORO-3-METHYLPHENOL	ND	ND	ND	ND
FLUORANTHENE	560	1800	ND	7200
4-CHLOROPHENYL PHENYL ETHER	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	ND	ND	ND	ND
HEXACHLOROBUTADIENE	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 5 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
SEMI-VOLATILES CON'T (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
ISOPHORONE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	300 J	ND	ND	170 J	ND	ND	ND
NITROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIMETHYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIPROPYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	2100 J	1100	1300	ND	320	ND	1400	290
BUTYL BENZYL PHTHALATE	ND	880	340	ND	670	ND	660	ND
DI-N-BUTYL PHTHALATE	ND	1100 B	1200 B	ND	500 B	ND	1400 B	1900 B
DI-N-OCTYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
BENZO(A)ANTHRACENE	6800 J,B	2400	900	ND	1700	ND	1400	ND
BENZO(A)PYRENE	ND	2000	930	ND	2000	1900 J	1300	ND
BENZO(B)FLUORANTHENE	ND	1600	770	ND	2500	ND	1500	ND
BENZO(K)FLUORANTHENE	ND	1600	770	ND	2500	ND	1500	ND
CHRYSENE	ND	2800	1300	ND	4100	ND	1700	ND
ACENAPHTHYLENE	ND	240 J	230 J	ND	ND	ND	290	ND
ANTHRACENE	ND	490	320 J	ND	ND	ND	350	ND
BENZO(GHI)PERYLENE	ND	990	590	ND	1200	ND	960	ND
FLUORENE	ND	ND	ND	ND	190	ND	200 J	ND
PHENANTHRENE	ND	1900	820	ND	4900	ND	750	ND
DIBENZO(A,H)ANTHRACENE	ND	ND	ND	ND	ND	ND	ND	ND
INDENO(1,2,3-C,D)PYRENE	ND	1100	540	ND	1300	ND	880	ND
PYRENE	ND	3800	900	ND	6800	ND	1100	ND
ANILINE	ND	ND	ND	ND	ND	ND	ND	ND
BENZYL ALCOHOL	ND	ND	ND	ND	ND	ND	ND	ND
4-CHLOROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
DIBENZOFURAN	ND	ND	ND	ND	120 J	ND	ND	ND
2-METHYLNAPHTHALENE	ND	640	ND	ND	290 J	ND	ND	ND
2-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
3-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
4-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 6 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
SEMI-VOLATILES CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
ISOPHORONE	ND	ND	ND	ND
NAPHTHALENE	160 J	520	ND	160 J
NITROBENZENE	ND	ND	ND	ND
N-NITROSODIMETHYLAMINE	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	ND	ND	ND	ND
N-NITROSODIPROPYLAMINE	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	180 J	450	ND	450
BUTYL BENZYL PHTHALATE	1400	610	ND	680
DI-N-BUTYL PHTHALATE	1400 B	1000 B	ND	1200 B
DI-N-OCTYL PHTHALATE	ND	ND	ND	ND
DIETHYL PHTHALATE	ND	ND	ND	ND
DIMETHYL PHTHALATE	ND	ND	ND	ND
BENZO(A)ANTHRACENE	380	1200	ND	5800
BENZO(A)PYRENE	410	970	ND	4000
BENZO(B)FLUORANTHENE	390	1100	ND	2800
BENZO(K)FLUORANTHENE	390	1100	ND	2800
CHRYSENE	500	1500	ND	6100
ACENAPHTHYLENE	ND	95 J	ND	260 J
ANTHRACENE	150 J	270 J	ND	1100
BENZO(GHI)PERYLENE	240 J	330 J	ND	1900
FLUORENE	ND	ND	ND	320 J
PHENANTHRENE	640	2000	ND	4900
DIBENZO(A,H)ANTHRACENE	ND	ND	ND	ND
INDENO(1,2,3-C,D)PYRENE	210 J	320 J	ND	1900
PYRENE	700	2000	ND	8700
ANILINE	ND	ND	ND	ND
BENZYL ALCOHOL	ND	ND	ND	ND
4-CHLOROANILINE	ND	ND	ND	ND
DIBENZOFURAN	ND	ND	ND	ND
2-METHYLNAPHTHALENE	250 J	720	ND	300 J
2-NITROANILINE	ND	ND	ND	ND
3-NITROANILINE	ND	ND	ND	ND
4-NITROANILINE	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 7 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
							(1)	(2)
PESTICIDE/PCB'S (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	SS (22,23,24,25)	SS 23-01
ALDRIN	92000 C	64 C	6300 C	220000 C	1700 C	530000 C	7800 C	ND
DIELDRIN	79000 C	910 C	2900 C	210000 C	4100 C	57000 C	3300 C	ND
CHLORDANE	100000 C,*	350 C,*	12000 C,*	67000 C,*	3900 C,*	1100000 C	18000 C,*	ND
4,4'-DDT	25000 C	450 C	ND	13000 C	4200 C	33000 C	ND	ND
4,4'-DDE	4900	140	460	ND	620 C	ND	710	ND
4,4'-DDD	37000 C	ND	960 C	18000 C	720 C	ND	1500 C	ND
ENDOSULFAN I	ND	ND	ND	ND	ND	ND	ND	ND
ENDOSULFAN II	ND	ND	ND	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	ND	ND	ND	ND	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND	ND	ND	ND	ND
ENDRIN KETONE	1800	ND	210	870 C	160 C	6100	ND	ND
HEPTACHLOR	18000 C	31 C	1300 C	63000 C	1000 C	64000 C	21000 C	ND
HEPTACHLOR EPOXIDE	2700	80	410	ND	280	ND	600	ND
ALPHA-BHC	ND	21	ND	ND	14	2600	ND	ND
BETA-BHC	2400	21	ND	ND	120	ND	ND	ND
GAMMA-BHC (LINDANE)	ND	58	ND	ND	32	ND	ND	ND
DELTA-BHC	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1242	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR1254	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1221	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1232	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1248	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1260	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1016	ND	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	ND	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	ND	ND	ND	ND	ND	ND	7100 C	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 8 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
PESTICIDE/PCB'S CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
ALDRIN	ND	ND	170000 C	3700 C
DIELDRIN	74	220	200000 C	3700 C
CHLORDANE	ND	210 *	46000 C,*	28000 C
4,4'-DDT	120	940 C	2300	1400 C
4,4'-DDE	52	630	ND	ND
4,4'-DDD	ND	220	18000 C	ND
ENDOSULFAN I	ND	ND	ND	ND
ENDOSULFAN II	ND	ND	ND	ND
ENDOSULFAN SULFATE	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND
ENDRIN KETONE	ND	ND	4700	100
HEPTACHLOR	ND	ND	7800	2700 C
HEPTACHLOR EPOXIDE	93	160	ND	ND
ALPHA-BHC	ND	ND	ND	ND
BETA-BHC	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	ND	ND	ND	ND
DELTA-BHC	ND	ND	ND	ND
AROCHLOR 1242	ND	ND	ND	ND
AROCHLOR1254	ND	ND	ND	ND
AROCHLOR 1221	ND	ND	ND	ND
AROCHLOR 1232	ND	ND	ND	ND
AROCHLOR 1248	ND	ND	ND	ND
AROCHLOR 1260	ND	ND	ND	ND
AROCHLOR 1016	ND	ND	ND	ND
TOXAPHENE	ND	ND	ND	ND
METHOXYCHLOR	ND	ND	ND	ND

(1)=SAMPLE IS A DUPLICATE OF SS(04,05,06,07).
(2)=SAMPLE IS A FIELD BLANK.
SS=SURFACE SOIL SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED BY PARENTHESES.
SB=SOIL BORING SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED BY PARENTHESES.
ND=INDICATES COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
J=INDICATES AN ESTIMATED VALUE EXCEEDING ZERO BUT LESS THAN THE SPECIFIED DETECTION LIMIT.
B=INDICATES ANALYTE WAS FOUND IN THE BLANK AS WELL AS THE SAMPLE.
C=APPLIES TO PESTICIDE PARAMETERS WHERE THE IDENTIFICATION HAS BEEN CONFIRMED BY GC/MS.
*=INDICATES VALUE IS THE SUM OF ALPHA AND GAMMA CHLORDANES DUE TO ALTERATION IN PATTERN.

One of the surface soil samples exhibiting high concentration of chlorinated pesticides was composite sample SS(08, 09, 10, 11). This was not expected given the location of these samples in the parking lot area near the front of the plant. Sampling location SS11 was collected from a barren area adjacent to a rail spur. This area may have high levels of chlorinated pesticides and would thus bias the entire composite. The concentrations observed in SS(04, 05, 06,07) which were collected from a similar area but exhibit much lower levels of contamination support this contention.

The soil boring composite samples were all comprised of the interval 0.0 - 1.5 feet of each location. Examination of Table 3 shows the highest concentrations of chlorinated pesticides in samples SB(05, 06) and SB(07, 08). These borings were drilled beneath or adjacent to former drum storage areas. The concentration of chlorinated pesticides observed in sample SB(03, 04) cannot be readily explained. This area is well beyond Riverdale's operation. It is possible that contamination may have resulted during composite preparation but this is unlikely due to the strict decontamination procedures followed.

4.0 SUMMARY AND CONCLUSIONS

The results of the Phase I investigation have led to the following conclusions:

- 2,3,7,8-TCDD is present in surface and subsurface soils at the Riverdale plant. The extent of contamination is confined to the rear of the plant away from nearby residential areas.

- 2,3,7,8-TCDD contamination is present off-site. There is evidence that it is on the CHS property immediately to the west of the Riverdale site and has been transported by runoff into erosional channels emanating from the south property boundary.

- There is no indication that dioxin has migrated downward more than a few feet. Ground water contamination does not appear to be a problem.

- Chlorinated pesticides have been detected at high concentrations at the site. The highest levels of contamination are generally detected towards the back of the plant. However, high concentrations have been detected in sample SS(08, 09, 10, 11) which is towards the front of the plant.

- Volatile organic compounds are generally absent.

- Polynucleated aromatic hydrocarbons (PAHs) are present. Their source is considered to be the cinders and ash which make up a large part of the fill material.

5.0 RECOMMENDATIONS

Based on the results of the Phase I investigation, it appears that a Phase II investigation will be necessary. The Phase II investigation should involve additional soil sampling to better define those areas where 2,3,7,8-TCDD contamination has been detected off-site and to better define areas of pesticide contamination both on- and off-site. The details of the Phase II scope of work will be presented in a separate document, which will be issued approximately 10 days following issuance of this report.

DATE BEGAN: 10/15/85
DATE FINISHED: 10/15/85
GROUND SURFACE EL: 664.55

BORING NO. SB01

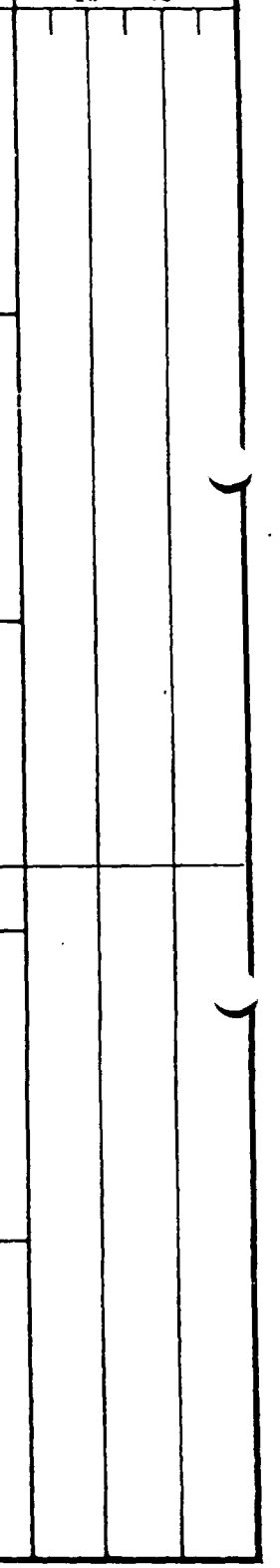
N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
				Soft black silt, organic 0.5	pt
		01		Fill, silty sand with cinders, ash, and rock and brick fragments dry to moist	hf
	2.5	02		2.9	
		03		Loose light brown silty sand, wet 3.1	sm
	5.0			Loose dark brown gray to black very fine sandy silt, moist 4.3	sm
		04		Soft dark gray silt, moist 4.5	ml
				No sample 5.0	
	7.5	05		Medium stiff to very stiff green gray silty clay, with yellow brown to orange mottles, moist	cl
		06		9.5	
	10.0	07		Very stiff to hard gray silty clay, with yellow brown mottles, moist 11.0	cl
	12.5	08		No Recovery	
670.55	14.0	09		Very stiff to hard gray silty clay, with yellow brown mottles and light gray fractures, fillings, dry 14.0	cl
				Bottom of Boring	

PENETRATION RESISTANCE (BLOWS PER FOOT)

WATER CONTENT (PERCENT)



PROJECT NO. 850037

DATE BEGAN: 10/15/85

DATE FINISHED: 10/15/85

GROUND SURFACE EL: 665.74

BORING NO. SB02

N N/A E N/A

FIELD ENGINEER: M. Hinchey

CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
		01		Soft black silt, highly organic, some brick fragments, moist 1.0	pt		
	2.5	02		Soft yellow brown to gray silty clay, mottled, moist 4.0	ml-cl		
		03		Loose gray to yellow silty medium grained sand, some gravel, moist 4.5	sm		
	5.0	04					
	7.5	05		Very stiff to hard yellow brown silty clay, occasional gravel, pieces, mottled, dry 9.0	cl		
		06					
	10.0	07		Medium stiff to stiff gray brown silty clay, mottled, moist	cl-ml		
		08		Very hard medium gray clay, some silt, occasional gravel pieces, occasional mottling, dry	cl-ch		
	12.5	09					
668.2	13.5			13.5			
				Bottom of Boring			

PROJECT NO. 850037

DATE BEGAN: 10/16/85
DATE FINISHED: 10/16/85
GROUND SURFACE EL: 665.65

BORING NO. SB03

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
		01		Fill - Black silty loam, with crushed stone, cinders, plant fragments, organic matter 1.5	hf		
	2.5	02		Medium stiff yellow gray clayey silt to silty clay, friable, dry 2.9	cl-ml		
				Loose brown fine sand, dry 3.2	sm		
		03		Medium stiff dark brown silt, some organic matter, dry 4.5	ml		
	5.0	04		Stiff yellow brown to gray silty clay, trace gravel, mottled, moist 6.0	cl		
	7.5	05		Stiff yellow brown to gray silty clay, mottled, moist 7.5	cl-ml		
		06		Stiff yellow brown clayey silt 9.0	ml		
	10.0	07					
		08		Hard light gray brown to light brown silty clay, dry	cl		
	12.5						
669.15	13.5	09		13.5			
				Bottom of Boring			

PROJECT NO. 850037

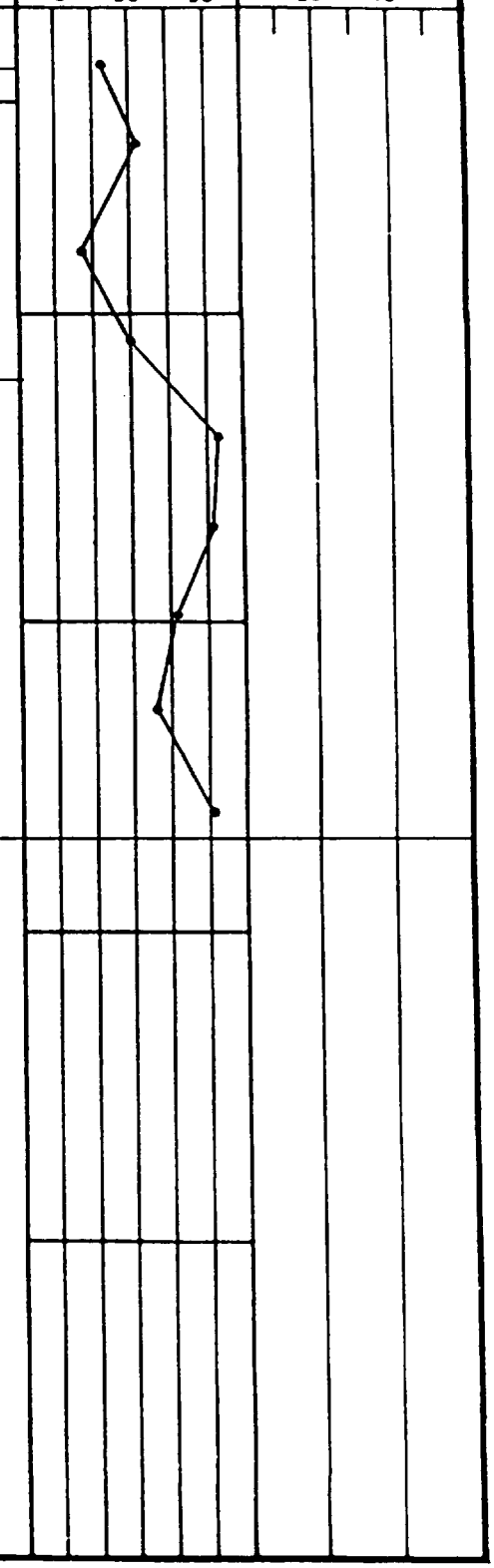
DATE BEGAN: 10/16/85
DATE FINISHED: 10/16/85
GROUND SURFACE EL: 665.33

BORING NO. SB04

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Loose dark brown to black silt 1.0	ml
				Stiff light yellow gray silty clay, dry 1.5	cl
	2.5	02			
		03		Very stiff light yellow brown to gray silty clay, some organic matter, trace gravel, mottled, dry	cl
	5.0	04		6.0	
	7.5	05		Hard yellow brown to gray silty clay, mottled, ¼ inch snad inclusion at approximately 9.0 feet, dry	cl
		06			
	10.0	07			
		08			
	12.5	09			
667.83	13.5			13.5	
				Bottom of Boring	



PROJECT NO. 850037

DATE BEGAN: 10/21/85
DATE FINISHED: 10/21/85
GROUND SURFACE EL.: 669.30

BORING NO. SB05

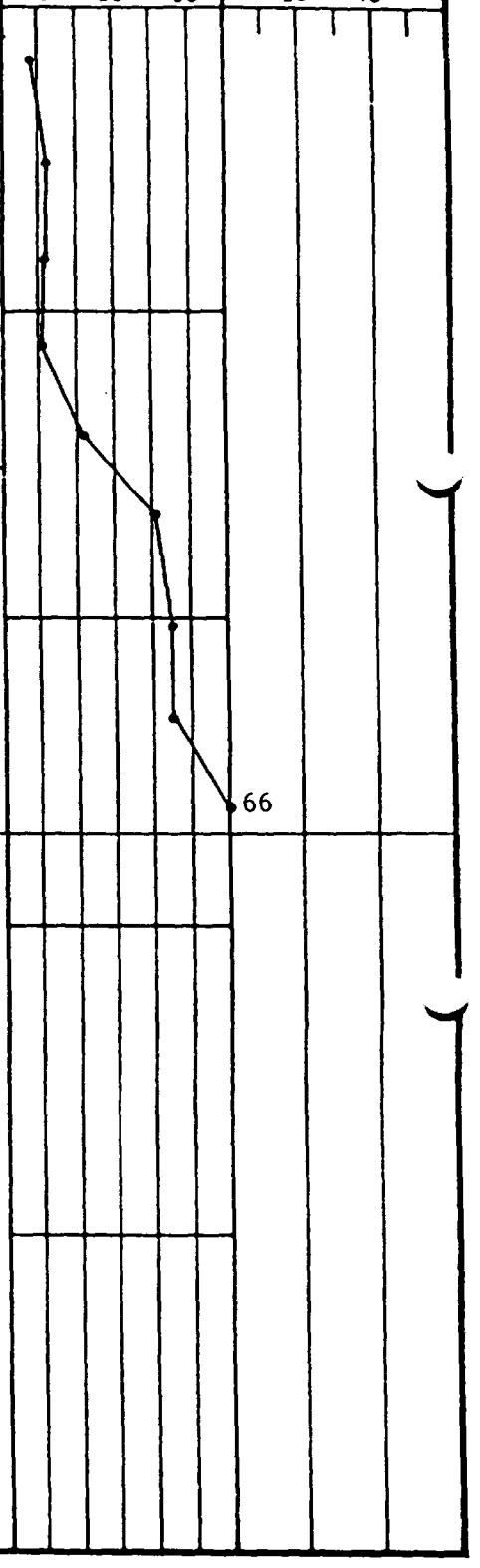
N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
				Fill, brown gray clay 0.5	hf
	2.5	01, 02		Fill, brown to dark gray silt with brick fragments, crushed rock, stone, dry to moist 3.0	hf
	5.0	03		Fill, dark brown to black silty sandy gravel, moist to wet 4.8	hf
	7.5	04, 05		Soft to hard yellow brown to gray silty clay, moist 7.5	cl
	10.0, 12.5	06, 07, 08		Hard yellow brown to gray silty clay, mottled, dry 13.5	cl
672.8	13.5	09		Bottom of Boring	

PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50

WATER CONTENT (PERCENT) 20 40



PROJECT NO. 850037

DATE BEGAN: 10/17/85
DATE FINISHED: 10/18/85
GROUND SURFACE EL: 671.33

BORING NO. SB06

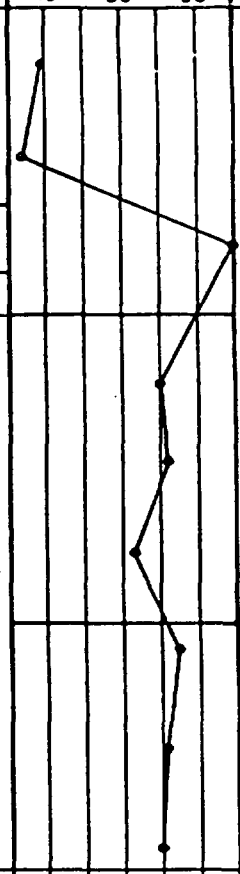
N N/A E N/A

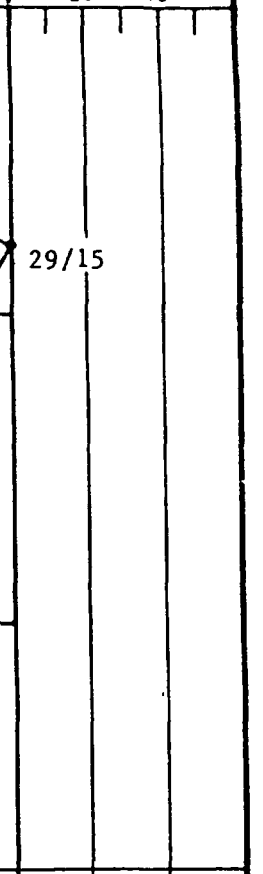
FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Fill, sandy gravel with brick fragments, rocks and cinders, wet	hf
	2.5	02			
				3.2	
		03		Soft to meduim stiff blue gray clayey silt, some organic matter, moist	hf
	5.0			4.3	
				No sample 5.0	
		04			
	7.5	05			
		06		Very stiff to hard yellow brown to gray silty clay to clay, some silt, dry	cl
	10.0	07			
		08			
	12.5				
		09			
674.33	14.0			14.0	
				Bottom of Boring	

NOTE: Boring was offset twice due to auger refusal at 1.0 and 5.0 feet.

High OVA readings were noted at 5.0 feet





PROJECT NO. 850037

DATE BEGAN: 10/17/85
DATE FINISHED: 10/17/85
GROUND SURFACE EL: 669.89

BORING NO. SB07

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS	PENETRATION RESISTANCE (BLOWS PER FOOT) 10 30 50	WATER CONTENT (PERCENT) 20 40
	2.5	01, 02		Fill, yellow brown to black silty clay with brick and rock fragments, cinders, dry 2.7	hf	55/12	
	5.0	03, 04		Soft to medium stiff yellow brown to gray silty clay, mottled, moist 6.0	cl		
	7.5, 10.0, 12.5	05, 06, 07, 08		Hard yellow brown to gray silty clay, mottled, dry 13.5	cl		
672.79	13.5	09					
				Bottom of Boring			

PROJECT NO. 850037

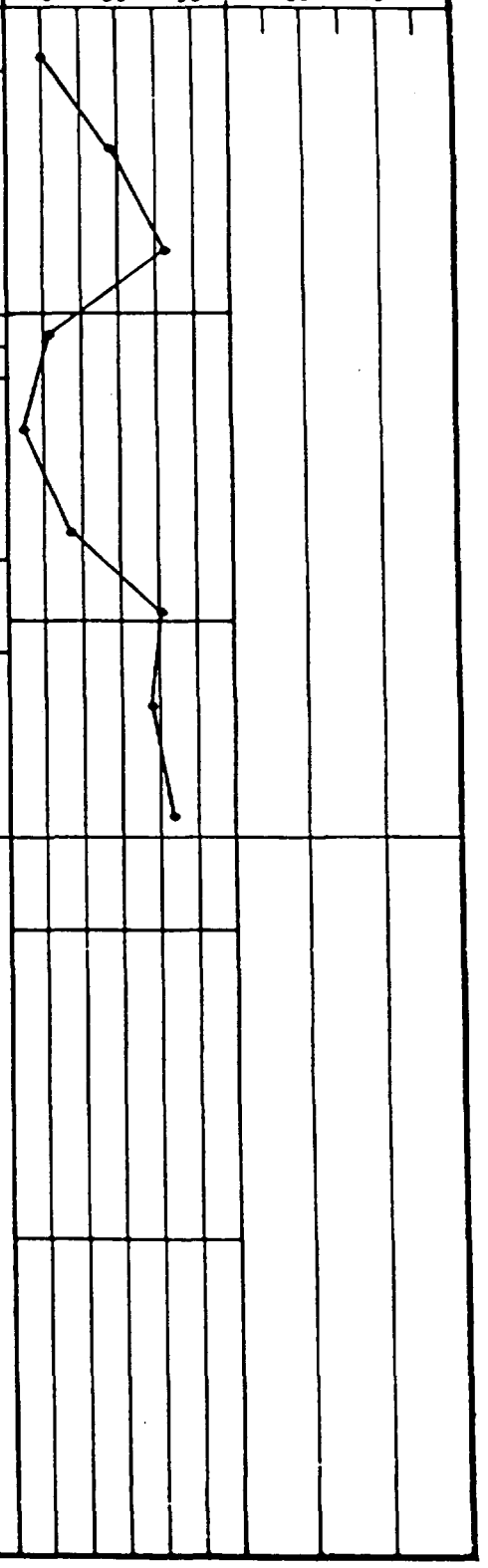
DATE BEGAN: 10/17/85
DATE FINISHED: 10/17/85
GROUND SURFACE EL: 672.22

BORING NO. SB08

N N/A E N/A

FIELD ENGINEER: M. Hinchey
CHECKED BY: R. Spanbauer

ELEV (FEET)	DEPTH (FEET)	SAMPLE TYPE	PROFILE	DESCRIPTION	USCS
		01		Medium stiff dark brown clay loam, dry 1.0	hf
	2.5	02		Medium stiff to hard yellow brown to gray silty clay, mottled, dry 5.0	cl
	5.0	03			
		04		Loose brown silty sand, trace gravel, moist 5.5	sm
				Grades to	
	7.5	05		Soft blue gray silty clay, some clay, moist 6.0	ml
		06		Soft to medium stiff yellow brown to gray silty clay, mottled, moist 9.0	cl
				Grades to	
	10.0	07		Hard light brown to yellow gray silty clay, dry 10.5	cl
	12.5	08		Hard light brown clay, trace to some silt, fractured, dry	cl
675.72	13.5	09		13.5	
				Bottom of Boring	



PROJECT NO. 850037

APPENDIX
F

APPENDIX F

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION

F.1 INTRODUCTION

The U.S. EPA requires all chemical data gathered during remedial investigations to be evaluated for their precision and accuracy. Errors in the data can originate either during sampling or during the analysis of the samples. The magnitude and source of these errors can be assessed through the collection and analysis of duplicate, split, spiked, and blank samples.

Generally, at least one field and laboratory blank and one field and laboratory duplicate are prepared for every set of samples submitted for analyses. The field blank (diatomaceous earth for soil samples) provides a means of identifying contaminants introduced during sampling. The laboratory blank has a similar function with respect to the identification of contaminants introduced during testing of the samples.

Duplicate samples enable an assessment to be made of the precision of the data. By comparing field and laboratory duplicates a determination can be made as to whether scatter in the data is due to sampling or chemical testing. Scatter attributable to chemical testing is detected by comparing the concentrations of spiked constituents in split portions of the same sample. Theoretically, the presence of greater scatter in the values reported for the field duplicates than is found among the laboratory duplicate data is attributable to sampling error.

The accuracy of chemical data is measured by splitting a sample into two portions, spiking (i.e., adding a known quantity of a given constituent) to one of the two samples, then measuring the concentration of this constituent in the two portions. The difference in the two concentration levels should be equal to the quantity of the spike added to one of the two samples. Samples are generally spiked with two types of compounds. Surrogate spikes are compounds that are not part of the CLP data packages and are not likely to be found outside the laboratory. Matrix spikes, on the other hand, are part of the data packages and may be present in some samples.

In addition to these methods, data quality can also be checked and/or evaluated by examining specific matching quality, DFTPP and BFB tuning results, chromatography resolution and sensitivity, and ICP interference and by performing ongoing calibration checks.

F.2 METHODS

The following sections review the quality of the data gathered during the remedial investigation at the Riverdale Chemical Company site. The discussion is based on the evaluations performed by the U.S. EPA of the test results obtained from the laboratory. All analytical testing was performed by IT Analytical Services in Knoxville, Tennessee. The evaluations labeled the data as acceptable for use, acceptable for use with qualifications, preliminary pending verification, or unacceptable for use. The evaluations did not include an assessment of the quantitative nature of the results. The assignment of these labels is based on an assessment of the laboratory spike and duplicate results. Spike recoveries (% R) are calculated as shown below:

$$(1) \quad \% R = C / Cs \times 100\%$$

C = the measured concentration increase due to spiking;
Cs = the known concentration increase in the spike.

One hundred percent recovery is equivalent to 100% accuracy.
A measure of the agreement (i.e., precision) between split portions of the same sample is obtained by calculating the relative percent difference (RPD) in the measured levels of a spiked constituent, where

$$RPD = \frac{S - D}{\frac{S + D}{2}} \times 100\%$$

and S and D are the concentration levels of the constituent in the two split portions.

A third parameter which is used in evaluating test data is the coefficient of variation (Cv) of the % R values. The coefficient of variation is calculated as follows:

$$Cv = \frac{SD}{APR} \times 100\%$$

SD = standard deviation of the percent recoveries;
APR = average (or mean) percent recovery.

The presence of contaminants in the field or laboratory blanks posed significant problems when these compounds were also detected in one or more of the investigation samples. Laboratory contaminants included methylene chloride and phthalate's.

Two different approaches can be taken to account for the presence of contaminants in the laboratory and field blanks. One approach is to subtract the level of a constituent in a blank from the levels detected in each of the investigation samples. This is only possible if the concentration in the investigation sample is higher than the level detected in the field blank. When the reverse is true, the results are reported as NDB, that is, not detectable due to blank.

The other approach takes into account the statistical nature of the values reported for the various laboratory and field contaminants. Although the concentration level of a contaminant detected in a blank is the single best estimate of the error introduced into the remaining samples, the actual error will span a range of values, with some being more and some less than the level detected in the blank. Consider, for example, a lab blank which is found to contain 5 ug/l of methylene chloride. Another sample from the same case is tested and is found to have 6 ug/l of methylene chloride. Should we assume that 5 ug/l of the methylene chloride in this sample is due to laboratory error and 1 ug/l is the actual concentration present in the field? Or is it just as likely that the entire concentration is a result of faulty laboratory

practices. The two values differ by such a small amount that the second conclusion is probably more appropriate. The problem is determining the point at which the levels detected in a sample are not entirely attributable to sampling or laboratory error.

Information on the distribution of contaminant values would allow the construction of a 90% to 99% confidence interval; any values falling outside this range would indicate that improper laboratory or field practices are probably not solely responsible for the presence of a compound in the sample. Unfortunately, such information is not available and an arbitrary cut-off point must be established. The criterion used in this report is to discard any value that does not exceed the concentration level detected in a blank by at least one order of magnitude. This is admittedly a very conservative criterion and concentration levels that fall below this cutoff value will at times be excluded even though they are not entirely attributable to laboratory or sampling error. The advantage in selecting such a conservative criterion is that the remaining values should withstand any legal test of their representativeness of the environment from which they were collected.

F.3 SANITARY SEWER SAMPLE

One sample of the sanitary sewer effluent was collected during the Phase I field activities. The sample (EF01) was analyzed for 2,3,7,8-TCDD only. The sample was analyzed in duplicate, with the original analysis reporting 2.1 ppt of 2,3,7,8-TCDD and the duplicate analysis reporting 2.4 ppt.

The data was judged to be acceptable for use with the qualifications noted below:

- The scan time in the MID descriptor is not being calculated correctly due to software problems. The impact on the data quality was deemed to be minimal.
- The response factor for 2,3,7,8-TCDD averaged 0.483. It was determined that this was due to the commercial supply of labelled TCDD and would not affect the reported concentrations.

F.4 AIR MONITORING SAMPLES

Two air monitoring samples (IH001 and IH002) and one field blank (IH003) were submitted for 2,3,7,8-TCDD analysis. The samples were collected on open-face glass-fiber filter cassettes.

The data was judged to be acceptable for use with the qualifications noted below:

- The scan time in the MID descriptor is not being calculated correctly due to software problems. The impact on the data quality was deemed to be minimal.
- The response factor for 2,3,7,8-TCDD averaged 0.483. IT was determined that this was due to the commercial supply of labelled TCDD and would not affect the reported concentrations.

F.5 SUBSURFACE SOILS

Nineteen Phase I subsurface soil samples, including one travel blank and one duplicate sample, were submitted for analysis of 2,3,7,8-TCDD. Sample SB09-0.0 is a duplicate of SB04-6.0. Sample SB10-0.0 is the travel blank. Two U.S. EPA supplied performance evaluation samples were also submitted for 2,3,7,8-TCDD analysis.

The data was judged to be acceptable for use with the following qualifications:

- Detection limits for samples SB01-6.5, SB03-1.5, and SB08-1.5 were overly optimistic. This does not affect data quality.
- Sample SB08-1.5 had a detection limit above the U.S. EPA action level of 1.0 ppb.
- The scan time in the MID descriptor is not being calculated correctly due to software problems. The impact on the data quality was deemed to be minimal.
- The response factor for 2,3,7,8-TCDD averaged 0.483. It was determined that this was due to the commercial supply of labeled TCDD and would not affect the reported concentrations.

In addition to the 19 samples submitted for 2,3,7,8-TCDD analysis, four composite samples (SB[01,02], SB[03,04], SB[05,06], and SB[07,08]) were submitted for analysis of HSL organics. The blanks and duplicates for the organic analyses are discussed in Section F.6, Surface Soil Samples.

The data was judged to be acceptable for use with the following qualifications:

- The BN/A fraction (semi-volatiles) for samples SB(01,02), SB(03,04), and SB(07,08) was extracted 19 days after being received at the laboratory. The results should be considered estimated due to the holding time.
- The response factor linearity for 4,4'-DDT was outside the CLP acceptance limit of 10% for samples SB(05,06) and SB(07,08). The results should be considered estimated.
- The calibration of the GC/MS for volatile analysis had low or variable response factors for 2-butanone. The VOA results for this should be considered estimated.

F.6 SURFACE SOIL SAMPLES

Sixteen surface soil samples were submitted for 2,3,7,8-TCDD analysis from the Phase I sampling event. Two samples, SS(04,05,06,07) and SB(08,09,10,11), were composites of four sampling locations, and one sample, SS22, was a duplicate of sample SS13. During the Phase II sampling events, an additional thirteen samples, including two blanks (SS41 and SS47) were submitted for 2,3,7,8-TCDD analysis.

The Phase I samples were judged to be acceptable for use with the following qualifications.

- Five samples, SS(04,05,06,07), SS(08,09,10,11), SS02, SS20, and SS21, had overly optimistic detection limits. This does not affect the sample results.
- Three samples, SS02, SS(04,05,06,07), and SS(08,09,10, 11), had detection limits greater than the U.S. EPA action level of 1 ppb.

- Sample SS18 had a surrogate percent accuracy of 151%, outside the U.S. EPA window limits of 60% to 140%.

- Sample SS01 had very poor chromatography, and the result should be considered estimated.

- The scan time in the MID descriptor was not calculated correctly due to software problems. The impact on the data is considered to be minimal.

- The response factors for 2,3,7,8-TCDD averaged 0.483 due to the commercially labelled TCDD. This would not affect the data reported.

The Phase II data was judged to be acceptable for use with the following qualifications:

- The 257/322 peak ratios for sample SS35 was 0.46, outside the CLP window requirement of 0.2 to 0.45. It was determined that this was due to slight interferences on the 257 ion and does not affect the data reported.

- The value for sample SS46 was recalculated to be 1.5 ppb versus the 1.6 ppb reported.

The following apply to samples SS15-2, SS30, SS31, SS33, SS34, SS36, SS37, SS38, SS39, SS40, and SS41.

- Performance check analyses were not within the specified time limit. The effect on the data was determined to be minimal.

- Due to the appearance of 1,4,7,8-TCDD in the performance check mixtures, reported analytical results could be biased high.

- The concentration reported for sample SS39 may be biased high.

- The isomer specificity for sample SS33 is doutful due to a poor GC peak shape.

- Detection limits for samples SS37 and SS40 are biased low. This should have no effect on the data.

In addition to the samples submitted for 2,3,7,8-TCDD analysis, eight Phase I samples and seventeen Phase II samples were submitted for analysis of HSL organics. Of the Phase I samples, sample SS(22,23,24,25) was a duplicate of

sample SS(04,05,06,07), and sample SS23 was a field blank. The Phase I samples were composites with the exception of the field blank. Sample SS47 was the field blank for the Phase II samples.

The Phase I samples were judged to be acceptable for use with the following qualifications.

- The volatile portion of sample SS23 was analyzed 20 days after receipt at the laboratory. The results should be considered biased low.

- The BN/A fraction (semi-volatiles) for samples SS(04, 05,06,07), SS(03,19,20,21), SS(12,13,14), and SS23 were extracted 19 days after receipt at the laboratory. The results for these samples should be considered estimated.

- The response factor linearity for 4,4'-DDT was outside the CLP limit of 10% for samples SS(04,05,06,07), SS(12,13,14), SS(15,16), SS(08,09,10,11), and SS23. The results should be considered estimated.

- Calibration of the GC/MS for volatile analysis revealed variable response factors for 2-butanone. The results for this compound should be considered estimated. It should be noted that 2-butanone was also detected in the laboratory blanks.

The Phase II samples SS08-2, SS09-2, SS10-2, SS11-2, SS15-2, SS30, SS31, SS33, SS34, SS35, SS36, and SS37 were judged to be acceptable for use. The Phase II samples SS43, SS44, SS45, SS46, and SS47 were judged to be acceptable for use with the following qualifications:

- 4,4'-DDT was outside acceptable limits. Results should be considered estimated.

Concentrations of Methylene Chloride, 2-butanone, and Di-n-butyl phthalate were detected in the laboratory blank for the Phase I samples. Using the order-of-magnitude criteria, the presence of these compounds in the analytical samples should be disregarded due to laboratory contamination.

Likewise, concentrations of Acetone, Pentachlorophenol, Benzoic Acid, and Bis(2-ethylhexyl) phthalate were detected in the Phase I field blank. Again, the presence of these compounds in other analytical samples should be disregarded due to sampling contamination.

APPENDIX
G

APPENDIX G

PHASE II REMEDIAL INVESTIGATION

PHASE II REMEDIAL INVESTIGATION REPORT
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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APPENDIX A - PHASE I SAMPLING RESULTS

APPENDIX B - PHASE I SAMPLING LOCATIONS

1.0 INTRODUCTION

International Technology Corporation (IT) was retained by Riverdale Chemical Company (Riverdale) to conduct a Remedial Investigation/Feasibility Study (RI/FS) at Riverdale's pesticide formulation and packaging facility in Chicago Heights, Illinois. The RI/FS is being conducted in compliance with, and following the guidelines of the Administrative Order of Consent entered into by the U.S. EPA Region V and Riverdale Chemical Company

The purpose of the Remedial Investigation (RI) is to define the extent of dioxin and pesticide contaminated soils on and adjacent to Riverdale property. The Remedial Investigation is being conducted under U.S. EPA supervision in a phased approach.

The first phase of the RI consisted of collecting twenty-one surface soil samples and augering eight soil borings. These were tested for 2,3,7,8-TCDD, dioxin, HSL organics and pesticides. IT mobilized for the Phase I investigation on October 14, 1985, and completed the field program on October 21, 1985. The methodologies employed and the specific findings of the investigation were presented in the report titled Preliminary Assessment - Phase I Remedial Investigation submitted to U.S. EPA for Quality Assurance Review in December 1985.

Based on the results of the Phase I RI, a Phase II investigation was proposed in December, 1985. The Phase II investigation was approved by U.S. EPA in May 1986. IT Corporation mobilized and conducted the Phase II investigation on June 18 and June 23, 1986.

2.0 FIELD INVESTIGATION

The Phase II field investigation consisted of collecting surface soil samples from seventeen locations on the Riverdale site. The methodologies used during the investigation are discussed in the following sections.

2.1 SURFACE SOIL SAMPLING

Surface soil samples were collected from 17 locations on and adjacent to the Riverdale property. Locations are shown in Figure 1.

At each location a square approximately 8 X 8 inches was inscribed on the ground surface. If present, grasses were carefully removed from the area prior to sampling. The soil within each area was scraped up with a stainless steel spoon to a depth of approximately one inch and thoroughly composited in a stainless steel tray. The contents of the tray were placed in labeled 120 ml or 500 ml amber glass jars with teflon-lined lids. Each location was marked with a wooden or metal stake showing the location number. Efforts were made to direct soil sample locations to areas of distressed vegetation or to low drainage areas.

2.2 SAMPLE SELECTION AND ANALYSIS

As stated in the Phase II Scope-of-Work, seventeen soil samples were collected at the site. Locations sampled and the analysis performed were selected according to the following rationale:

- Locations SS-30, SS-31, SS-33, SS-34, SS-36 and SS-37 were shipped for analysis of HSL pesticides and 2,3,7,8-TCDD to determine the extent of soil contamination in the western property area.

- Locations SS-08-1, SS-09-1, SS-10-1 and SS-11-1 were resampled and analyzed for HSL pesticides. The Phase I composite sample of these locations exhibited pesticide contamination. The locations were resampled to determine which of the four locations contained the contamination.

- Location SS-15-1 was resampled and analyzed for HSL pesticides and 2,3,7,8-TCDD due to difficulties encountered during the Phase I analysis.

The major classes of semi-volatile organics found in the surface and boring soils are the phthalate esters and PAHs. Compounds of concern include:

- Phthalate Esters: Bis(2-ethylhexyl) phthalate, (better known as diethylhexyl phthalate [DEHP]) and butyl benzyl phthalate (BBP). Di-n-butyl phthalate (DNBP) was also found, but was found at a higher concentration in the field blank.

- PAHs: Carcinogenic PAHs include benzo(A) anthracene (BAA), benzo(A) pyrene (BAP), benzo(B) fluoranthene (BBF), benzo(K) fluoranthene (BKF), and indeno(1,2,3-c,d) pyrene. Non-carcinogenic PAHs include fluoranthene, chrysene, anthracene, benzo(g,h,i) perylene, fluorene, phenanthrene, and pyrene.

Of greatest toxicological concern is the presence of 2,3,7,8-TCDD and pesticides found in the surface and boring soils. Included in this list are:

- 2,3,7,8-TCDD
- Aldrin and dieldrin, chlordane
- DDT and its homologs DDE and DDD
- Endrin ketone
- Heptachlor and heptachlor epoxide.

4.4.2 Occurrence and Distribution

An examination of the analytical results presented in Tables 12 and 13 serves to distinguish the distribution patterns of the hazardous constituents found in the surface and subsurface soils on this site. The patterns, as described in this presentation, may be influenced to some extent by the sampling and analysis program and the division of the site into four sectors. However, the description focuses on the elements that impact on potential exposure for further use in the endangerment assessment.

It would appear that the greatest factors influencing the distribution of pesticides and 2,3,7,8-TCDD is the physical movement of the surface and near subsurface soils by past site construction activities and mobilization of surface soils by storm water runoff. The chemical nature, i.e., persistence in the environment, of the constituents accounts for their presence after so many years since discontinuance of their use.

There were no toxicological significant levels of volatile organic constituents found in the analyzed surface and boring soils from any quadrant. Volatile organic compounds detected were:

- o Trace concentrations found, below the method detection limit (MDL), in 13 surface soils and boring soils (0.0 to 1.5 feet):
  - Chlorobenzene (2 samples); ethylbenzene (2 samples); tetrachloroethylene (5 samples); vinyl chloride (1 sample).
- o Constituents found in the field blank that may be laboratory contaminants:
  - Methylene chloride: 16 to 91 ppb (13 of 13 samples)
  - 2-butanone: 8.7 to 21 ppb (13 of 13 samples, below MDL).
- o Constituents found infrequently at or near the detection limit:
  - Acetone at 60 ppb (1 of 13 samples)
  - Toluene at 14 ppb (4 other samples below detection limit)
  - Total xylene at 24-39 ppb (2 of 13 samples, one location).

The volatile organics do not exhibit any contamination pattern in the surface and boring soils.

4.4.2.1 Quadrant I (Northeast Sector)

Two major classes of semi-volatile organic constituents were found in the one composite (of four sample locations) and a duplicate composite from the same locations. They include polycyclic aromatic hydrocarbons (PAHs), and phthalate esters. An evaluation of the distribution pattern cannot be conducted with a data base of one sample.

Observed concentrations of the PAHs found in the surface soil composite (and its replicate) ranged from 340 ppb (330 ppb detection limit) to 1,700 ppb. The carcinogenic PAHs were found in levels of 770 to 1,500 ppb.

Phthalate esters, namely DEHP, BBP, and DNBP were found in the surface soils at concentrations ranging from 340 ppb to 1,400 ppb. They are not present at toxicologically significant levels.

Constituents found in this zone that possess the greatest implications to health risks due to exposure are the pesticides and 2,3,7,8-TCDDs found at concentrations above detection limits. Since the site is not located in an agricultural area where application of these constituents to the soils was practiced, it is assumed that their origin is from past activities at the plant when formulations using these constituents were included in the plant's operation.

The pesticides found in the composite surface soils include:

- Aldrin and dieldrin at a maximum observed concentrations of 7,800 ppb and 3,300 ppb, respectively. At some distance from the plant buildings the concentrations were considerably lower at 26 ppb and 36 ppb , respectively.

- Chlordane concentrations were at the highest levels of all of the individual pesticides at 18,000 ppb near the buildings and 130 ppb at some distance.

- DDT and its homologs DDE and DDD were found in the surface soils. DDT was not present above detection limits in the samples collected near the buildings. It was found at a relatively low concentration (110 ppb) at some distance. The homologs (DDE, DDD) were found in concentrations that ranged from 460 ppb to 1,500 ppb in the near samples. They were not found in the sample near the property line.

- Heptachlor and heptachlor epoxide were found above detection limits in all of the samples. In the near samples, the levels ranged from 410 ppb to 710 ppb of heptachlor epoxide, and 1,300 to 21,000 ppb of heptachlor. Considerably lower concentrations, 46 ppb and 19 ppb of heptachlor epoxide and heptachlor respectively were found in the far sample.

- 2,3,7,8-TCDD was not detected above the detection limit (0.69 ppb) in this zone.

Based on the above distribution, it is concluded that the pesticides have not been transported from an area close to the buildings in this zone.

The toxicological significance of the presence of these constituents in Quadrant I will be explored in later sections of this PHE.

4.4.2.2 Quadrant II (Southeast Sector)

The same major classes of semi-volatile organic constituents, namely PAHs and phthalate esters were detected. Soils included those collected from the surface and from borings in the 0.0 to 1.5 foot horizon. Phthalate ester concentrations did not exceed 1 mg/kg.

Concentrations of the PAHs were found to be at the same levels in this quadrant as in Quadrant 1, these being:

- PAHs were not found above detection limits in the surface soils composite taken behind Building #2. However, the detection limits were higher than the levels found in the other samples. Only benzo-a-anthracene was detected at trace levels in that sample.
- Observed concentrations in the carcinogenic PAHs (BAA, BAP, BBF, BKF, I[1,2,3-c,d]P) ranged from 380 ppb to 5,800 ppb.

An evaluation of the toxicological significance of the PAH levels will be performed in Section 5. However, to provide some background for the import of the observed levels, the clean-up levels for PAHs is over 10,000 ppb. None of the observed values exceeded this level.

Pesticides were found at elevated levels behind Building No. 2 (surface soils composite SS(01,02,17,18) and in the upper boring soils near the fence line behind the same building (SB05). A comparison of pesticide levels in the above samples would indicate that the higher levels found in the soil boring composite SB(05,06) came from the SB05 boring location. Surface soils near the tank storage area SS(12,13,14) contained lower levels of pesticides. Based on this analysis, the more heavily affected area is some distance behind

Building No. 2 but inside of the newly extended fence. This conclusion assumes SS01 and SS02 of the composite surface soil sample SS(01,02,17,18) were not major contributors of pesticides.

Pesticides found in this quadrant of the site include:

PESTICIDE	MORE AFFECTED AREA	LESS AFFECTED AREA*
Aldrin	92,000-170,000 ppb	64 ppb
Dieldrin	79,000-200,000 ppb	74-910 ppb
Chlordane	46,000-100,000 ppb	210-350 ppb
4,4'-DDT	2,300-25,000 ppb	120-940 ppb
4,4'-DDE	4,900 ppb	52-630 ppb
4,4'-DDD	18,000-37,000 ppb	220 ppb
Endrin Ketone	1,800-4,700 ppb	Not Detected
Heptachlor	7,800-18,000 ppb	31 ppb
Heptachlor Epoxide	2,700 ppb	80-160 ppb
Beta-BHC	2,400 ppb	21 ppb

*Does not include soil boring composite SB(07,08). The pesticides in this sample are attributed to SB-08 in Quadrant III.

2,3,7,8-TCDD levels on this quadrant ranged from 1.4 to 10.5 ppb in the soil samples collected during Phase I. During the Phase II sampling program, 2,3,7,8-TCDD concentrations above detection limits ranged from 5.6 to 12.9 ppb in two of the three samples. The eastern area of the quadrant does not appear to be affected.

4.4.2.3 Quadrant III (Southwest Sector)

PAHs, phthalate esters and pesticides were found in the surface soils and soil boring (SB-08). The highest concentrations of 2,3,7,8-TCDD were found in this zone. Phthalate esters may not be present at toxicologically significant levels; concentrations of DEHP ranged from 320-450 ppb, BBP ranged from 670 to 680 ppb, and DNBP ranged from 500 to 1,200 ppb with this compound found in the field blank at 1900 ppb.

PAHs were found at relatively low levels (6,100 ppb, maximum observed level of BAA) in one surface soils composite taken near Building No. 1 and the Tank Storage Area. It is assumed that the source of PAHs in the composite soil

boring SB(07,08) were present in the soils taken from SB08. As a measure of the importance of these constituents found in the surface soils, the total carcinogenic PAHs range from 7,500 ppb in SS(12,13,14) to 17,300 ppb in SB-08.

Generally, all of the pesticides were found in both Phase I surface soil composites, but at different levels. In the composite from the tank storage area, concentrations ranged from 32 to 4,200 ppb. This was considerably lower than the fence line composite where levels ranged from 2,600 to 1,100,000 ppb. This leads to the conclusion that highest concentrations would be found at the fence line area.

Second phase sampling was carried out to confirm this conclusion and to determine the extent of migration of the pesticides and 2,3,7,8-TCDD.

Pesticides frequently found in this quadrant include:

PESTICIDE	MORE AFFECTED AREA* (WESTERN FENCELINE)	LESS AFFECTED AREA** (TANK STORAGE AREA)
Aldrin	3,700-530,000 ppb	1,700-3,600 ppb
Dieldrin	3,700-57,000 ppb	3,700-4,100 ppb
Chlordane	28,000-1,100,000 ppb	3,900-28,000 ppb
4,4'-DDT	1,400-33,000 ppb	1,400-2,200 ppb
Heptachlor	2-64,000 ppb	1,000-2,700 ppb
Endrin Ketone	100-6,100 ppb	100-160 ppb

*Includes SS(15,16) and SS(15-2)
**Includes SS(12,13,14) and SB-08. SB-07 is attributed to Quadrant II.

2,3,7,8-TCDD levels in the surface soils were found at the highest concentrations on the site. In the less affected area the 2,3,7,8-TCDD concentrations ranged from 3.6 to 7.7 ppb in the surface soils. The soil boring (SB-06) contained 2,3,7,8-TCDD at 33.7 ppb in the upper horizon with a sample taken at a depth of 8 feet, showing 0.80 ppb indicating little or no vertical migration.

The more affected area (by pesticide concentration levels) have surface soils containing 2,3,7,8-TCDD of 1.1 to 197 ppb. A verification sample (SS-15-2) taken from the same location to confirm the 197 ppb observation showed the 2,3,7,8-TCDD level to be 14.6 ppb.

Additional Phase II sampling was conducted to determine the extent of the 2,3,7,8-TCDD migration (Figure 7). Based on the sample results, past migration of 2,3,7,8-TCDD appears to have occurred.

4.4.2.4 Quadrant IV (Northwest Sector)

This area appears to be free of PAHs. One sample (of four locations) did not contain any PAHs above the method detection limit.

The Phase I composite surface soil sample SS(08,09,10,11) contained the pesticides of concern at relatively high levels. During the Phase II sampling program, individual samples were collected from the same locations to provide a better characterization of the pesticides in the surface soils. The front section (north of the buildings) is less affected than between buildings #1 and #2.

Pesticides found in this quadrant of the site include:

PESTICIDE	MORE AFFECTED AREA* (Between Bldgs. 1 & 2)	LESS AFFECTED AREA** (North of Buildings 1 & 2)
Aldrin	91,000-120,000 ppb	18-1,000 ppb
Dieldrin	120,000-190,000 ppb	49-11,000 ppb
Chlordane	68,000-90,000 ppb	190-17,000 ppb
4,4'-DDT	9,300-27,000 ppb	890-3,600 ppb
4,4'-DDD	7,100 ppb	25-19,000 ppb
Endrin Ketone	6,000 ppb	180-4,300 ppb
Heptachlor	16,000-51,000 ppb	33-800 ppb

*Includes SS(10-2) and SS(11-2)
**Includes SS(08-2), SS(09-2), SS43, and SS44

2,3,7,8-TCDD was not found above detection limits in any of the surface soils collected from this quadrant.

4.4.3 Sanitary Sewer

Only one sample and it's duplicate were collected from the sanitary sewer during the RI. A concentration of 2.1 ppt 2,3,7,8-TCDD was detected in the sample, while the duplicate had a concentration of 2.4 ppt 2,3,7,8-TCDD. Additional sampling performed by Riverdale on June 13, 1986 and January 7, 1987 did not detect the presence of 2,3,7,8-TCDD in the sewer effluent.

In view of the fact that 2,3,7,8-TCDD is hydrophobic and has a very low solubility in water, and the fact that it has been several years since Riverdale has used 2,3,7,8-TCDD contaminated products, the detection of 2,3,7,8-TCDD during the RI sampling event appears to be the result of the sampling technique. The most plausible explanation for the presence of 2,3,7,8-TCDD in the sewer effluent is residual contamination adsorbed to sediment particulates within the sewer. Use of a stainless steel beaker on a wooden pole to collect the RI sample may have disturbed the sediments and inadvertantly contaminated the sample, producing erroneous results. The subsequent 24-hour composite samples utilized an ISCO Water Sampler which, in all probability, would not have disturbed the sediments.

Based on the results of the 24-hour composite sampling, 2,3,7,8-TCDD contamination of the sewer effluent is not occurring, and discussions concerning the transport, distribution, and public health evaluation criteria are not practical. The presence of 2,3,7,8-TCDD in the RI sample appears to indicate the possibility of contaminated sediments within the sewer, however because of the method of sampling and the fact that only one sample was collected, discussions concerning the occurrence, transport, distribution, and public health evaluation criteria are impractical.

4.5 ENVIRONMENTAL FATE AND TRANSPORT OF CONTAMINANTS

The major classes of contaminants associated with the surface and shallow soil borings on the Riverdale site are: (1) phthalate esters, (2) PAHs, (3) pesticides, and (4) 2,3,7,8-TCDD. Table 15 contains a list of environmental transport parameters that serve to characterize the contaminants most likely environmental fate.

TABLE 15
ENVIRONMENTAL FATE PARAMETERS FOR THE CHEMICALS OF CONCERN
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

PARAMETER	CONCENTRATION RANGE IN SURFACE SOILS (ug/kg)	MOLECULAR WEIGHT (g/mole)	SPECIFIC GRAVITY	WATER SOLUBILITY (mg/l)	VAPOR PRESSURE	LOG Kow PARTITION COEFF (ml/g)	LOG Koc SOIL ADSORP. COEFF.	MOBILITY INDEX IN SOILS	MOBILITY DESCRIPTOR	BIODEGRADATION
SEMI-VOLATILES										
BIS(2-ETHYLHEXYL PHTHALATE)	320 - 1,100	390.6	0.99	1.3	2.7E-07	8.73	3.58	-10.3	Immobile	350 - 3900
BUTYL BENZYL PHTHALATE	340 - 1,400	312	1.1 (25/25)	2.9	8.6E-06	4.78	3.38/3.97	-8.6/-7.9	Immobile	
BENZO(A)ANTHRACENE	380 - 5,800	228	NA	5.7E-03	2.2E-08	5.6	5.1	-15.0	Immobile	
BENZO(A)PYRENE	410 - 4,000	252	NA	1.20E-03	5.6E-09	6.06	6.74	-17.9	Immobile	
BENZO(B)FLUORANTHENE	390 - 2,800	252		1.4E-02	5.0E-07	6.06	5.74	-13.9	Immobile	
BENZO(K)FLUORANTHENE	390 - 2,800	252		4.3E-03	5.1E-07	6.06	5.74	-14.4	Immobile	
INDENO(1,2,3-C,D)PYRENE	880 - 1,900	276		5.3E-04	1.0E-10	6.5	6.2	-19.5	Immobile	
Flouranthene	560 - 7,200	202	1.25	2.6E-01	5.0E-06	4.90	4.6	-10.5	Immobile	
CHRYSENE	500 - 6,100	228	1.274	1.8E-03	6.3E-09	5.61	5.3	-16.2	Immobile	
ANTHRACENE	350 - 1,100	178		4.5E-02	1.95E-04	4.15	4.45	-9.5	Immobile	
BENZO(GHI)PERYLENE	590 - 1,900	276		7.0E-04	1.03E-10	6.20	6.51	-19.65	Immobile	
PHENANTHRENE	640 - 4.900	178.23	1.025	1.00E+00	6.80E-04	4.46	4.15	-7.3	Immobile	
PYRENE	700 - 8,700	202	1.27	1.32E-01	2.50E-06	4.88	4.58	-11.1	Immobile	6.504
PESTICIDES/PCB'S										
ALDRIN	18 - 220,000	365		1.80E-01	6.00E-06	4.98	5.3	-11.3	Immobile	1000 - 10000
DIELDRIN	74 - 210.000	381	1.75	1.95E-01	1.70E-07	3.50	3.2	-10.7	Immobile	
CHLORDANE	130 - 1,100,000	406		5.6E-01	1.00E-05	3.32	5.15	-10.4	Immobile	
4,4' - DDT	93 - 33,000	354.5		5.00E-03	5.50E-06	6.19	5.39	-12.3	Immobile	
4,4' - DDE	140 - 4,990	318.9		4.00E-02	6.50E-06	7.00	6.64	-13.2	Immobile	
4,4' - DDD	25 - 37,000	320		1.00E-01	1.89E-06	6.20	5.89	-12.6	Immobile	
ENDRIN KETONE (SURROGATE ENDRIN)	77 - 6,000	381		0.26	2.0E-07	5.6	4.42	-11.2	Immobile	
HEPTACHLOR	18 - 640,000	373.5	1.57	1.80E-01	3.00E-04	4.40	4.08	-8.3	Immobile	
HEPTACHLOR EPOXIDE	21 - 16,000			3.50E-01	3.00E-04	2.70	2.34	-6.3	Immobile	
2,3,7,8 TCDD	0.18 - 197			2.0E-04	1.70E-06	6.72	6.52	-16.0	Immobile	

The potential for migration of chemicals found in the various environmental media is a function of the physical and chemical nature of the substances. A number of relevant physical and chemical parameters have been compiled for these constituents in Table 15. They include specific gravity, vapor pressure, solubility in water, octanol/water partition coefficient (Kow), soil adsorption coefficient (Koc), and a mobility index based on a combination of some of the previously listed factors with a descriptor.

4.5.1 Specific Gravity

This parameter may be an indicator of a constituent's propensity to sink or float in an aqueous solution. Low specific gravity (less than 1.0) will rise to the top of the water column. However, information suggests that gravimetric stratification of chemicals in the environment is generally not affected by specific gravity unless said chemicals are present at levels approaching their saturation concentration (Cline, 1983). This parameter is generally useful only in cases where chemicals are present in surface or ground water at very high concentrations.

4.5.2 Vapor Pressure

The vapor pressure of a chemical compound is directly related to the rate at which it will volatilize (evaporate or sublimate) from soils or surface waters. Chemicals with higher vapor pressures will tend to evaporate more readily at an air interface. "Vapor pressure values provide indications of the tendency of pure substances to vaporize in an unperturbed situation, and thus provide a method for ranking the relative volatilities of chemicals" (Verschueren, 1983).

4.5.3 Water Solubility

Leaching of a chemical from the residue or soils by water infiltration is probably the dominant transport mechanism contributing to ground water contamination. Water solubility is a direct measure of the amenability of a chemical to leach from its matrix. "Highly soluble chemicals are easily and quickly distributed by the hydrologic cycle. These chemicals tend to have relatively low adsorption coefficients for soils and sediments and relatively low bioconcentration factors in aquatic life" (Lyman, 1982).

4.5.4 Octanol/Water Partition Coefficient (Kow)

This parameter indicates a chemical's tendency to partition between an aqueous and an organic phase and has become increasingly important in environmental fate studies over recent years. The Kow is related to such other parameters as solubility, Koc, and bioconcentration factors. "Values of Kow can be considered to have some meaning in themselves, since they represent the tendency of the chemical to partition itself between an organic phase (e.g., a fish, a soil) and an aqueous phase. Chemicals with low Kow values (e.g., less than 10) may be considered relatively hydrophilic; they tend to have high water solubilities, small sediment/soil adsorption coefficients, and small bioconcentration factors for aquatic life. Conversely, chemicals with high Kow values (e.g., greater than 10^4) are very hydrophobic" (Lyman, 1982). Such compounds may be expected to adsorb to organic soils to a relatively high degree and exhibit bioaccumulation tendencies.

4.5.5 Soil Adsorption Coefficient (Koc)

This parameter (Koc) provides an indication of the relative tendency for chemicals to adsorb to organic sediments or soils and thus presents a measure of the mobility of chemicals in the media. This parameter is considered most useful in considering ground water mobilization of contaminants and in addressing migration because of soil erosion. "This parameter has an important bearing on assessments of the fate and transport of chemicals in soils and sediments. Koc is commonly used in river models, runoff models, and soil/ground water models where the transport of a specific chemical is being investigated" (Lyman, 1982). Chemicals with relatively high Koc are generally immobile in the hydrosphere but this same tendency makes them mobile with respect to surface water convection (erosion of contaminated soil or sediment particles).

4.5.6 Henry's Law Constant

This parameter is considered to be important in evaluating air exposure pathways. Its derivation includes vapor pressure and water solubility.

$$\text{Henry's Law Constant} = \frac{\text{Vapor Pressure X Mole Weight}}{\text{Water Solubility}}$$

It is useful for evaluating the tendency of a volatile organic constituent migrating from an air/water interface. Chemicals with a high vapor pressure and low water solubility (higher Henry's Constant) will have a greater tendency to move from surface water to ambient air. It may not be important for this particular site.

4.5.7 Mobility Index

This parameter, which is calculated in a manner similar to the above, is presented as a comparative measure of the mobility of a constituent in the soil environment (Ford and Gurba, 1983).

$$\text{Mobility Index} = \text{Log}\left(\frac{\text{Water Solubility} \times \text{Vapor Pressure}}{\text{Koc}}\right)$$

Descriptors were assigned to the tendency of a chemical to move through the soils in five mobility index units (range of each descriptor is 10^5) as follows:

- Greater than 5 = Extremely mobile
- 0 to 5 = Very mobile
- -5 to 0 = Slightly mobile
- Less than -5 = Immobile.

4.5.8 Weighted Bioconcentration Factor

The parameter characterizes the tendency of a chemical in water to accumulate in the lipid tissue of aquatic organisms. In some cases, it is an observed value and in others it has been derived from a regression equation (Veith, 1980).

4.6 MIGRATION POTENTIAL OF THE CHEMICAL CLASSES

Each of the listed classes of chemical constituents; i.e., phthalate esters, PAHs, pesticides and 2,3,7,8-TCDD will behave in the environmental media according to their chemical and physical nature:

- Migration of Phthalate Esters - The phthalate esters have a relatively low water solubility, i.e., 1.3 milligram per liter (mg/l) for bis (2-ethylhexyl) phthalate and should be immobile in sediments. It will not be transported to surface water due to low water

solubility, and will not readily volatilize as indicated by the very low vapor pressure. Consequently, phthalates will only be carried along during physical transport of the surface and boring soils.

- Migration of PAHs - Generally, PAHs are highly immobile in soils due to their low water solubility (thus not leaching). Their high partition coefficient (Kow) and high soil adsorption coefficients (Koc) combined with their resistance to oxidation or hydrolysis are indicative of their persistence in the soil environment. They are usually found bound to particulates and soils, unless there are high concentrations of organic solvents present in the soils to allow migration of organic contaminants by nonaqueous phase liquid (NAPL) flow conditions (Villaume, 1985). The absence of organic solvents at high concentrations in the soils are an indicator that nonaqueous phase liquids are not present at this site.

  PAHs will not volatilize as indicated by the low vapor pressure. They are not subject to hydrolysis or oxidation but may be biodegraded by selective soil microorganisms. PAHs will not usually be transported except by physical means as sediment in surface runoff during storm events. They are usually found in confined pockets that are indicative of low mobility.

- Migration of Pesticides - Generally, all of the listed pesticides are immobile in soils due to their low water solubility (all are below 1 mg/l) and will not leach to ground water. Their high partition coefficients and soil absorption coefficients are indicative of a tendency to adsorb strongly to soil particles and resist migration except as part of the soils. They will not volatilize as indicated by the very low (3×10^{-4} to 1.78×10^{-7} mm Hg at $20^{o}C$) vapor pressure. They are highly persistent in the soil environment. DDT has a half-life that ranges from 1,000 to 5,500 days.

- 2,3,7,8-TCDD - This constituent will be highly persistent in the soils. The half-life of 2,3,7,8-TCDD in soils has been reported at a range of 1 to 10 years. The low water solubility, high soil adsorption coefficient would indicate that it adsorbs strongly to soils. 2,3,7,8-TCDD is not readily biodegraded. It may be photodegraded in the presence of organic solvents, however there is no indication of organic solvents in the surface soils. It would be resistant to oxidation and hydrolysis. Volatilization of 2,3,7,8-TCDD adsorbed on soils is expected to proceed at a very slow rate due to the extremely low vapor pressure of 2,3,7,8-TCDD.

4.6.1 Other Factors Affecting Migration

All of the chemicals of concern are considered to be immobile in the surface soils and shallow soil borings. Mobility index ranges from -6.3 to -19.65. Consequently, the constituents can move only as a component of the soils. Factors affecting soil migration at the site include:

- Migration of surface soils due to soil erosion and mobilization by surface runoff. However, the site is relatively flat with only localized drainageways leading into the southeastern portion of the site.
- Surface soils could be transported as air particulates due to wind erosion and/or vehicular traffic over the affected areas.
- Surface soils could be redistributed during any construction or earthmoving activity.

The most likely mechanism that distributed the pesticides and 2,3,7,8-TCDD on site was past releases of dust and air particulate discharge during the period of formulation of the specific pesticides, and the use of 2,4,5-T, with 2,3,7,8-TCDD as a contaminant, during the formulation processes.

5.0 PUBLIC HEALTH EVALUATION

The Public Health Evaluation presented in this section of the report is based on the site assessment (Section 4.0).

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 100, November 20, 1985 Federal Register, pp 47974, 47975) requires development of a PHE at inactive hazardous waste sites under the Comprehensive Environmental Response Conservation and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

Major objectives of the PHE are:

- To characterize the potential and actual health risks posed by exposure to the constituents of concern found on-site
- To provide some focus for the Feasibility Study required to select the appropriate remedial alternative.

The PHE that follows establishes the baseline condition of the site and serves as an assessment of the "no action" alternative of the Feasibility Study (FS).

The principal guidance document used to prepare this PHE is "The Endangerment Assessment Handbook", ICAIR Life Sciences Inc. U.S. Office of Waste Programs Enforcement, draft dated August 1985 (ICAIR, 1985).

Other endangerment assessment guidance documents, health risk assessment reports and references consulted in the preparation of this PHE include:

- Versar (1986) Superfund Exposure Assessment Manual, Draft, Washington, D.C.: U.S. EPA, Office of Emergency and Remedial Response. Contract No. 68-01-6871, draft dated January 14, 1986.
- EPA (1986) Superfund Public Health Evaluation Manual, Washington, D.C.: U.S. EPA, Office of Emergency and Remedial Response. Contract No. 68-01-7090 Task 7,

EPA 540/1-86/060, October 1986, (prior drafts dated December 18, 1985 and May 22, 1985 were entitled Superfund Health Assessment Manual).

- ICAIR, Life Systems Inc. (1985) Toxicology Handbook: Principles Related to Hazardous Waste Site Investigations, Draft, Washington, D.C.: Environmental Protection Agency, Office of Waste Programs Enforcement, Contract No. 68-01-7037, draft dated August 1985.

- EPA (1984) Endangerment Assessment Guidance, internal memorandum from Lee Thomas, EPA Administrator, to EPA Regional Administrators, Regions I-X.

- EPA (1985) Endangerment Assessment Guidance, Draft, memorandum from J. Winston Porter, EPA Asst. Administrator, dated September 20, 1985.

- EPA (1986) Guideline for Carcinogenic Risk Assessment (Federal Register, September 24, 1986).

- EPA 1986) Guideline for Exposure Assessment (Federal Register, September 24, 1986).

- EPA (1986) Guideline for Mutagenicity Risk Assessment (Federal Register, September 24, 1986).

- EPA 1986) Guideline for Assessment of Chemical Mixtures, (Federal Register, September 24, 1986).

- EPA (1986) Guideline for Assessment of Suspect Developmental Toxicants (Federal Register, September 24, 1986).

- U.S. Interagency Staff Group on Carcinogens (1986) "Chemical Carcinogens: A Review of the Science and its Associated Principles", Environmental Health Perspectives, Vol. 67, pp. 201-282.

The hazards associated with the site constituents are identified in Section 5.1. Chemicals of concern are selected to represent the hazards posed by the site on the basis of concentration levels, toxicity, frequency of detection as a measure of prevalence across the site in various media, and persistence in the environment. The site constituents are evaluated in terms of acute, subchronic and chronic toxicity; carcinogenicity; mutagenicity; and potential health consequences.

The dose-response relationships (where available) of the indicator chemicals are presented in the context of site-specific exposure potential in Section 5.2. Pharmacokinetics, relevant and absorption factors are presented to be used in the qualification of health risks.

Section 5.3 describes the site-specific exposure assessment. Receptors, both human and environmental, are defined using appropriate descriptions. Pathways for potential exposure are hypothesized and evaluated for plausibility. Exposure concentrations, where appropriate for this pathway assessment, are calculated at the potential receptor locations for the postulated scenarios.

Section 5.4 completes the PHE for the "no-action" alternative, characterizing the risks associated with exposure to the site constituents in the plausible exposure scenarios. Risks are quantified for carcinogenicity and chronic toxicity.

The conclusions derived from the PHE are presented in Section 5.5. Inter-risk comparisons are presented in Appendix H, to provide perspective associated with the calculated risk levels derived in the PHE.

5.1 HAZARD IDENTIFICATION

A single fundamental concept forms the foundation for any risk assessment. That is, in order for a risk to be incurred, two conditions must be met: a hazard must be present and an exposure to the hazard must occur. In mathematical terms, risk equals level of toxicity (hazard) times level of exposure (concentration). There is no risk if either factor, hazard or exposure, is not present. This section and the dose-response relationships will define the hazards in site-specific terms. The exposure assessment provides an evaluation of the exposure part of the equation.

Hazards associated with chemicals are described toxicologically in terms of exposure mode and time duration. Modes of exposure are usually categorized as inhalation, ingestion, and direct contact (dermal adsorption). There may be indirect exposures by ingestion of contaminated foods, by dermal adsorption during bathing or swimming, and inhalation of volatilized contaminants during bathing and recreational activities.

Exposure durations are separated into four classes, i.e., acute, which is of short duration and frequency, subchronic (ten days), chronic (which implies months and years of continuous or frequent exposure), and lifetime (70 years).

In addition to these attributes, the character of the health effects are divided into two main categories; those health end points that can occur at any exposure level greater than zero (carcinogenicity), and where the effect will not be manifested at exposures below some threshold value.

5.1.1 Selection of the Indicator Chemicals

To perform the PHE, it is necessary to address the hazards associated with the constituents found in the surface and shallow boring soils during the RI. To consider all of the contaminants that were detected would not add to the effectiveness of the evaluation. It would also tend to mask the most critical concerns and make the selection of remedial alternatives unnecessarily complicated. Therefore, selection of indicator chemicals of concern by chemical or chemical class will furnish adequate data and provide a representative evaluation of the present situation. This approach presumes that remediation of the indicator chemicals will also remediate less prevalent and lower concentration constituents that were not included in the evaluation.

The following criteria were utilized to select the indicator chemicals for the health risk assessment and environmental impact analysis:

- If there were significant health consequences, based on toxicological potential or level of exposure, associated with an individual contaminant in site-specific circumstances, the contaminant was considered to be significant and included in the risk assessment. All of the selected indicator chemicals are in this category.

- Constituents that were reported below the quantitation (detection) limit were not included because the actual concentrations were unknown (the reported values are estimates and are usually of no toxicological significance in site-specific exposure situations). Chlorobenzene, ethylbenzene, tetrachloroethylene, and vinyl chloride were not selected as indicator chemicals among the volatile organics. Acenaphthene, acenaphthylene and fluorene, all PAHs, were also eliminated from the selection.

- If within a class of related chemicals, the overall effects of exposure to any of these contaminants could be adequately described and evaluated based on a single chemical within the class, then that indicator contaminant was chosen. This was the case with the following:

  - Bis(2-ethylhexyl)phthalate was selected to evaluate the phthalates.

  - Benzo(A)pyrene will represent the carcinogenic PAHs.

- In some instances, there are some detected chemicals that are considered to be laboratory artifacts because they did not display a distribution pattern consistent with the other analytical data and have in the past been associated with laboratory contamination problems. Also, several of the detected chemicals have been found in the field blank and, in most cases, above the sample values. Consequently, it is difficult to determine their source. Among the reported chemicals falling in this category were methylene chloride, acetone and 2-butanone of the volatile organic constituents. Di-n-butylphthalate was also found in the blank. They were not included in the indicator chemical list for this reason.

- Some constituents were infrequently found in the soils. Exclusion will not have any effect on the quantitation of health risks and qualitative analysis of environmental impact evaluation. Excluded for this reason were: toluene, xylene (and because they were not found at toxicologically significant concentrations); naphthalene, dibenzofuran and 2-methylnaphthalene. The pesticides beta-BHC, lindane and methoxyclor were not considered to be indicator chemicals for this site.

- Endrin ketone, a breakdown product of endrin will be evaluated using endrin as a surrogate because there is no developed toxicology data for endrin ketone.

The selected indicator chemicals that adequately represent the hazards and potential exposure at this site are listed below:

INDICATOR CHEMICALS

bis(2-ethylhexyl)phthalate
benzo(A)pyrene
pyrene
aldrin
dieldrin
chlordane

DDT and homologs DDE, DDD
Endrin (Endrin Ketone surrogate)
Heptachlor and Heptachlor Epoxide
2,3,7,8-TCDD

5.2 TOXICITY OF THE INDICATOR CHEMICALS

The hazardous nature of the selected chemicals is based on the toxicology data base for each individual constituent. Potential synergistic or antagonistic effects of the total mix of contaminants are unknown, and the mediating effect of the matrix in which they may exist in site-specific circumstances is not amenable to evaluation. Consequently, based on the recommended guidelines for mixed chemicals (Federal Register, 1986a), the health impact of exposure to multiple chemicals is considered to be additive.

5.2.1 Acute Toxicity

Table 16 contains the appropriate toxicity parameters associated with acute exposures and an estimate of the required exposure level (single dose) needed to induce a toxic response. None of the "indicator chemicals" would be expected to cause a health impact after an acute exposure, i.e., ingesting contaminated surface and boring soils during a single episode or infrequent dermal exposure. The low concentrations would preclude this possibility. Based on threshold levels, there is no other potential for a toxic response due to an acute exposure.

5.2.2 Subchronic and Chronic Toxicity

Inherent in the characterization of risk due to chronic exposure to toxic substances is the premise that there may be no threshold limit for suspected carcinogenic constituents. Consequently, the carcinogenic substances must be evaluated further. Also, basic to the assessment procedure is the idea that, in the case of suspected carcinogenic materials, cancer risk may be the limiting factor for acceptability. Other toxic responses due to chronic exposure to these substances may not be the critical factor. However, this report considers both aspects, i.e., chronic toxicity and carcinogenicity if the data are available to do so.

TABLE 16
INDICATOR CHEMICALS: ACUTE TOXICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	APPROPRIATE ACUTE TOXICITY PARAMETER (a)(1)	PERCENTAGE OF THRESHOLD TOXICITY LEVEL @ SIR = 100 mg/day AND TOTAL G.I. ABSORPTION *		REQUIRED ACUTE EXPOSURE TO REACH TOXICITY LEVEL
			25 kg child	70 kg adult	
BIS(2-ETHYLHEXYL) PHTHALATE	320 - 1,400	oral-man TDlo = 143 mg/kg oral-rat LD50 = 31,000 mg/kg	3.1E-6	1.1E-6	ingestion of 3250 kg (7150 lbs) of soil
			[based on oral-man TDlo]		
BENZO(A)PYRENE	410 - 4,000	none reported via oral route	---		---
ALDRIN	18 - 530,000	oral-human TDlo = 14 mg/kg oral-child LDlo = 1,250 mg/kg oral-rat LD50 = 39 mg/kg	6.3E-3	2.2E-3	ingestion of 87.5 kg (192.5 lbs) of soil
			[based on oral-man TDlo]		
DIELDRIN	74 - 210,000	oral-rat LD50 = 38.3 mg/kg oral-monkey LD50 = 3 mg/kg	2.8E-2	1.0E-2	ingestion of 0.357 kg (0.785 lbs) of soil
			[based on oral-monkey LD50]		
ENDRIN (KETONE) **	77 - 6,100	oral-rat LD50 = 3 mg/kg oral-monkey LD50 = 3 mg/kg	8.0E-4	2.9E-4	ingestion of 12.5 kg (27.5 lbs) of soil
			[based on oral-monkey LD50]		
CHLORDANE	130 - 1,100,000	oral-human LDlo = 40 mg/kg oral-rat LD50 = 283 mg/kg	1.1E-2	3.9E-3	ingestion of 0.91 kg (2.0 lbs) of soil
			[based on oral-human LD50]		
4,4'-DDT	93 - 33,000	unk-man LDlo = 221 mg/kg oral-infant LDlo = 150 mg/kg oral-rat LD50 = 87 mg/kg	1.5E-4	5.4E-5	ingestion of 65.9 kg (145 lbs) of soil

TABLE 16
INDICATOR CHEMICALS: ACUTE TOXICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	APPROPRIATE ACUTE TOXICITY PARAMETER (a)(1)	PERCENTAGE OF THRESHOLD TOXICITY LEVEL @ SIR = 100 mg/day AND TOTAL G.I. ABSORPTION *		REQUIRED ACUTE EXPOSURE TO REACH TOXICITY LEVEL
			25 kg child	70 kg adult	
4,4'-DDD	25 - 37,000	oral-rat LD50 = 113 mg/kg	1.3E-4	4.7E-5	ingestion of 76.4 kg (168 lbs) of soil
4,4'-DDE	140 - 4,900	oral-rat LD50 = 880 mg/kg	1.8E-5	6.3E-6	ingestion of 4490 kg (9878 lbs) of soil
HEPTACHLOR	18 - 64,000	oral-rat LD50 = 40 mg/kg	6.5E-4	2.3E-4	ingestion of 16 kg (34 lbs) of soil
HEPTACHLOR EPOXIDE	21 - 160,000	oral-rat LD50 = 40 mg/kg	1.6E-3	5.7E-4	ingestion of 6.25 kg (13.8 lbs) of soil
2,3,7,8-TCDD	0.18 - 197 ***	oral-rat LD50 = 0.0225 mg/kg oral-monkey LD50 = 0.070 mg/kg	3.5E-4 (6.2E-5)	1.3E-4 (2.2E-5)	ingestion of 2.8/16.5 kg (6.2/36.3 lbs) of soil

(a) - Most appropriate acute toxicity parameters are those associated with human ingestion, i.e. human TDlo (lowest reported toxic dose). In the absence of human data, animal test results such as oral-rat LD50 (lethal dose at which 50% of test animals died after 48 hours) are listed. No uncertainty factors are applied.
(1) - RTECS, USDHHS, 1984.
* - Dermal absorption is assumed to be of no consequence, estimate based on oral-rat LD50 unless otherwise stated
** - Surrogate for Endrin Epoxide, a breakdown product
*** - Verification sample at same location contained 14.6 ug/kg 2,3,7,8-TCDD

The most appropriate available chronic toxicity data that characterize the "indicator chemicals" found in the toxicology literature are listed in Table 17. These are the Lowest Observed Adverse Effect Level (LOAELs) by the EPA Office of Drinking Water. Any effects, regardless of the severity of the health impact on the test animal, are reported and the given value is the lowest reported dose at which the health effect was exhibited. No uncertainty factors are applied. Application of an uncertainty factor to the LOAELs, based on the quality of the data is the method used to develop Adjusted Acceptable Daily Intakes (AADIs) or Reference Doses (RfDs).

For subchronic exposure, LOAEL and No Observed Adverse Effect Level (NOAEL) used to establish the 10-day health advisories by the Office of Drinking Water may be the most appropriate available data.

Assuming an exposure scenario of limited exposure, in which 26 trespasses per year take place over a two-year period and a soil ingestion rate of 100 mg/day, a 25 kg child will not be exposed at the chronic toxicity level for any of the indicator chemicals. Also, the infrequent exposure may not elicit the same response as that of an animal study where the constituent was administered daily.

5.2.3 Carcinogenicity

For the purposes of assessing cancer risk and providing input into the decision-making process, the Office of Science and Technology Policy has decided that an animal carcinogen is considered to be a human carcinogen (Federal Register, 1984b). The following quotation clarifies the limitations inherent in using animal test data to assess cancer risk:

> o "The risk--likelihood of developing cancer--depends on the intensity, route, and duration of exposure to a carcinogen. Individuals may respond differently to similar exposures, depending on host factors such as age, sex, nutritional status, overall health, and inherited characteristics. Only in a few instances, where studies of long-term human exposures and cancer incidences in restricted environments, can risk be estimated with confidence [U.S. Department of Health & Human Services (USDHHS), 1985]."

TABLE 17
INDICATOR CHEMICALS: CHRONIC TOXICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	APPROPRIATE CHRONIC TOXICITY PARAMETER (DOES NOT INCLUDE CARCINOGENICITY)	PERCENTAGE OF THRESHOLD TOXICITY LEVEL @ SIR = 100 mg/day, 26 exposures/year AND TOTAL G.I. ABSORPTION (a)	REQUIRED CHRONIC EXPOSURE TO REACH CHRONIC TOXICITY LEVEL (ASSUMING MAX. OBSERVED CONC. OF INDICATOR CHEMICAL IN SOIL) *
BIS(2-ETHYLHEXYL) PHTHALATE	320 - 1,400 (48.3) **	NOAEL = 4,200 mg/day	5.1E-7	ingestion of 1363 kg (3000 lbs) of soil
BENZO(A)PYRENE	410 - 4,000 (850)	—	—	—
ALDRIN	18 - 530,000 (2,582)	no true LOAEL established, effects exhibited @ 1 mg/kg	6.2E-3	ingestion of 0.11 kg (0.25 lbs) of soil
DIELDRIN	74 - 210,000 (5,162)	no true LOAEL established, effects exhibited @ 0.5 mg/kg	1.2E-2	ingestion of 0.06 kg (0.13 lbs) of soil
ENDRIN (KETONE) ***	77 - 6,100 (327)	NOAEL (chronic) = 0.045 mg/kg NOAEL (sub-chronic) = 0.05 mg/kg	3.8E-3	ingestion of 0.19 kg (0.41 lbs) of soil
CHLORDANE	130 - 1,100,000 (8,848)	NOAEL (chronic) = 0.075 mg/kg LOAEL (sub-chronic) = 6.25 mg/kg	0.43	ingestion of 0.0017 kg (0.004 lbs) of soil
4,4'-DDT	93 - 33,000 (1,368)	LOAEL (chronic) = 0.125 mg/kg LOAEL (sub-chronic) = 5 ppm	7.4E-3	ingestion of 0.095 kg (0.2 lbs) of soil

TABLE 17
INDICATOR CHEMICALS: CHRONIC TOXICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	APPROPRIATE CHRONIC TOXICITY PARAMETER (DOES NOT INCLUDE CARCINOGENICITY)	PERCENTAGE OF THRESHOLD TOXICITY LEVEL @ SIR = 100 mg/day, 26 exposures/year AND TOTAL G.I. ABSORPTION (a)	REQUIRED CHRONIC EXPOSURE TO REACH CHRONIC TOXICITY LEVEL (ASSUMING MAX. OBSERVED CONC. OF INDICATOR CHEMICAL IN SOIL) *
4,4'-DDD	25 - 37,000	LOAEL (chronic) = 0.125 mg/kg LOAEL (sub-chronic) = 5 ppm	7.4E-3	ingestion of 0.638 kg (1.4 lbs) of soil
4,4'-DDE	140 - 4,900	LOAEL (chronic) = 0.125 mg/kg LOAEL (sub-chronic) = 5 ppm	7.4E-3	ingestion of 0.084 kg (0.19 lbs) of soil
HEPTACHLOR	18 - 64,000 (1,452)	NOAEL (chronic) = 0.025 mg/kg NOAEL (sub-chronic) = 1.0 mg/kg	7.2E-2	ingestion of 0.01 kg (0.02 lbs) of soil
HEPTACHLOR EPOXIDE	21 - 160,000 (422)	NOAEL (chronic) = 0.025 mg/kg NOAEL (sub-chronic) = 1.0 mg/kg	0.2	ingestion of 0.004 kg (0.009 lbs) of soil
2,3,7,8-TCDD	0.18 - 197 **** (1.3 and 0.713 for surface and shallow boring soils respectively)	LOAEL (chronic) = 0.001 ug/kg LOAEL (sub-chronic) = 0.01 ug/kg	5.5 0.41	ingestion of 1.3E-4 kg (2.8E-4 lbs) and 1.7E-3 kg (3.8E-3 lbs) of soil

(a) - Dermal absorption is assumed to be a minor contributor to dose.
* - Daily ingestion over a two year period by a 25 kg child is implied.
** - Value in ( ) is the geometric mean using the detection limit for non-detect observations.
*** - Surrogate for Endrin Epoxide, a breakdown product
**** - Verification sample at same location contained 14.6 ug/kg 2,3,7,8-TCDD

Table 18 lists the suspected animal and human carcinogens among the selected indicator chemicals. One measure of the strength of the classification is the "weight of evidence" assigned by the International Agency for Research in Cancer (IARC). Another is the EPA carcinogenic classification defined in the guidelines for carcinogenic risk assessment (Federal Register, 1986) of the compounds listed.

EPA is proposing to specify an appropriate risk level on a "weight-of-evidence" basis described in the Federal Register (Federal Register, 1986). Suggested risk levels are presented for some of the selected indicator chemicals, e.g., chlordane at 10^{-4} and heptachlor at 10^{-5}. Regulatory limits for the Toxicity Characteristic Leaching Procedure leachate are also based on a 10^{-5} cancer risk.

5.2.4 Developmental Toxicity

Some of the indicator chemicals have exhibited developmental toxicity, i.e., they can induce structural and/or other abnormalities in the developing fetus. They also may have some impact on the male and female reproductive system. Included in this category are: bis(2-ethylhexyl) phthalate, aldrin/dieldrin, DDT, endrin, chlordane and 2,3,7,8-TCDD. For the pesticides and 2,3,7,8-TCDD the lowest reported toxic dose (TD_{lo}) in mouse studies where the constituent was orally administered ranged from 3 ug/kg body weight for 2,3,7,8-TCDD to 152 mg/kg body weight for chlordane.

It must be pointed out that exposure of pregnant women in the first Trimester is not likely at this site. The main human receptors will be young boys ranging in age from 7 to 17 years in the trespass mode. It is also unclear whether the health effect will be manifested due to the relative low frequency of exposure, i.e., 13 to 26 times per year and none during the winter months.

There are no parameters that will allow a quantitative risk characterization. A qualitative evaluation of exposure to these constituents in site-specific circumstances would indicate a very low risk level.

TABLE 18
INDICATOR CHEMICALS: CARCINOGENICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	WEIGHT OF EVIDENCE		CATEGORIZATION		CARCINOGENIC POTENCY [1/(mg/kg/day)]	REMARKS
		HUMAN	ANIMAL	IARC	USEPA		
BIS(2-ETHYLHEXYL) PHTHALATE	320 - 1,400	insufficient	sufficient	2B	B2	6.84E-4	
BENZO(A)PYRENE	410 - 4,000	insufficient	sufficient	2B	B2	11.5	
ALDRIN	18 - 530,000	insufficient	sufficient	2B	B2	11.4	
DIELDRIN	74 - 210,000	insufficient	sufficient	2B	B2	30	
CHLORDANE	130 - 1,100,000	insufficient	limited		B2	1.61	
4,4'-DDT	93 - 33,000	insufficient	sufficient	2B	B2	0.34	Since DDT is a mixture of the Homologs DDE and DDD, Total (DDT + DDE + DDD) values will be used in the quantitation of cancer risks.
4,4'-DDD	25 - 37,000	insufficient	sufficient	2B	B2	0.34	

TABLE 18
INDICATOR CHEMICALS: CARCINOGENICITY PARAMETERS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 2)

INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	WEIGHT OF EVIDENCE		CATEGORIZATION		CARCINOGENIC POTENCY [1/(mg/kg/day)]	REMARKS
		HUMAN	ANIMAL	IARC	USEPA		
4,4'-DDE	148 - 4,900	insufficient	sufficient	2B	B2	0.34	
HEPTACHLOR	18 - 64,000	insufficient	sufficient	2B	B2	3.37	
HEPTACHLOR EPOXIDE	21 - 160,000	sufficient	sufficient	2B	B2	3.37	heptachlor is a surrogate for heptachlor epoxide
2,3,7,8-TCDD	0.18 - 197 *	insufficient	sufficient	2B	B2	1.56E5	

* - Verification sample at same location contained 14.6 ug/kg 2,3,7,8-TCDD

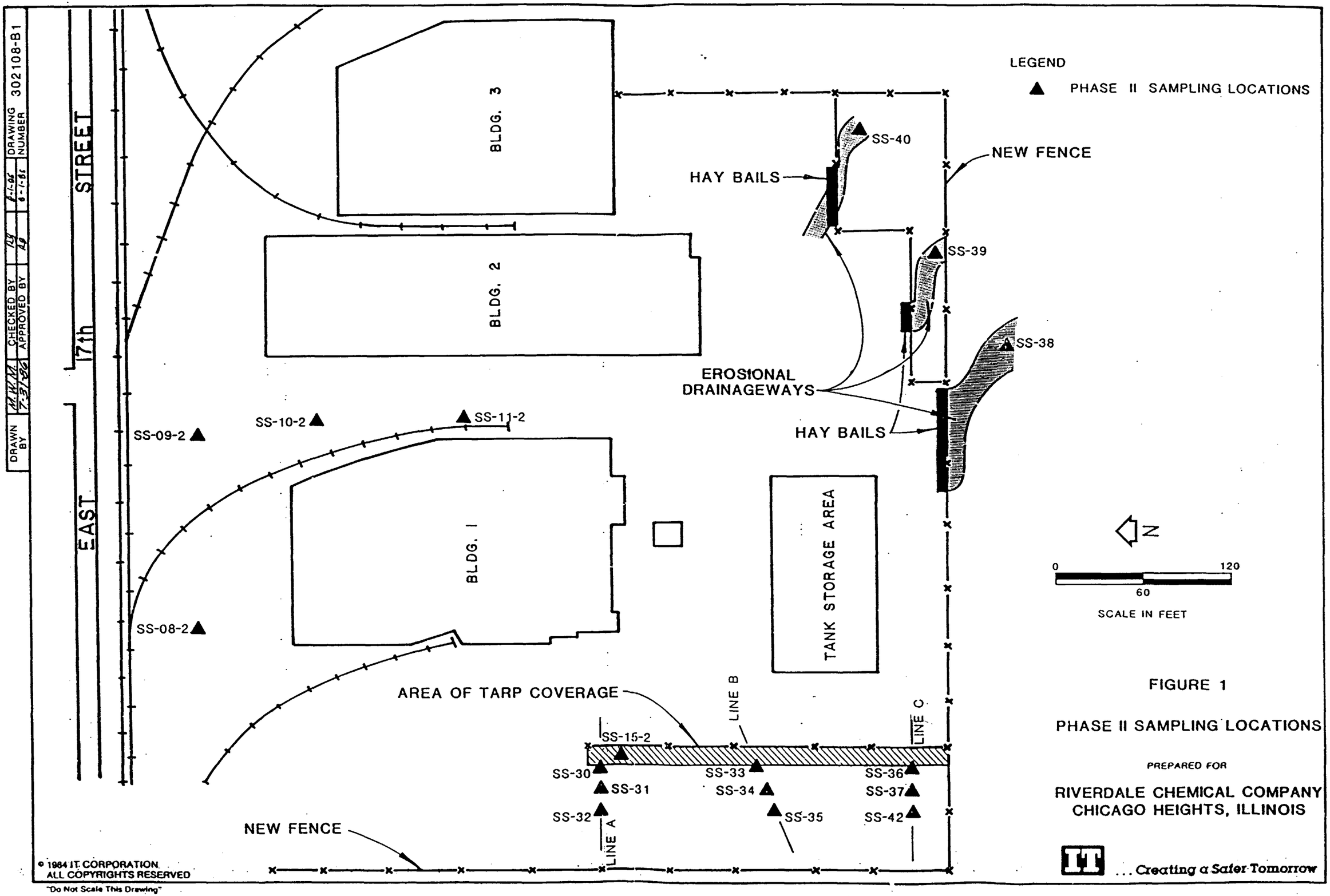


FIGURE 1

PHASE II SAMPLING LOCATIONS

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

TABLE 19
INDICATOR CHEMICALS: ABSORPTION FACTORS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 2)

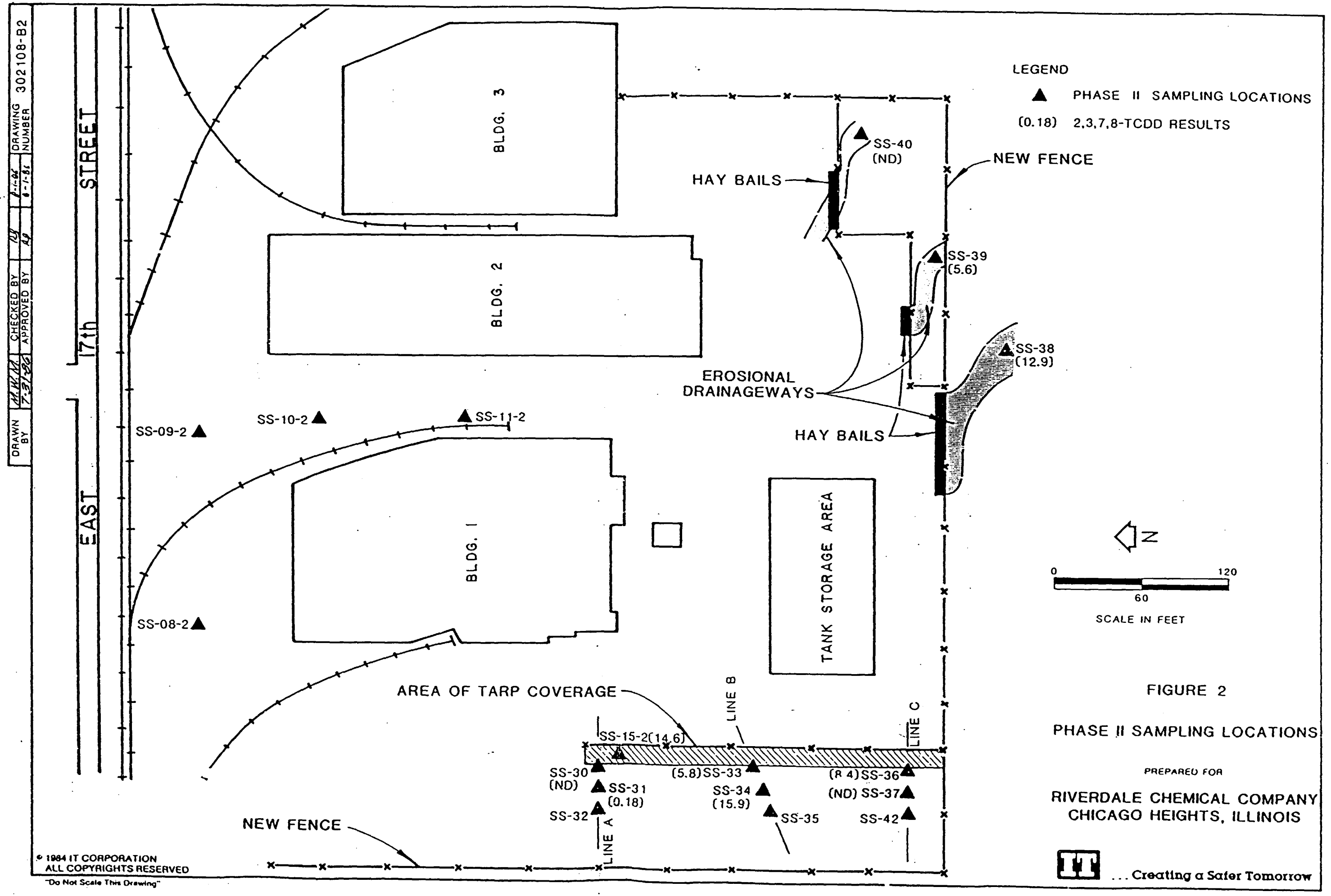
INDICATOR CHEMICALS	OBSERVED CONC. RANGE (ug/kg)	ABSORPTION RATE (percent) G.I. TRACT	DERMAL	REMARKS
BIS(2-ETHYLHEXYL) PHTHALATE	320 - 1,400			
BENZO(A)PYRENE	410 - 4,000	0.5		
ALDRIN	18 - 530,000		0.0034 (1)	
DIELDRIN	74 - 210,000		0.0057 (1)	
CHLORDANE	130 - 1,100,000	0.02 - 0.085		
4,4'-DDT	93 - 33,000	95% in vegetable oil, 20% in water suspension	0.104 (man)	
4,4'-DDD	25 - 37,000	95% in vegetable oil, 20% in water suspension	0.104 (man)	

TABLE 1
SUMMARY OF ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

COMPOUND (ppb)	SS-08-1	SS-09-1	SS-10-1	SS-11-1	SS-15-1	SS-30	SS-31	SS-33	SS-34	SS-36	SS-37	SS-38	SS-39	SS-40	SS-41(1)
Aldrin	120	18	120,000	91,000	18,000	170	20	9,500	61,000	5,500	ND	--	--	--	--
Dieldrin	2,300	49	120,000	190,000	ND	1,000	380	12,000	27,000	8,400	210	--	--	--	--
Chlordane	1,900	190	90,000	68,000	120,000	860	310	19,000	180,000	26,000	170	--	--	--	--
4-4'-DDT	890	ND	9,300	27,000	ND	220	170	310	ND	4,300	93	--	--	--	--
4-4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
4-4'-DDD	300	25	7,100	ND	25,000	ND	ND	ND	32,000	ND	ND	--	--	--	--
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Endlsulfan Sulfate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Endrin	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Endrin Ketone	180	77	6,000	13,000	ND	ND	ND	330	ND	ND	ND	--	--	--	--
Heptachlor	570	33	51,000	16,000	28,000	91	29	8,700	38,000	6,000	18	--	--	--	--
Heptachlor Epoxide	210	ND	ND	ND	ND	300	250	1,800	ND	3,000	100	--	--	--	--
Alpha-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Gamma-BHC (Lindane)	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Delta-BHC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1254	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1221	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Arochlor-1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND	ND	3,400	ND	--	--	--	--
2,3,7,8-TCDD	--	--	--	--	14.6	ND	0.18	5.8	15.9/ 12.0	8.4	ND	12.9	5.6	ND	ND

(1) Field blank for 2,3,7,8-TCDD

-- = Compound not analyzed for.
ND = None detected.


DRAWN BY
CHECKED BY
APPROVED BY
DRAWING NUMBER 302108-B2
EAST 17th STREET
BLDG. 3
BLDG. 2
BLDG. 1
TANK STORAGE AREA
LEGEND
PHASE II SAMPLING LOCATIONS
(0.18) 2,3,7,8-TCDD RESULTS
SS-40 (ND)
NEW FENCE
HAY BAILS
SS-39 (5.6)
SS-38 (12.9)
EROSIONAL DRAINAGEWAYS
HAY BAILS
SS-09-2
SS-10-2
SS-11-2
SS-08-2
N
0
120
60
SCALE IN FEET
AREA OF TARP COVERAGE
LINE B
LINE C
SS-15-2(14.6)
SS-30 (ND)
SS-31 (0.18)
SS-32
(5.8)SS-33
SS-34 (15.9)
SS-35
(R 4)SS-36
(ND) SS-37
SS-42
LINE A
NEW FENCE
© 1984 IT CORPORATION
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"Do Not Scale This Drawing"
FIGURE 2
PHASE II SAMPLING LOCATIONS
PREPARED FOR
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
IT
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- Locations SS-38, SS-39 and SS-40 were sampled and analyzed for 2,3,7,8-TCDD to determine the extent of contamination in the drainage areas.

- Locations SS-32, SS-35 and SS-42 were sampled but not analyzed. These samples were stored pending the results of the other samples collected from the western area.

3.0 ASSESSMENT

The following sections present an assessment of the site conditions and the analytical results of the Phase II sampling.

3.1 SITE ASSESSMENT

As a result of the Phase I sampling and analytical activities, the Phase II Scope-of-Work recommended implementation of two Initial Remedial Measures (IRMs). The IRMs recommended were:

- Placement of a geotextile fabric tarp over an area of soil in the southwest corner of the plant.
- Reduction of off-site sediment transport via the erosional drainage ways along the southern property boundary.

During the Phase II field activities, it was noted that these measures had been implemented. In addition to the IRMs, Riverdale also constructed additional fencing around the western and southern areas to control access to the site.

3.2 2,3,7,8-TCDD RESULTS

Surface soil samples from ten locations were submitted for analysis of 2,3,7,8-TCDD. The analytical results are presented in Table 1 and Figure 2. Positive results ranging from 15.9 ppb to 0.18 ppb were recorded for seven of the ten locations.

As can be seen from Figure 2, the extent of the dioxin contamination along lines "A" and "C" in the western portion of the site appears to be limited to within 30 feet of the old fence. Both samples collected along line "B" tested positive for dioxin, and the extent was not determined. It should be noted that the samples obtained along line "B" were collected from a low-vegetated area, and evidence of surface run-off from areas east of and across the tarped area existed.

Two of the three samples collected from the drainways along the southern property line tested positive for dioxin contamination. Only sample SS-40

from the southeastern drainage way did not contain dioxin. It should be noted that soil samples in the lowland area below these drainage maps have previously tested low (Phase I, SS-01, 1.6) or negative (SS-02, SS-21, SS-03, SB03) for dioxin.

3.3 PESTICIDES

Seven surface soil samples from the western portion of the site were submitted for analysis of pesticides. Table 1 presents the results of the analyses performed.

Concentrations of chlorinated pesticides were detected in each of the samples analyzed from the western area. It should be noted that the sample with the highest concentration was collected in the low-vegetated area along line "B". Samples collected from the 30-foot mark along lines "A" and "C" exhibited significant decreases in total concentration of the compounds. This appears to indicate that these samples are located at or near the furthest extent of pesticide contamination in these areas.

Each of the four samples collected from the northern area of the plant exhibited some pesticide contamination (Table 1). Consistent with the Phase I sampling results, the levels of SS-09 and SS-08 taken from the northern property area were significantly lower than SS-10 and SS-11 taken between Buildings No. 1 and No. 2.

4.0 SUMMARY AND CONCLUSIONS

The results of the Phase II investigations have led to the following conclusions:

- Soil sample SS-15 has been retested. This sample previously had analytical difficulties and was reported at the highest level (197 PPB). Retesting showed 14.6 PPB.
- The extent of 2,3,7,8-TCDD has been substantially defined along the western and southeastern portions of the site.
- Along the western property of the site the extent of 2,3,7,8 TCDD has been determined with the exception of along line "B" where an additional sample is to be analyzed.
- At the southern end of the site 2,3,7,8 TCDD has been identified along two out of three erosional drainage-ways.
- The approximate extent of the pesticide contamination has been defined along the western portion of the site.
- Resampling on northern property demonstrated low levels of pesticides on the most northern areas (in front of the plant) while higher levels were found between the plant buildings.

5.0 RECOMMENDATIONS

It is our recommendation that the following actions be taken:

- Submit sample SS-35 for analysis. Based on the fact that both samples collected along line "B" tested positive for dioxin, sample SS-35 should be submitted for analysis as detailed in the Phase II Scope-of-Work. Analysis of this sample may determine the extent of contamination along this line.

- Submit to the U.S. EPA the raw data package for the samples already analyzed. This will permit the U.S. EPA to perform a quality control/quality assurance review of the data, and provide approval of this phase of the investigation.

- Following receipt of approval for the Phase II investigation, perform a Risk Assessment Study in preparation for conducting a Feasibility Study. The details of the Risk Assessment Scope-of-Work will be presented in a separate document to be issued 10 days following issuance of this report.

TABLE 1 - SAMPLES SUBMITTED FOR ANALYSIS

2,3,7,8-TCDD		HSL ORGANICS	
SURFACE SOIL SAMPLES	SOIL BORING SAMPLES	SURFACE SOIL SAMPLES	SOIL BORING SAMPLES
RIV-(SS01)-1	RIV-SB01-1.5-1	RIV-SS-(04, 05, 06, 07)-1	RIV-SB-(01-02)-1
RIV-(SS02)-1	RIV-SB01-6.5-1	RIV-SS-(08, 09, 10, 11)-1	Composite of SB01-1.5-1 and SB02-1.5-1
RIV-(SS03)-1	RIV-SB02-1.5-1	RIV-SS-(01, 02, 17, 18)-1	RIV-SB-(03, 04)-1
RIV-(SS12)-1	RIV-SB02-6.0-1	RIV-SS-(03, 19, 20, 21)-1	Composite of SB03-1.5-1 and SB04-1.5-1
RIV-(SS13)-1	RIV-SB03-1.5-1	RIV-SS-(12, 13, 14)-1	RIV-SB-(05, 06)-1
RIV-(SS14)-1	RIV-SB03-6.0-1	RIV-SS-(15, 16)-1	Composite of SB05-3.0-1 and SB06-3.0-1
RIV-(SS15)-1	RIV-SB04-1.5-1	RIV-SS-(22, 23, 24, 25)-1[4]	RIV-SB-(07, 08)-1
RIV-(SS16)-1	RIV-SB04-6.0-1	RIV-SS-(23)-1[5]	Composite of SB07-1.5-1 and SB08-1.5-1
RIV-(SS17)-1	RIV-SB05-3.0-1		
RIV-(SS18)-1	RIV-SB05-7.5-1		
RIV-(SS19)-1	RIV-SB06-3.0-1		
RIV-(SS20)-1	RIV-SB06-8.0-1		
RIV-(SS21)-1	RIV-SB07-1.5-1		
RIV-(SS22)-1[1]	RIV-SB07-6.0-1		
RDC-1[2]	RIV-SB08-1.5-1		
RDC-2[2]	RIV-SB08-4.5-1		
Composites	RIV-SB09-0.0-1[3]		
RIV-SS-(04, 05, 06, 07)-1	RIV-SB10-0.0-1[5]		
RIV-SS-(08, 09, 10, 11)-1			

Notes

(1) Duplicate of SS13
(2) QA samples provided by U.S. EPA.
(3) Duplicate of SB04-6.0-1.
(4) Duplicate of SS-(04, 05, 06, 07)-1
(5) Blank

APPENDIX A

PHASE I SAMPLING RESULTS

TABLE 2
DIOXIN CONCENTRATION ANALYTICAL RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

SAMPLE I.D. NUMBER	2,3,7,8-TCDD CONC. (PPB)
SS01	1.6
SS02	ND
SS03	ND
SS(04,05,06,07)	ND
SS(08,09,10,11)	ND
SS12	ND
SS13	3.6
SS14	7.7
SS15	197
SS16	1.1
SS17	9.6
SS18	10.5
SS19	5.1
SS20	ND
SS21	ND
SS22 (1)	3.8
SB01-1.5	ND
SB01-6.5	ND
SB02-1.5	ND
SB02-6.0	ND
SB03-1.5	ND
SB03-6.0	ND
SB04-1.5	ND
SB04-6.0	ND
SB05-3.0	26.0
SB05-7.5	ND
SB06-3.0	33.7
SB06-8.0	0.80
SB07-1.5	1.4
SB07-6.0	ND
SB08-1.5	ND
SB08-4.5	ND
SB09-0.0 (2)	ND
SB10-0.0 (3)	ND
RDC-1 (4)	ND
RDC-2 (4)	4.8

SS=SURFACE SOIL SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED IN PARENTHESES.
SB=SOIL BORING SAMPLE. NUMBER SUCCEEDING HYPHEN IS DEPTH FROM WHICH SAMPLE WAS COLLECTED.
ND=INDICATES COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
(1)=SAMPLE IS DUPLICATE OF SS13.
(2)=SAMPLE IS DUPLICATE OF SB04-6.0.
(3)=SAMPLE IS A TRAVEL BLANK.
(4)=QC SAMPLE PROVIDED BY U.S. EPA

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
VOLATILES (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
BENZENE	ND	ND	ND	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROBENZENE	ND	ND	ND	2.1 J	ND	ND	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,2-DICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	2.0 J	ND	ND	ND	2.9 J	ND
METHYLENE CHLORIDE	55 B	33 B	16 B	58 B	20 B	91 B	28 B	70 B
CHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BROMOFORM	ND	ND	ND	ND	ND	ND	ND	ND
BROMODICHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
DIBROMOCHLOROMETHANE	ND	ND	ND	ND	ND	ND	ND	ND
TETRACHLOROETHENE	ND	ND	ND	3.9 J	ND	ND	ND	ND
TOLUENE	ND	ND	ND	1.6 J	ND	ND	ND	ND
TRICHLOROETHENE	ND	ND	ND	ND	ND	ND	ND	ND
VINYL CHLORIDE	ND	ND	1.4 J,B	ND	ND	ND	ND	ND
ACETONE	68	ND	ND	ND	ND	ND	ND	160
2-BUTANONE	21 B	13 B	13 B	8.7 J,B	9.8 J,B	10 B	10 B	28 J,B
CARBON DISULFIDE	ND	ND	ND	ND	ND	ND	ND	ND
2-HEXANONE	ND	ND	ND	ND	ND	ND	ND	ND
4-METHYL-2-PENTANONE	ND	ND	ND	ND	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND
VINYL ACETATE	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL XYLENES	11	ND	24	ND	ND	ND	39	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
VOLATILES (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
BENZENE	ND	ND	ND	ND
CARBON TETRACHLORIDE	ND	ND	ND	ND
CHLOROBENZENE	ND	3.5 J	ND	ND
1,2-DICHLOROETHANE	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	ND	ND	ND	ND
1,1-DICHLOROETHANE	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	ND	ND	ND	ND
CHLOROETHANE	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	ND	ND	ND	ND
CHLOROFORM	ND	ND	ND	ND
1,1-DICHLOROETHENE	ND	ND	ND	ND
TRANS-1,2-DICHLOROETHENE	ND	ND	ND	ND
1,2-DICHLOROPROPANE	ND	ND	ND	ND
TRANS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
CIS-1,3-DICHLOROPROPENE	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND
METHYLENE CHLORIDE	34 B	83 B	52 B	68 B
CHLOROMETHANE	ND	ND	ND	ND
BROMOMETHANE	ND	ND	ND	ND
BROMOFORM	ND	ND	ND	ND
BROMODICHLOROMETHANE	ND	ND	ND	ND
DIBROMOCHLOROMETHANE	ND	ND	ND	ND
TETRACHLOROETHENE	1.8 J	4.3 J	ND	1.6 J
TOLUENE	4.0 J	14	ND	4.3 J
TRICHLOROETHENE	ND	ND	ND	ND
VINYL CHLORIDE	ND	ND	ND	ND
ACETONE	ND	ND	ND	ND
2-BUTANONE	11 B	10 B	9.0 J,B	8.9 J,B
CARBON DISULFIDE	ND	ND	ND	ND
2-HEXANONE	ND	ND	ND	ND
4-METHYL-2-PENTANONE	ND	ND	ND	ND
STYRENE	ND	ND	ND	ND
VINYL ACETATE	ND	ND	ND	ND
TOTAL XYLENES	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
SEMI-VOLATILES (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
2,4,6-TRICHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	ND	ND	470	ND	ND	ND	520	ND
2,4-DIMETHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2-NITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
4-NITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
4,6-DINITRO-2-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	210
PHENOL	ND	ND	ND	ND	ND	ND	ND	ND
BENZOIC ACID	ND	ND	ND	ND	ND	ND	ND	800
2-METHYLPHENOL	ND	ND	300 J	ND	ND	ND	310 J	ND
4-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-TRICHLOROPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
ACENAPHTHENE	ND	ND	ND	ND	ND	ND	ND	ND
BENZIDINE	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROETHANE	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROETHYL)ETHER	ND	ND	ND	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	ND	ND	ND	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	ND	ND	ND	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	ND	ND	ND	ND	ND	ND	ND	ND
4-CHLORO-3-METHYLPHENOL	ND	ND	ND	ND	ND	ND	ND	ND
FLUORANTHENE	5000 J	3600	930	1700 J	4800	4600 J	600	ND
4-CHLOROPHENYL PHENYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	ND	ND	ND	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
SEMI-VOLATILES CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
2,4,6-TRICHLOROPHENOL	ND	ND	ND	ND
2-CHLOROPHENOL	ND	ND	ND	ND
2,4-DICHLOROPHENOL	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	ND	ND	ND	ND
2-NITROPHENOL	ND	ND	ND	ND
4-NITROPHENOL	ND	ND	ND	ND
2,4-DINITROPHENOL	ND	ND	ND	ND
4,6-DINITRO-2-METHYLPHENOL	ND	ND	ND	ND
PENTACHLOROPHENOL	ND	ND	ND	ND
PHENOL	ND	ND	ND	ND
BENZOIC ACID	ND	ND	ND	ND
2-METHYLPHENOL	ND	ND	ND	ND
4-METHYLPHENOL	ND	ND	ND	ND
2,4,5-TRICHLOROPHENOL	ND	ND	ND	ND
ACENAPHTHENE	ND	ND	ND	150 J
BENZIDINE	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	ND	ND	ND	ND
HEXACHLOROBENZENE	ND	ND	ND	ND
HEXACHLOROETHANE	ND	ND	ND	ND
BIS(2-CHLOROETHYL)ETHER	ND	ND	ND	ND
2-CHLORONAPHTHALENE	ND	ND	ND	ND
1,2-DICHLOROBENZENE	ND	ND	ND	ND
1,3-DICHLOROBENZENE	ND	ND	ND	ND
1,4-DICHLOROBENZENE	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	ND	ND	ND	ND
2,4-DINITROTOLUENE	ND	ND	ND	ND
2,6-DINITROTOLUENE	ND	ND	ND	ND
4-CHLORO-3-METHYLPHENOL	ND	ND	ND	ND
FLUORANTHENE	560	1800	ND	7200
4-CHLOROPHENYL PHENYL ETHER	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	ND	ND	ND	ND
HEXACHLOROBUTADIENE	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 5 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
SEMI-VOLATILES CON'T (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
ISOPHORONE	ND	ND	ND	ND	ND	ND	ND	ND
NAPHTHALENE	ND	300 J	ND	ND	170 J	ND	ND	ND
NITROBENZENE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIMETHYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
N-NITROSODIPROPYLAMINE	ND	ND	ND	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	2100 J	1100	1300	ND	320	ND	1400	290
BUTYL BENZYL PHTHALATE	ND	880	340	ND	670	ND	660	ND
DI-N-BUTYL PHTHALATE	ND	1100 B	1200 B	ND	500 B	ND	1400 B	1900 B
DI-N-OCTYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	ND	ND	ND	ND	ND	ND	ND	ND
BENZO(A)ANTHRACENE	6800 J,B	2400	900	ND	1700	ND	1400	ND
BENZO(A)PYRENE	ND	2000	930	ND	2000	1900 J	1300	ND
BENZO(B)FLUORANTHENE	ND	1600	770	ND	2500	ND	1500	ND
BENZO(K)FLUORANTHENE	ND	1600	770	ND	2500	ND	1500	ND
CHRYSENE	ND	2800	1300	ND	4100	ND	1700	ND
ACENAPHTHYLENE	ND	240 J	230 J	ND	ND	ND	290	ND
ANTHRACENE	ND	490	320 J	ND	ND	ND	350	ND
BENZO(GHI)PERYLENE	ND	990	590	ND	1200	ND	960	ND
FLUORENE	ND	ND	ND	ND	190	ND	200 J	ND
PHENANTHRENE	ND	1900	820	ND	4900	ND	750	ND
DIBENZO(A,H)ANTHRACENE	ND	ND	ND	ND	ND	ND	ND	ND
INDENO(1,2,3-C,D)PYRENE	ND	1100	540	ND	1300	ND	880	ND
PYRENE	ND	3800	900	ND	6800	ND	1100	ND
ANILINE	ND	ND	ND	ND	ND	ND	ND	ND
BENZYL ALCOHOL	ND	ND	ND	ND	ND	ND	ND	ND
4-CHLOROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
DIBENZOFURAN	ND	ND	ND	ND	120 J	ND	ND	ND
2-METHYLNAPHTHALENE	ND	640	ND	ND	290 J	ND	ND	ND
2-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
3-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND
4-NITROANILINE	ND	ND	ND	ND	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 6 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
SEMI-VOLATILES CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
ISOPHORONE	ND	ND	ND	ND
NAPHTHALENE	160 J	520	ND	160 J
NITROBENZENE	ND	ND	ND	ND
N-NITROSODIMETHYLAMINE	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	ND	ND	ND	ND
N-NITROSODIPROPYLAMINE	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	180 J	450	ND	450
BUTYL BENZYL PHTHALATE	1400	610	ND	680
DI-N-BUTYL PHTHALATE	1400 B	1000 B	ND	1200 B
DI-N-OCTYL PHTHALATE	ND	ND	ND	ND
DIETHYL PHTHALATE	ND	ND	ND	ND
DIMETHYL PHTHALATE	ND	ND	ND	ND
BENZO(A)ANTHRACENE	380	1200	ND	5800
BENZO(A)PYRENE	410	970	ND	4000
BENZO(B)FLUORANTHENE	390	1100	ND	2800
BENZO(K)FLUORANTHENE	390	1100	ND	2800
CHRYSENE	500	1500	ND	6100
ACENAPHTHYLENE	ND	95 J	ND	260 J
ANTHRACENE	150 J	270 J	ND	1100
BENZO(GHI)PERYLENE	240 J	330 J	ND	1900
FLUORENE	ND	ND	ND	320 J
PHENANTHRENE	640	2000	ND	4900
DIBENZO(A,H)ANTHRACENE	ND	ND	ND	ND
INDENO(1,2,3-C,D)PYRENE	210 J	320 J	ND	1900
PYRENE	700	2000	ND	8700
ANILINE	ND	ND	ND	ND
BENZYL ALCOHOL	ND	ND	ND	ND
4-CHLOROANILINE	ND	ND	ND	ND
DIBENZOFURAN	ND	ND	ND	ND
2-METHYLNAPHTHALENE	250 J	720	ND	300 J
2-NITROANILINE	ND	ND	ND	ND
3-NITROANILINE	ND	ND	ND	ND
4-NITROANILINE	ND	ND	ND	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 7 OF 8)

PARAMETER	SAMPLE I.D. NUMBER							
PESTICIDE/PCB'S (UG/KG)	SS (01,02,17,18)	SS (03,19,20,21)	SS (04,05,06,07)	SS (08,09,10,11)	SS (12,13,14)	SS (15,16)	(1) SS (22,23,24,25)	(2) SS 23-01
ALDRIN	92000 C	64 C	5300 C	220000 C	1700 C	530000 C	7800 C	ND
DIELDRIN	79000 C	910 C	2900 C	210000 C	4100 C	57000 C	3300 C	ND
CHLORDANE	100000 C,*	350 C,*	12000 C,*	67000 C,*	3900 C,*	1100000 C	18000 C,*	ND
4,4'-DDT	25000 C	450 C	ND	13000 C	4200 C	33000 C	ND	ND
4,4'-DDE	4900	140	460	ND	620 C	ND	710	ND
4,4'-DDD	37000 C	ND	960 C	18000 C	720 C	ND	1500 C	ND
ENDOSULFAN I	ND	ND	ND	ND	ND	ND	ND	ND
ENDOSULFAN II	ND	ND	ND	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	ND	ND	ND	ND	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND	ND	ND	ND	ND
ENDRIN KETONE	1800	ND	210	870 C	160 C	6100	ND	ND
HEPTACHLOR	18000 C	31 C	1300 C	63000 C	1000 C	64000 C	21000 C	ND
HEPTACHLOR EPOXIDE	2700	80	410	ND	280	ND	600	ND
ALPHA-BHC	ND	21	ND	ND	14	2600	ND	ND
BETA-BHC	2400	21	ND	ND	120	ND	ND	ND
GAMMA-BHC (LINDANE)	ND	58	ND	ND	32	ND	ND	ND
DELTA-BHC	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1242	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR1254	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1221	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1232	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1248	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1260	ND	ND	ND	ND	ND	ND	ND	ND
AROCHLOR 1016	ND	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	ND	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	ND	ND	ND	ND	ND	ND	7100 C	ND

TABLE 3
PHASE I SOIL SAMPLING RESULTS
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
(PAGE 8 OF 8)

PARAMETER	SAMPLE I.D. NUMBER			
PESTICIDE/PCB'S CON'T (UG/KG)	SB (01,02)	SB (03,04)	SB (05,06)	SB (07,08)
ALDRIN	ND	ND	170000 C	3700 C
DIELDRIN	74	220	200000 C	3700 C
CHLORDANE	ND	210 *	46000 C,*	28000 C
4,4'-DDT	120	940 C	2300	1400 C
4,4'-DDE	52	630	ND	ND
4,4'-DDD	ND	220	18000 C	ND
ENDOSULFAN I	ND	ND	ND	ND
ENDOSULFAN II	ND	ND	ND	ND
ENDOSULFAN SULFATE	ND	ND	ND	ND
ENDRIN	ND	ND	ND	ND
ENDRIN KETONE	ND	ND	4700	100
HEPTACHLOR	ND	ND	7800	2700 C
HEPTACHLOR EPOXIDE	93	160	ND	ND
ALPHA-BHC	ND	ND	ND	ND
BETA-BHC	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	ND	ND	ND	ND
DELTA-BHC	ND	ND	ND	ND
AROCHLOR 1242	ND	ND	ND	ND
AROCHLOR1254	ND	ND	ND	ND
AROCHLOR 1221	ND	ND	ND	ND
AROCHLOR 1232	ND	ND	ND	ND
AROCHLOR 1248	ND	ND	ND	ND
AROCHLOR 1260	ND	ND	ND	ND
AROCHLOR 1016	ND	ND	ND	ND
TOXAPHENE	ND	ND	ND	ND
METHOXYCHLOR	ND	ND	ND	ND

(1)=SAMPLE IS A DUPLICATE OF SS(04,05,06,07).
(2)=SAMPLE IS A FIELD BLANK.
SS=SURFACE SOIL SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED BY PARENTHESES.
SB=SOIL BORING SAMPLE. COMPOSITED SAMPLE NUMBERS ENCLOSED BY PARENTHESES.
ND=INDICATES COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
J=INDICATES AN ESTIMATED VALUE EXCEEDING ZERO BUT LESS THAN THE SPECIFIED DETECTION LIMIT.
B=INDICATES ANALYTE WAS FOUND IN THE BLANK AS WELL AS THE SAMPLE.
C=APPLIES TO PESTICIDE PARAMETERS WHERE THE IDENTIFI[illegible]ION HAS BEEN CONFIRMED BY GC/MS.
*=INDICATES VALUE IS THE SUM OF ALPHA AND GAMMA CHL[illegible]IES DUE TO ALTERATION IN PATTERN.

APPENDIX B

PHASE I SAMPLING LOCATIONS

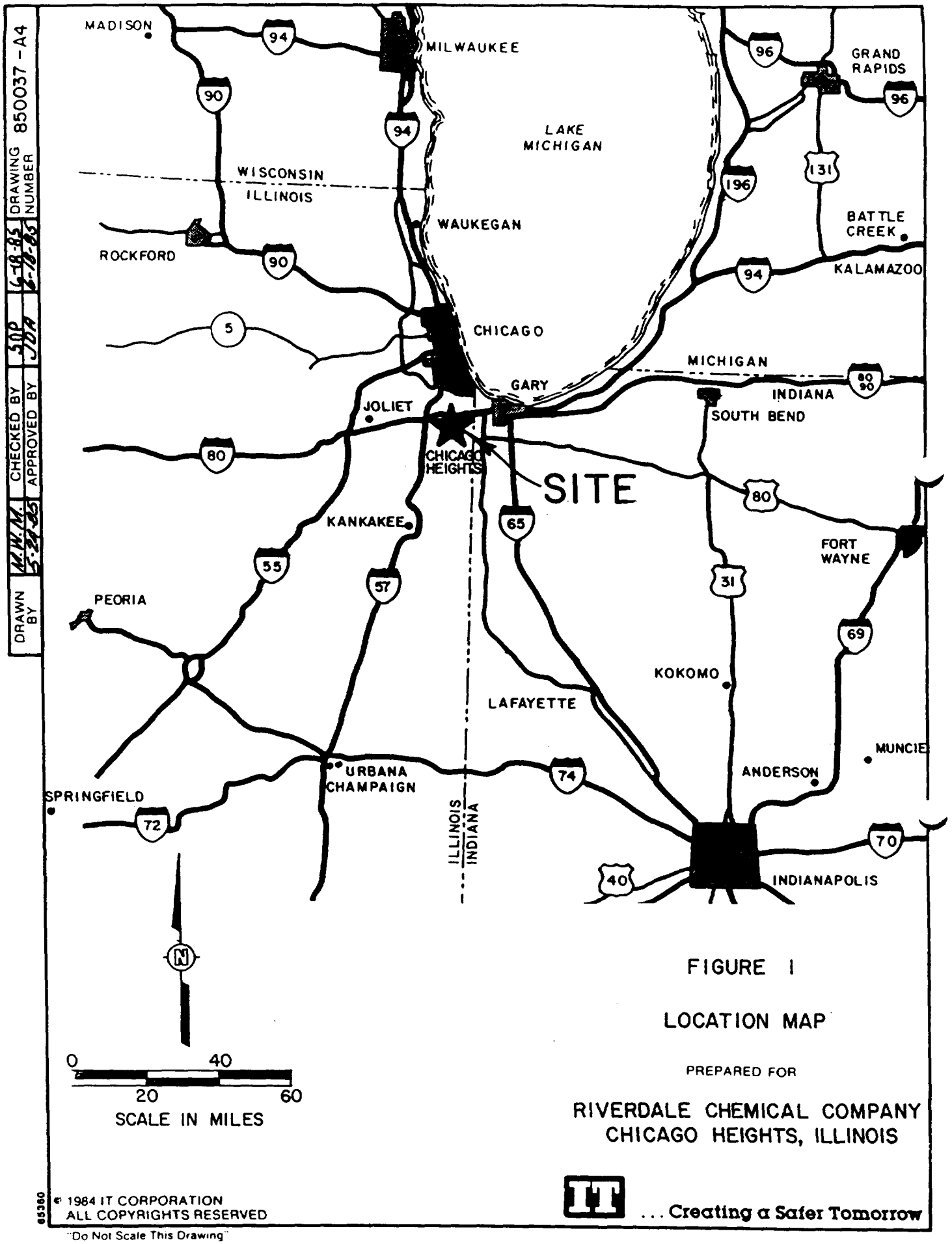

FIGURE 1

LOCATION MAP

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWN BY M.W.M. 5-29-85
CHECKED BY SOP 6-18-85
APPROVED BY JDA 6-18-85
DRAWING NUMBER 850037-A4

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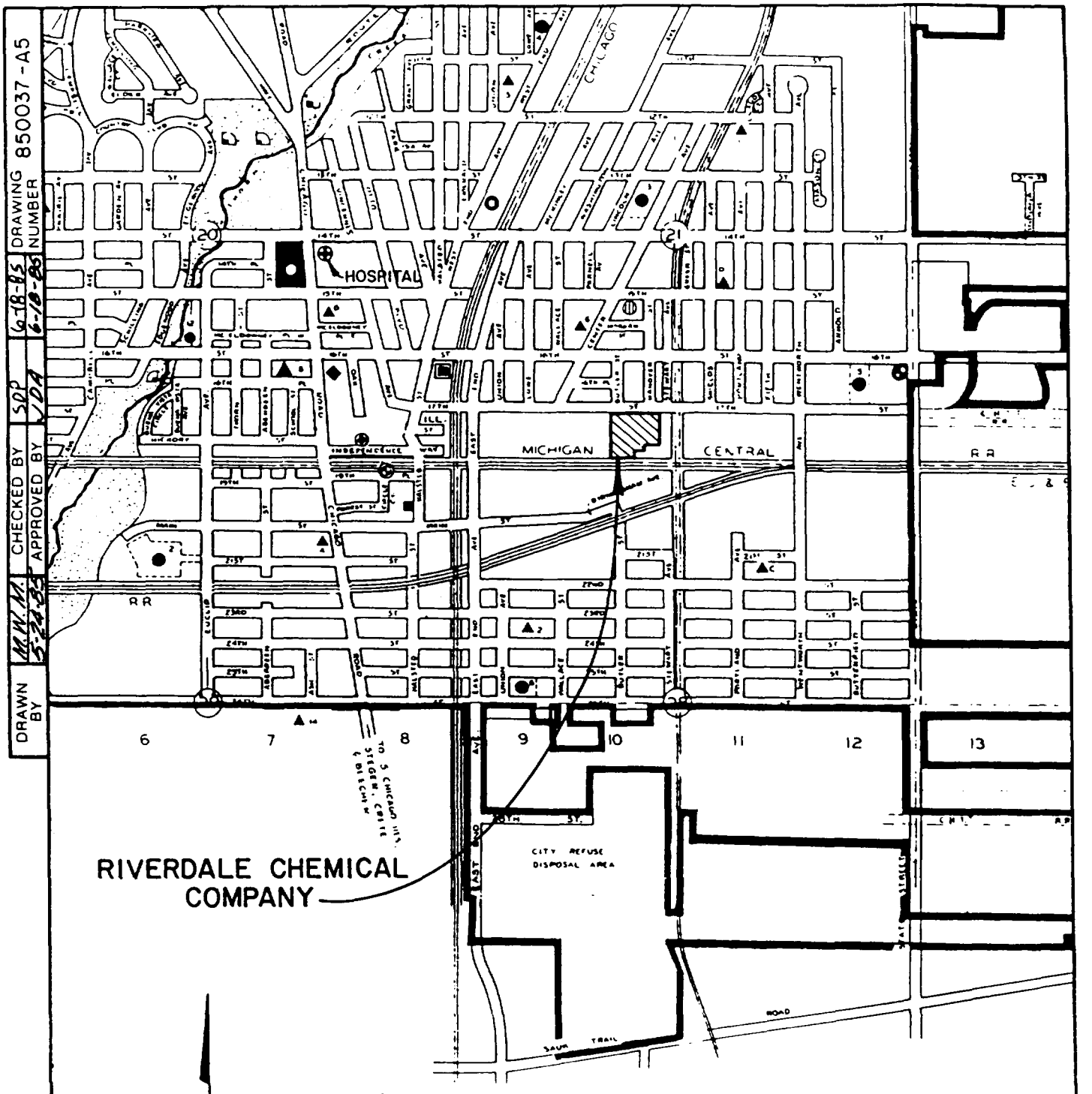

DRAWN BY M.W.N. 5-24-85
CHECKED BY SDP 6-18-85
APPROVED BY VDA 6-18-85
DRAWING NUMBER 850037-A5

N

0 1000 2000
500 1500 2640
SCALE IN FEET

FIGURE 2

VICINITY MAP

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

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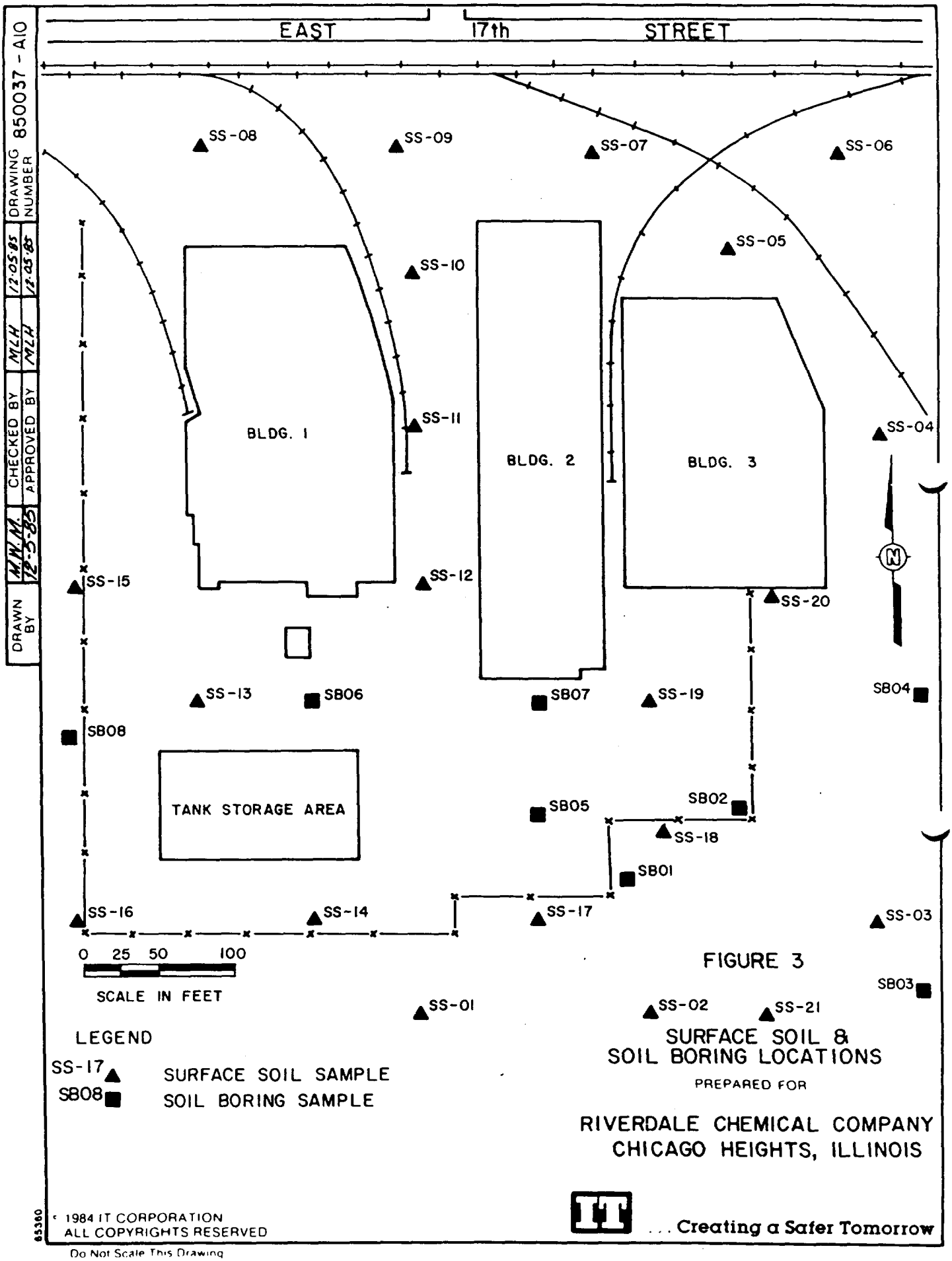

FIGURE 3

SURFACE SOIL & SOIL BORING LOCATIONS

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

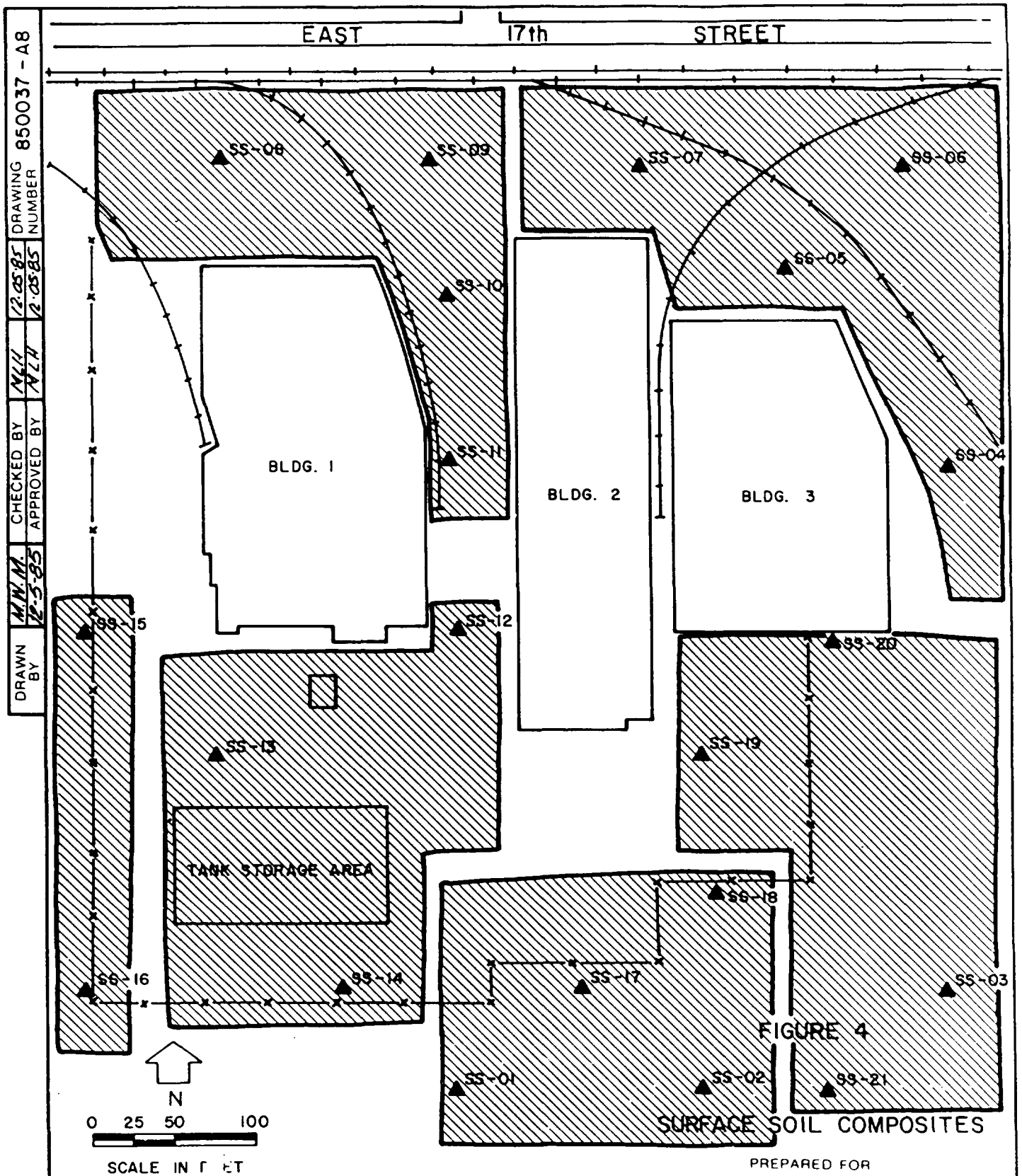

FIGURE 4

SURFACE SOIL COMPOSITES

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWING NUMBER 850037 - A8
12-05-85
12-05-85
CHECKED BY
APPROVED BY
12-5-85
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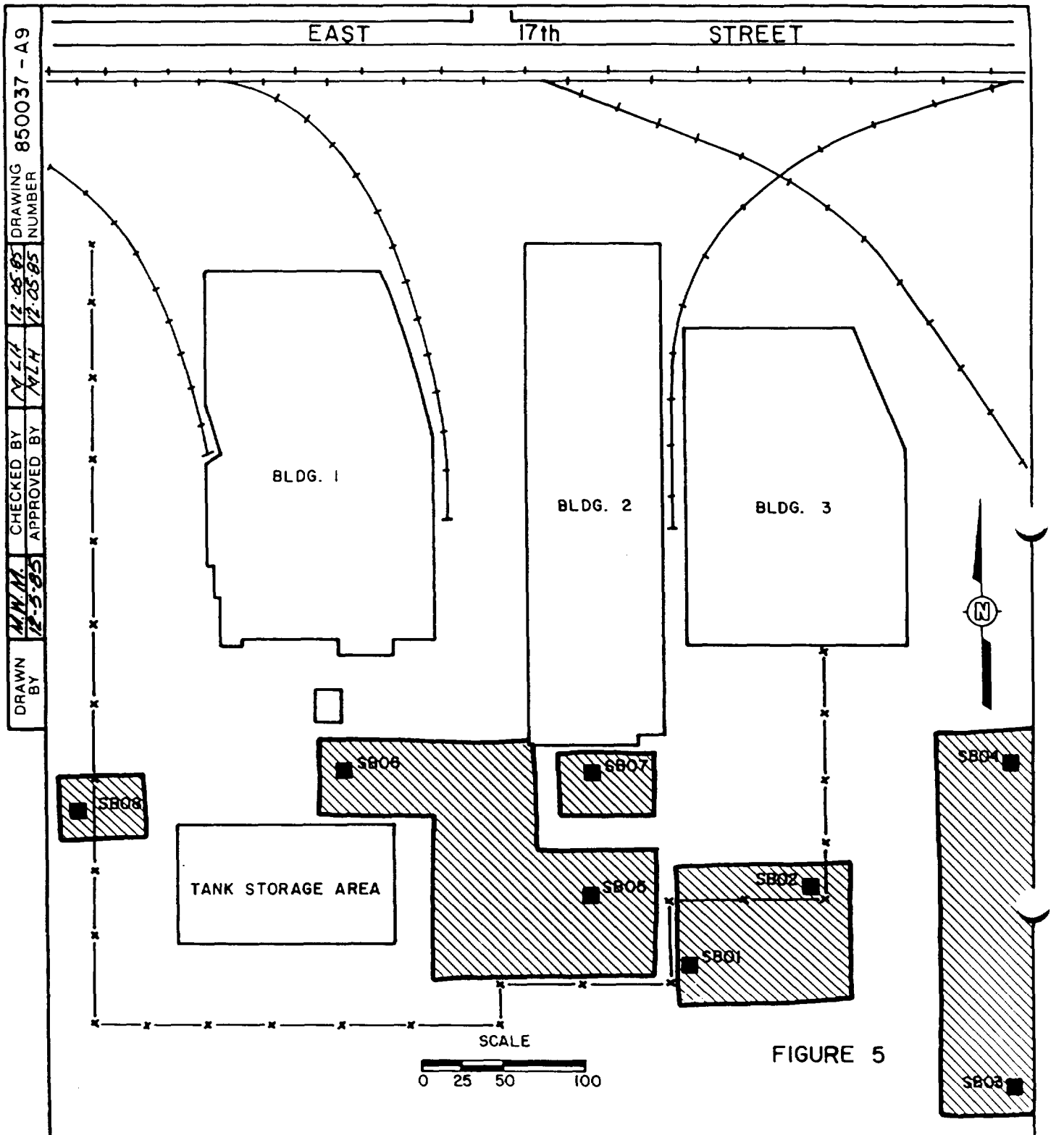

FIGURE 5

SOIL BORING COMPOSITES

PREPARED FOR

RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS

DRAWN BY	M.W.M. 12-5-85
CHECKED BY	M.L.H. 12-05-85
APPROVED BY	M.L.H. 12-05-85
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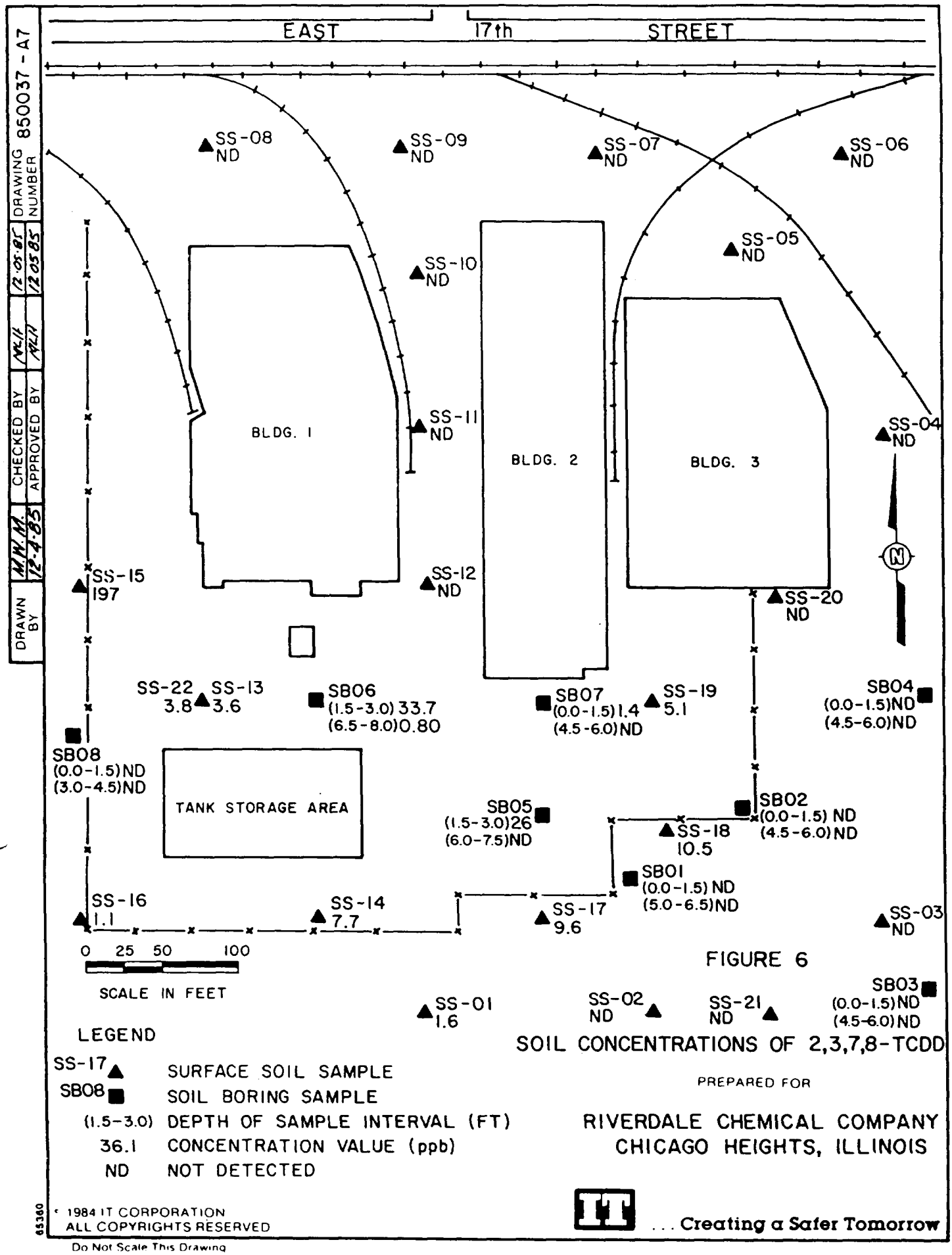
EAST 17th STREET
SS-08 ND
SS-09 ND
SS-07 ND
SS-06 ND
SS-05 ND
SS-10 ND
SS-11 ND
SS-04 ND
BLDG. 1
BLDG. 2
BLDG. 3
SS-15 197
SS-12 ND
SS-20 ND
SS-22 3.8
SS-13 3.6
SB06 (1.5-3.0) 33.7 (6.5-8.0) 0.80
SB07 (0.0-1.5) 1.4 (4.5-6.0) ND
SS-19 5.1
SB04 (0.0-1.5) ND (4.5-6.0) ND
SB08 (0.0-1.5) ND (3.0-4.5) ND
TANK STORAGE AREA
SB05 (1.5-3.0) 26 (6.0-7.5) ND
SB02 (0.0-1.5) ND (4.5-6.0) ND
SS-18 10.5
SB01 (0.0-1.5) ND (5.0-6.5) ND
SS-16 1.1
SS-14 7.7
SS-17 9.6
SS-03 ND
0 25 50 100
SCALE IN FEET
SS-01 1.6
SS-02 ND
SS-21 ND
SB03 (0.0-1.5) ND (4.5-6.0) ND
N
LEGEND
SS-17 SURFACE SOIL SAMPLE
SB08 SOIL BORING SAMPLE
(1.5-3.0) DEPTH OF SAMPLE INTERVAL (FT)
36.1 CONCENTRATION VALUE (ppb)
ND NOT DETECTED
FIGURE 6
SOIL CONCENTRATIONS OF 2,3,7,8-TCDD
PREPARED FOR
RIVERDALE CHEMICAL COMPANY
CHICAGO HEIGHTS, ILLINOIS
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CHECKED BY MJH 12-05-85
APPROVED BY MJH 12-05-85
DRAWING NUMBER 850037 - A7

APPENDIX
H

APPENDIX H

SANITARY SEWER EFFLUENT SAMPLE RESULTS

HAZLETON LABORATORIES AMERICA, INC. Chemical & BioMedical Sciences Division
3301 KINSMAN BLVD. • P.O. BOX 7545 • MADISON, WISCONSIN 53707 • PHONE (608) 241-4471 • TLX 703956 HAZRAL MDS UD

REPORT OF ANALYSIS

[NISE PECEO
GULF COAST LABORATORIES, INC.
2417 BOND STREET
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SAMPLE NUMBER: 60603829
DATE ENTERED: 06/18/86
REPORT PRINTED: 08/14/86

[ATER: 86548

[IRCHASE ORDER NUMBER: 4081

PHENOXY ACIDS

COMPOUND NAME	MCG/L
2,4-D	LESS THAN 2.0
2,4,5-TP (SILVEX)	LESS THAN 0.5
2,4,5-T	LESS THAN 0.5

2,3,7,8-TCDD (DIOXIN)

NONE DETECTED 0.0002 PPB LIMIT OF DETECTION

ESTICIDE FRACTION

COMPOUND NAME	MCG/L
ALDRIN	LESS THAN 0.01
ALPHA-BHC	LESS THAN 0.01
BETA-BHC	LESS THAN 0.01
GAMMA-BHC (LINDANE)	LESS THAN 0.01
DELTA-BHC	LESS THAN 0.01
TECHNICAL CHLORDANE	LESS THAN 0.1
4,4'-DDT	LESS THAN 0.02
4,4'-DDD	LESS THAN 0.02
4,4'-DDE	LESS THAN 0.02
DIELDRIN	LESS THAN 0.02
ENDOSULFAN I	LESS THAN 0.02
ENDOSULFAN II	LESS THAN 0.02
ENDOSULFAN SULFATE	LESS THAN 0.02
ENDRIN	LESS THAN 0.02
ENDRIN ALDEHYDE	LESS THAN 0.04
HEPTACHLOR	LESS THAN 0.01
HEPTACHLOR EPOXIDE	LESS THAN 0.01
PCB-1242	LESS THAN 0.10
PCB-1254	LESS THAN 0.10
PCB-1221	LESS THAN 0.10
PCB-1232	LESS THAN 0.10
PCB-1248	LESS THAN 0.10
PCB-1260	LESS THAN 0.10

HAZLETON LABORATORIES AMERICA, INC. Chemical & BioMedical Sciences Division
3301 KINSMAN BLVD. • P.O. BOX 7545 • MADISON, WISCONSIN 53707 • PHONE (608) 241-4471 • TLX 703956 HAZRAL MDS UD

SAMPLE NUMBER: 60603829

LATER: 86548

PESTICIDE FRACTION (CONTINUED)

PCB-1016	LESS THAN 0.10
TOXAPHENE	LESS THAN 0.2

METHOD REFERENCES

PHENOXY ACIDS
FEDERAL REGISTER, VOLUME 38, NUMBER 75, PART II (1973).

2,3,7,8-TCDD (DIOXIN)
USEPA CONTRACT NO. 68-01-6913
OTHER METHODS OR MODIFICATIONS AS LISTED ABOVE WITH RESULTS.

PESTICIDE FRACTION
METHODS FOR ORGANIC ANALYSIS OF MUNICIPAL AND INDUSTRIAL WASTEWATER, EPA PUBLICATION NO. 600/4-82-057, METHOD 608, U.S. EPA, CINCINNATI, OH (REVISED OCTOBER 1984)
U.S. EPA METHOD 608 (FEDERAL REGISTER, VOLUME 49, NO. 209, PG. 43321-43336, OCTOBER 26, 1984)
TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION NO. SW-846, SECOND EDITION, METHOD 8080, U.S. EPA, WASHINGTON, DC (REVISED APRIL 1984)

GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones (312) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

TO: Riverdale Chemical Company
270 East 17th Street
Chicago Heights Il 60411

ATTN: Dr. Michael Champion

DATE: 02/16/87

RE: 24 Hr Composite ISCO
Wastewater Sample
Sample Date: 01/07/87
Date Received: 01/07/87
GCL Number: 97641

GCL #	PARAMETERS	ANALYST	RESULTS		
97641	2,4 - Dichlorophenoxy Acetic Acid	haz		7.7	ug/l
97641	2,4,5 - Trichlorophenoxy Propionic Acid	haz	<	0.5	ug/l
97641	2,4,5 - Trichlorophenoxyacetic Acid	haz	<	0.5	ug/l
97641	Chemical Oxygen Demand	efl	<5000		ug/l
97641	Chlordane	haz	<	0.10	ug/l
97641	Dioxin (2,3,7,8-TCDD)	haz	<	0.0006	ug/l
97641	Kerosene	dek	< 500		ug/l
97641	n-octyl Alcohol	dek	< 200		ug/l
97641	Oil and Grease (Freon Extraction)	bt	<5000		ug/l
97641	Phenols	efl	<	5	ug/l

Approved: John Boudreau Analyst _____ Date 02/19/8

APPENDIX
I

APPENDIX I

CALCULATIONS FOR PUBLIC HEALTH EVALUATION

TABLE I-1
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 4)

INDICATOR CHEMICALS	QUADRANT I [Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	1.4	1.35	2.2E-7	2.1E-7	1.0	3.5E-8	3.3E-8	6.84E-4	2.4E-11	2.3E-11
BENZO(A)PYRENE	1.4	1.12	2.2E-7	1.8E-7	0.5	1.7E-8	1.4E-8	11.5	2.0E-7	1.6E-7
ALDRIN	7.8	6.55	1.2E-6	1.0E-6	1.0	1.9E-7	1.6E-7	11.4	2.1E-6	1.8E-6
DIELDRIN	3.3	3.1	5.2E-7	4.9E-7	1.0	8.2E-8	7.7E-8	30.4	2.5E-6	2.3E-6
CHLORDANE	18	15	2.8E-6	2.4E-6	1.0	4.4E-7	3.8E-7	1.61	7.1E-7	6.1E-7
4,4'-DDT**	2.21	1.8	3.5E-7	2.8E-7	0.2	1.1E-8	8.8E-9	0.34	3.7E-9	3.0E-9
HEPTACHLOR**	21.6	11.6	3.4E-6	1.8E-6	1.0	5.3E-7	2.8E-7	3.37	1.8E-6	9.5E-7
2,3,7,8-TCDD***	—	—	—	—	0.005	—	—	15,600	—	—
								TOTAL CANCER RISK	7.3E-6	5.8E-6

TABLE I-1
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 4)

QUADRANT II

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.1	0.37	3.3E-7	5.8E-8	1.0	5.2E-8	9.1E-9	6.84E-4	3.5E-11	6.2E-12
BENZO(A)PYRENE	4.0	0.84	6.3E-7	1.3E-7	0.5	4.9E-8	1.0E-8	11.5	5.7E-7	1.2E-7
ALDRIN	170	1.0	2.7E-5	1.6E-7	1.0	4.2E-6	2.5E-8	11.4	4.8E-5	2.8E-7
DIELDRIN	200	3.1	3.1E-5	4.9E-7	1.0	4.9E-6	7.6E-8	30.4	1.5E-4	2.3E-6
CHLORDANE	100	1.44	1.6E-5	2.3E-7	1.0	2.5E-6	3.6E-8	1.61	3.9E-6	5.7E-8
4,4'-DDT**	111	1.9	1.7E-5	3.0E-7	0.2	5.4E-7	9.3E-9	0.34	1.9E-7	3.2E-9
HEPTACHLOR**	20.7	4.2	3.2E-6	6.6E-7	1.0	5.1E-7	1.0E-7	3.37	1.7E-6	3.5E-7
2,3,7,8-TCDD***	0.0105	0.0011	1.6E-9	1.7E-10	0.005	1.3E-12	1.4E-13	15,600	2.0E-8	2.1E-9
								TOTAL CANCER RISK	2.0E-4	3.1E-6

TABLE I-1
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 4)

QUADRANT III

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	0.45	0.35	7.1E-8	5.5E-8	1.0	1.1E-8	8.6E-9	6.84E-4	7.6E-12	5.9E-12
BENZO(A)PYRENE	4.0	0.84	6.3E-7	1.3E-7	0.5	4.9E-8	1.0E-8	11.5	5.7E-7	1.2E-7
ALDRIN	530	3.9	8.3E-5	6.1E-7	1.0	1.3E-5	9.6E-8	11.4	1.5E-4	1.1E-6
DIELDRIN	57	5.5	8.9E-6	8.6E-7	1.0	1.4E-6	1.4E-7	30.4	4.3E-5	4.1E-6
CHLORDANE	1,100	9.5	1.7E-4	1.5E-6	1.0	2.7E-5	2.3E-7	1.61	4.4E-5	3.8E-7
4,4'-DDT**	33	1.1	5.2E-6	1.7E-7	0.2	1.6E-7	5.4E-9	0.34	5.5E-8	1.8E-9
HEPTACHLOR**	67	1.7	1.1E-5	2.7E-7	1.0	1.7E-6	4.2E-8	3.37	5.6E-6	1.4E-7
2,3,7,8-TCDD***	0.0146	0.0018	2.3E-9	2.8E-10	0.005	1.8E-12	2.2E-13	15,600	2.8E-8	3.5E-9
								TOTAL CANCER RISK	2.4E-4	5.8E-6

TABLE I-1
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 4)

QUADRANT IV

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	---	---	---	---	1.0	---	---	6.84E-4	---	---
BENZO(A)PYRENE	---	---	---	---	0.5	---	---	11.5	---	---
ALDRIN	220	3.4	3.5E-5	5.3E-7	1.0	5.4E-6	8.4E-8	11.4	6.2E-5	9.6E-7
DIELDRIN	210	9.2	3.3E-5	1.4E-6	1.0	5.2E-6	2.3E-7	30.4	1.6E-4	6.9E-6
CHLORDANE	90	11.2	1.4E-5	1.8E-6	1.0	2.2E-6	2.8E-7	1.61	3.6E-6	4.4E-7
4,4'-DDT**	46	4.2	7.2E-6	6.6E-7	0.2	2.3E-7	2.1E-8	0.34	7.7E-8	7.0E-9
HEPTACHLOR**	79	3.5	1.2E-5	5.5E-7	1.0	1.9E-6	8.6E-8	3.37	6.6E-6	2.9E-7
2,3,7,8-TCDD***	---	---	---	---	0.005	---	---	15,600	---	---
								TOTAL CANCER RISK	2.3E-4	8.6E-6

* - Daily Chemical Ingestion Rate (DCIR) = 1.57E-7 Ci,
Effective Dose (De) = DCIR x (Absorption Factor) x [(Exposure Duration)/70], where Exposure Duration = 11 years,
Cancer Risk = De x q*
** - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)
*** - Surface soils only (does not include borings)

TABLE I-2
SOIL INGESTION CANCER RISK CALCULATIONS*
63 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 4)

QUADRANT I										
INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg)		[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day)		[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day)		[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK	
	MAX.	MEAN	MAX.	MEAN		MAX.	MEAN		MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	1.4	1.35	1.5E-7	1.5E-7	1.0	1.4E-7	1.4E-7	6.84E-4	9.6E-11	9.6E-11
BENZO(A)PYRENE	1.4	1.12	1.5E-7	1.2E-7	0.5	6.8E-8	5.4E-8	11.5	7.8E-7	6.3E-7
ALDRIN	7.8	6.55	8.4E-7	7.1E-7	1.0	7.6E-7	6.4E-7	11.4	8.6E-6	7.3E-6
DIELDRIN	3.3	3.1	3.6E-7	3.3E-7	1.0	3.2E-7	3.0E-7	30.4	9.8E-6	9.2E-6
CHLORDANE	18	15	1.9E-6	1.6E-6	1.0	1.7E-6	1.5E-6	1.61	2.8E-6	2.3E-6
4,4'-DDT**	2.21	1.8	2.4E-7	1.9E-7	0.2	4.3E-8	3.5E-8	0.34	1.5E-8	1.2E-8
HEPTACHLOR**	21.6	11.6	2.3E-6	1.3E-6	1.0	2.1E-6	1.1E-6	3.37	7.1E-6	3.8E-6
2,3,7,8-TCDD***	---	---	---	---	0.005	---	---	15,600	---	---
								TOTAL CANCER RISK	2.9E-5	2.3E-5

TABLE I-2
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 4)

QUADRANT II										
INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg)		[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day)		[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day)		[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK	
	MAX.	MEAN	MAX.	MEAN		MAX.	MEAN		MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.1	0.37	2.3E-7	4.0E-8	1.0	2.1E-7	3.6E-8	6.84E-4	1.4E-10	2.5E-11
BENZO(A)PYRENE	4.0	0.84	4.3E-7	9.1E-8	0.5	1.9E-7	4.1E-8	11.5	2.2E-6	4.7E-7
ALDRIN	170	1.0	1.8E-5	1.1E-7	1.0	1.6E-5	9.9E-8	11.4	1.8E-4	1.1E-6
DIELDRIN	200	3.1	2.2E-5	3.3E-7	1.0	2.0E-5	3.0E-7	30.4	6.0E-4	9.0E-6
CHLORDANE	100	1.44	1.1E-5	1.6E-7	1.0	9.9E-6	1.4E-7	1.61	1.6E-5	2.3E-7
4,4'-DDT**	111	1.9	1.2E-5	2.1E-7	0.2	2.2E-6	3.7E-8	0.34	7.3E-7	1.3E-8
HEPTACHLOR**	20.7	4.2	2.2E-6	4.5E-7	1.0	2.0E-6	4.1E-7	3.37	6.8E-6	1.4E-6
2,3,7,8-TCDD***	0.0105	0.0011	1.1E-9	1.2E-10	0.005	5.1E-12	5.3E-13	15,600	8.0E-8	8.3E-9
								TOTAL CANCER RISK	8.1E-4	1.2E-5

TABLE I-2
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 4)

QUADRANT III

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	0.45	0.35	4.9E-8	3.8E-8	1.0	4.4E-8	3.4E-8	6.84E-4	3.0E-11	2.3E-11
BENZO(A)PYRENE	4.0	0.84	4.3E-7	9.1E-8	0.5	1.9E-7	4.1E-8	11.5	2.2E-6	4.7E-7
ALDRIN	530	3.9	5.7E-5	4.2E-7	1.0	5.2E-5	3.8E-7	11.4	5.9E-4	4.3E-6
DIELDRIN	57	5.5	6.2E-6	5.9E-7	1.0	5.5E-6	5.3E-7	30.4	1.7E-4	1.6E-5
CHLORDANE	1,100	9.5	1.2E-4	1.0E-6	1.0	1.1E-4	9.2E-7	1.61	1.7E-4	1.5E-6
4,4'-DDT**	33	1.1	3.6E-6	1.2E-7	0.2	6.4E-7	2.1E-8	0.34	2.2E-7	7.3E-9
HEPTACHLOR**	67	1.7	7.2E-6	1.8E-7	1.0	6.5E-6	1.7E-7	3.37	2.2E-5	5.6E-7
2,3,7,8-TCDD***	0.0146	0.0018	1.6E-9	1.9E-10	0.005	7.1E-12	8.7E-13	15,600	1.1E-7	1.4E-8
								TOTAL CANCER RISK	9.6E-4	2.3E-5

TABLE I-2
SOIL INGESTION CANCER RISK CALCULATIONS*
11 YEAR TRESPASS SCENARIO
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 4)

QUADRANT IV										
INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg)		[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day)		[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day)		[q*] CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK	
	MAX.	MEAN	MAX.	MEAN		MAX.	MEAN		MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	---	---	---	---	1.0	---	---	6.84E-4	---	---
BENZO(A)PYRENE	---	---	---	---	0.5	---	---	11.5	---	---
ALDRIN	220	3.4	2.4E-5	3.7E-7	1.0	2.1E-5	3.3E-7	11.4	2.4E-4	3.8E-6
DIELDRIN	210	9.2	2.3E-5	9.9E-7	1.0	2.0E-5	8.9E-7	30.4	6.2E-4	2.7E-5
CHLORDANE	90	11.2	9.7E-6	1.2E-6	1.0	8.7E-6	1.1E-6	1.61	1.4E-5	1.8E-6
4,4'-DDT**	46	4.2	5.0E-6	4.5E-7	0.2	8.9E-7	8.2E-8	0.34	3.0E-7	2.8E-8
HEPTACHLOR**	79	3.5	8.5E-6	3.8E-7	1.0	7.7E-6	3.4E-7	3.37	2.6E-5	1.1E-6
2,3,7,8-TCDD***	---	---	---	---	0.005	---	---	15,600	---	---
								TOTAL CANCER RISK	9.0E-4	3.3E-5

* - Daily Chemical Ingestion Rate (DCIR) = 1.08E-7 Ci,
Effective Dose (De) = DCIR x (Absorption Factor) x [(Exposure Duration)/70], where Exposure Duration = 63 years,
Cancer Risk = De x q*
** - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)
*** - Surface soils only (does not include borings)

TABLE I-3
SOIL INGESTION CHRONIC TOXICITY CALCULATIONS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 4)

QUADRANT I

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[RfD] RRfD or ADI (mg/kg/day)	[De/RRfD or ADI] FRACTION OF RRfD or ADI MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	1.4	1.35	3.6E-7	3.5E-7	1.0	3.6E-7	3.5E-7	2.0E-2	1.8E-5	1.7E-5
BENZO(A)PYRENE	1.4	1.12	3.6E-7	2.9E-7	0.5	1.8E-7	1.4E-7	4.2E-1	4.3E-7	3.4E-7
ALDRIN	7.8	6.55	2.0E-6	1.7E-6	1.0	2.0E-6	1.7E-6	3.0E-5	6.7E-2	5.6E-2
DIELDRIN	3.3	3.1	8.4E-7	7.9E-7	1.0	8.4E-7	7.9E-7	2.9E-5	2.9E-2	2.7E-2
CHLORDANE	18	15	4.6E-6	3.8E-6	1.0	4.6E-6	3.8E-6	2.7E-2	1.7E-4	1.4E-4
4,4'-DDT**	2.21	1.8	5.7E-7	4.6E-7	0.2	1.1E-7	9.2E-8	5.0E-4	2.3E-4	1.8E-4
HEPTACHLOR**	21.6	11.6	5.5E-6	3.0E-6	1.0	5.5E-6	3.0E-6	3.0E-5	1.8E-1	9.9E-2
2,3,7,8-TCDD***	—	—	—	—	0.005	—	—	1.0E-9	—	—
ENDRIN+	0.21	---	5.4E-8	—	1.0	5.4E-8	—	4.5E-4	1.2E-4	—
								TOTAL RRfD RATIO	2.8E-1	1.8E-1

TABLE I-3
SOIL INGESTION CHRONIC TOXICITY CALCULATIONS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 4)

INDICATOR CHEMICALS	QUADRANT II [Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[RfD] RRfD or ADI (mg/kg/day)	[De/RRfD or ADI] FRACTION OF RRfD or ADI MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.1	0.37	5.4E-7	9.4E-8	1.0	5.4E-7	9.4E-8	2.0E-2	2.7E-5	4.7E-6
BENZO(A)PYRENE	4.0	0.84	1.0E-6	2.1E-7	0.5	5.1E-7	1.1E-7	4.2E-1	1.2E-6	2.6E-7
ALDRIN	170	1.0	4.4E-5	2.6E-7	1.0	4.4E-5	2.6E-7	3.0E-5	1.45	8.5E-3
DIELDRIN	200	3.0	5.1E-5	7.7E-7	1.0	5.1E-5	7.7E-7	2.9E-5	1.77	2.7E-2
CHLORDANE	100	1.44	2.6E-5	3.7E-7	1.0	2.6E-5	3.7E-7	2.7E-2	9.0E-4	1.4E-5
4,4'-DDT**	111	1.9	2.8E-5	4.9E-7	0.2	5.7E-6	9.7E-8	5.0E-4	1.1E-2	2.0E-4
HEPTACHLOR**	20.7	4.2	5.3E-6	1.1E-6	1.0	5.3E-6	1.1E-6	3.0E-5	1.8E-1	3.7E-2
2,3,7,8-TCDD***	0.0105	0.0011	2.7E-9	2.8E-10	0.005	1.3E-11	1.4E-12	1.0E-9	1.3E-2	1.4E-3
ENDRIN+	4.7	0.146	1.2E-6	3.7E-8	1.0	1.2E-6	3.7E-8	4.5E-4	2.7E-3	8.3E-5
								TOTAL RRfD RATIO	3.43	7.4E-2

TABLE I-3
SOIL INGESTION CHRONIC TOXICITY CALCULATIONS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 4)

INDICATOR CHEMICALS	QUADRANT III [Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[RfD] RRfD or ADI (mg/kg/day)	[De/RRfD or ADI] FRACTION OF RRfD or ADI MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	0.45	0.35	1.2E-7	9.0E-8	1.0	1.2E-7	9.0E-8	2.0E-2	5.8E-6	4.5E-6
BENZO(A)PYRENE	4.0	0.84	1.0E-6	2.2E-7	0.5	5.1E-7	1.1E-7	4.2E-1	1.2E-6	2.6E-7
ALDRIN	530	3.9	1.4E-4	1.0E-6	1.0	1.4E-4	1.0E-6	3.0E-5	4.52	3.3E-2
DIELDRIN	57	5.5	1.5E-5	1.4E-6	1.0	1.5E-5	1.4E-6	2.9E-5	5.0E-1	4.9E-2
CHLORDANE	1,100	9.5	2.8E-4	2.4E-6	1.0	2.8E-4	2.4E-6	2.7E-2	1.0E-2	9.0E-5
4,4'-DDT**	33	1.1	8.4E-6	2.8E-7	0.2	1.7E-6	5.6E-8	5.0E-4	3.0E-3	1.1E-4
HEPTACHLOR**	67	1.7	1.7E-5	4.4E-7	1.0	1.7E-5	4.4E-7	3.0E-5	5.7E-1	1.5E-2
2,3,7,8-TCDD***	0.0146	0.0018	3.7E-9	4.6E-10	0.005	1.9E-11	2.3E-12	1.0E-9	1.9E-2	2.0E-3
ENDRIN+	6.1	0.149	1.6E-6	3.0E-8	1.0	1.6E-6	3.0E-8	4.5E-4	3.0E-3	8.4E-5
								TOTAL RRfD RATIO	5.63	9.9E-2

TABLE I-3
SOIL INGESTION CHRONIC TOXICITY CALCULATIONS*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 4)

QUADRANT IV

INDICATOR CHEMICALS	[Ci] SOIL CONCENTRATION (mg/kg) MAX.	MEAN	[DCIR] DAILY CHEMICAL INGESTION RATE (mg/kg-body weight/day) MAX.	MEAN	[AF] ABSORPTION FACTOR	[De] EFFECTIVE DOSE (mg/kg/day) MAX.	MEAN	[RfD] RRfD or ADI (mg/kg/day)	[De/RRfD or ADI] FRACTION OF RRfD or ADI MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	---	---	---	---	1.0	---	---	2.0E-2	---	---
BENZO(A)PYRENE	---	---	---	---	0.5	---	---	4.2E-1	---	---
ALDRIN	220	3.4	5.6E-5	8.7E-7	1.0	5.6E-5	8.7E-7	3.0E-5	1.87	2.9E-2
DIELDRIN	210	9.2	5.4E-5	2.4E-6	1.0	5.4E-5	2.4E-6	2.9E-5	1.85	8.1E-2
CHLORDANE	90	11.2	2.3E-5	2.9E-6	1.0	2.3E-5	2.9E-6	2.7E-2	8.5E-4	1.1E-4
4,4'-DDT**	46	4.2	1.2E-5	1.1E-6	0.2	2.4E-6	2.2E-7	5.0E-4	5.0E-3	4.3E-4
HEPTACHLOR**	79	3.5	2.0E-5	9.0E-7	1.0	2.0E-5	9.0E-7	3.0E-5	6.7E-1	3.0E-2
2,3,7,8-TCDD***	---	---	---	---	0.005	---	---	1.0E-9	---	---
ENDRIN+	6.0	0.447	1.5E-6	1.1E-7	1.0	1.5E-6	1.1E-7	4.5E-4	3.0E-3	2.5E-4
								TOTAL RRfD RATIO	4.402	1.4E-1

* - Daily Chemical Ingestion Rate (DCIR) = 2.56E-7 Ci,
Most sensitive receptor is child 7 - 9 years old, body weight = 27.8 kg,
18 month - 2 year exposure is assumed
** - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)
*** - Surface soils only (does not include bori
\+ - Endrin is a surrogate for Endrin Ketone.

TABLE I-4
INHALATION CANCER RISK CALCULATIONS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 1 OF 4)

INDICATOR CHEMICALS	SOIL CONCENTRATION (mg/kg) MAX.	SOIL CONCENTRATION (mg/kg) MEAN	AIR PARTICULATE (SOILS) CONC. IN AMBIENT AIR (mg/cubic meter)	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MAX.	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MEAN	QUADRANT I DAILY CHEMICAL INHALATION RATE MAX.	QUADRANT I DAILY CHEMICAL INHALATION RATE MEAN	WIND FACTOR	EFFECTIVE DOSE (mg/kg/day) MAX.	EFFECTIVE DOSE (mg/kg/day) MEAN	CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	CANCER RISK MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	1.4	1.35	4.5E-4	6.3E-10	6.1E-10	1.8E-10	1.7E-10	0.175	3.2E-11	3.0E-11	6.84E-4	2.2E-14	2.1E-14
BENZO(A)PYRENE	1.4	1.12	4.5E-4	6.3E-10	5.0E-10	1.8E-10	1.4E-10	0.175	3.2E-11	2.5E-11	6.11	2.0E-10	1.5E-10
ALDRIN	7.8	6.55	4.5E-4	3.5E-9	2.9E-9	1.0E-9	8.3E-10	0.175	1.8E-10	1.5E-10	11.4	2.1E-9	1.7E-9
DIELDRIN	3.3	3.1	4.5E-4	1.5E-9	1.4E-9	4.3E-10	4.0E-10	0.175	7.5E-11	7.0E-11	30.4	2.3E-9	2.1E-9
CHLORDANE	18	15	4.5E-4	8.1E-9	6.8E-9	2.3E-9	1.9E-9	0.175	4.0E-10	3.3E-10	1.61	6.4E-10	5.3E-10
4,4'-DDT*	2.2	1.8	4.5E-4	9.9E-10	8.1E-10	2.8E-10	2.3E-10	0.175	4.9E-11	4.0E-11	0.34	1.7E-11	1.4E-11
HEPTACHLOR*	21.6	11.6	4.5E-4	9.7E-9	5.2E-9	2.8E-9	1.5E-9	0.175	4.9E-10	2.6E-10	3.37	1.7E-9	8.8E-10
2,3,7,8-TCDD	---	---	4.5E-4	---	---	---	---	0.175	---	---	15,600	---	---

TABLE I-4
INHALATION CANCER RISK CALCULATIONS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 2 OF 4)

INDICATOR CHEMICALS	SOIL CONCENTRATION (mg/kg) MAX.	SOIL CONCENTRATION (mg/kg) MEAN	AIR PARTICULATE (SOILS) CONC. IN AMBIENT AIR (mg/cubic meter)	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MAX.	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MEAN	QUADRANT II DAILY CHEMICAL INHALATION RATE MAX.	QUADRANT II DAILY CHEMICAL INHALATION RATE MEAN	WIND FACTOR	EFFECTIVE DOSE (mg/kg/day) MAX.	EFFECTIVE DOSE (mg/kg/day) MEAN	CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	CANCER RISK MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.1	0.369	2.9E-4	6.1E-10	1.1E-10	1.7E-10	3.1E-11	0.175	3.0E-11	5.3E-12	6.84E-4	2.0E-14	3.7E-15
BENZO(A)PYRENE	4.0	0.838	2.9E-4	1.2E-9	2.4E-10	3.3E-10	6.9E-11	0.175	5.8E-11	1.2E-11	6.11	3.5E-10	7.4E-11
ALDRIN	170	1.0	2.9E-4	4.9E-8	2.9E-10	1.4E-8	8.3E-11	0.175	2.5E-9	1.5E-11	11.4	2.8E-8	1.7E-10
DIELDRIN	200	3.1	2.9E-4	5.8E-8	9.0E-10	1.7E-8	2.6E-10	0.175	2.9E-9	4.5E-11	30.4	8.8E-8	1.4E-9
CHLORDANE	100	1.44	2.9E-4	2.9E-8	4.2E-10	8.3E-9	1.2E-10	0.175	1.5E-9	2.1E-11	1.61	2.3E-9	3.4E-11
4,4'-DDT*	111	1.9	2.9E-4	3.2E-8	5.5E-10	9.2E-9	1.6E-10	0.175	1.6E-9	2.7E-11	0.34	5.4E-10	9.4E-12
HEPTACHLOR*	20.7	4.2	2.9E-4	6.0E-9	1.2E-9	1.7E-9	3.5E-10	0.175	3.0E-10	6.1E-11	3.37	1.0E-9	2.1E-10
2,3,7,8-TCDD	0.0105	0.0011	2.9E-4	3.0E-12	3.2E-13	8.7E-13	9.1E-14	0.175	1.5E-13	1.6E-14	15,600	2.4E-9	2.4E-10

TABLE I-4
INHALATION CANCER RISK CALCULATIONS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 3 OF 4)

INDICATOR CHEMICALS	SOIL CONCENTRATION (mg/kg) MAX.	SOIL CONCENTRATION (mg/kg) MEAN	AIR PARTICULATE (SOILS) CONC. IN AMBIENT AIR (mg/cubic meter)	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MAX.	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MEAN	QUADRANT III DAILY CHEMICAL INHALATION RATE MAX.	QUADRANT III DAILY CHEMICAL INHALATION RATE MEAN	WIND FACTOR	EFFECTIVE DOSE (mg/kg/day) MAX.	EFFECTIVE DOSE (mg/kg/day) MEAN	CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	CANCER RISK MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	0.45	0.35	2.4E-4	1.1E-10	8.4E-11	3.1E-11	2.4E-11	0.175	5.4E-12	4.2E-12	6.84E-4	3.7E-15	2.9E-15
BENZO(A)PYRENE	4.0	0.842	2.4E-4	9.6E-10	2.0E-10	1.7E-10	5.8E-11	0.175	2.9E-11	1.0E-11	6.11	1.8E-10	6.2E-11
ALDRIN	530	3.9	2.4E-4	1.3E-7	9.4E-10	3.6E-8	2.7E-10	0.175	6.4E-9	4.7E-11	11.4	7.3E-8	5.3E-10
DIELDRIN	57	5.5	2.4E-4	1.4E-8	1.3E-9	3.9E-9	3.8E-10	0.175	6.8E-10	6.6E-11	30.4	2.1E-8	2.0E-9
CHLORDANE	1,100	9.5	2.4E-4	2.6E-7	2.3E-9	7.5E-8	6.5E-10	0.175	1.3E-8	1.1E-10	1.61	2.1E-8	1.8E-10
4,4'-DDT*	33	1.1	2.4E-4	7.9E-9	2.6E-10	2.3E-9	7.5E-11	0.175	4.0E-10	1.3E-11	0.34	1.3E-10	4.5E-12
HEPTACHLOR*	67	1.7	2.4E-4	1.6E-8	4.1E-10	4.6E-9	1.2E-10	0.175	8.0E-10	2.0E-11	3.37	2.7E-9	6.9E-11
2,3,7,8-TCDD	0.0146	0.0018	2.4E-4	3.5E-12	4.3E-13	1.0E-12	1.2E-13	0.175	1.8E-13	2.2E-14	15,600	2.7E-9	3.4E-10

TABLE I-4
INHALATION CANCER RISK CALCULATIONS
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS
(PAGE 4 OF 4)

INDICATOR CHEMICALS	QUADRANT IV: SOIL CONCENTRATION (mg/kg) MAX.	SOIL CONCENTRATION (mg/kg) MEAN	AIR PARTICULATE (SOILS) CONC. IN AMBIENT AIR (mg/cubic meter)	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MAX.	CHEMICAL CONC. IN AMBIENT AIR (mg/cubic meter) MEAN	DAILY CHEMICAL INHALATION RATE MAX.	DAILY CHEMICAL INHALATION RATE MEAN	WIND FACTOR	EFFECTIVE DOSE (mg/kg/day) MAX.	EFFECTIVE DOSE (mg/kg/day) MEAN	CARCINOGENIC POTENCY [1/(mg/kg/day)]	CANCER RISK MAX.	CANCER RISK MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	—	—	5.3E-4	—	—	—	—	0.175	—	—	6.84E-4	—	—
BENZO(A)PYRENE	—	—	5.3E-4	—	—	—	—	0.175	—	—	6.11	—	—
ALDRIN	220	3.4	5.3E-4	1.2E-7	1.8E-9	3.3E-8	5.1E-10	0.175	5.8E-9	9.0E-11	11.4	6.6E-8	1.0E-9
DIELDRIN	210	9.2	5.3E-4	1.1E-7	4.9E-9	3.2E-8	1.4E-9	0.175	5.6E-9	2.4E-10	30.4	1.7E-7	7.4E-9
CHLORDANE	90	11.2	5.3E-4	4.8E-8	5.9E-9	1.4E-8	1.7E-9	0.175	2.4E-9	3.0E-10	1.61	3.8E-9	4.8E-10
4,4'-DDT*	46	4.2	5.3E-4	2.4E-8	2.2E-9	7.0E-9	6.4E-10	0.175	1.2E-9	1.1E-10	0.34	4.1E-10	3.8E-11
HEPTACHLOR*	79	3.5	5.3E-4	4.2E-8	1.9E-9	1.2E-8	5.3E-10	0.175	2.1E-9	9.3E-11	3.37	7.1E-9	3.1E-10
2,3,7,8-TCDD	—	—	5.3E-4	—	—	—	—	0.175	—	—	15,600	—	—

* - Total DDT (DDT + DDE + DDD) and Heptachlor (Heptachlor + Heptachlor Epoxide)

TABLE I-5
TOTAL POTENTIAL CANCER RISK
AT NEAREST RECEPTOR LOCATION*
RIVERDALE CHEMICAL COMPANY RI/FS
CHICAGO HEIGHTS, ILLINOIS

INDICATOR CHEMICALS	CANCER RISK QUADRANT I		CANCER RISK QUADRANT II		CANCER RISK QUADRANT III		CANCER RISK QUADRANT IV		RECEPTOR CANCER RISK TOTAL AT LOCATION	
	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN	MAX.	MEAN
BIS(2-ETHYLHEXYL) PHTHALATE	2.2E-14	2.1E-14	2.0E-14	3.7E-15	3.7E-15	2.9E-15	---	---	4.6E-14	2.7E-14
BENZO(A)PYRENE	2.0E-10	1.5E-10	3.5E-10	7.4E-11	1.8E-10	6.2E-11	---	---	7.3E-10	2.9E-10
ALDRIN	2.1E-9	1.7E-9	2.8E-8	1.7E-10	7.3E-8	5.3E-10	6.6E-8	1.0E-9	1.7E-7	3.4E-9
DIELDRIN	2.3E-9	2.1E-9	8.8E-8	1.4E-9	2.1E-8	2.0E-9	1.7E-7	7.4E-9	2.8E-7	1.3E-8
CHLORDANE	6.4E-10	5.3E-10	2.3E-9	3.4E-11	2.1E-8	1.8E-10	3.8E-9	4.8E-10	2.8E-8	1.2E-9
4,4'-DDT	1.7E-11	1.4E-11	5.4E-10	9.4E-12	1.3E-10	4.5E-12	4.1E-10	3.8E-11	1.1E-9	6.6E-11
HEPTACHLOR	1.7E-9	8.8E-10	1.0E-9	2.1E-10	2.7E-9	6.9E-11	7.1E-9	3.1E-10	1.3E-8	1.5E-8
2,3,7,8-TCDD	---	---	2.4E-9	2.4E-10	2.7E-9	3.4E-10	---	---	5.1E-9	5.8E-10
							TOTAL CANCER RISK		5.0E-7	3.3E-8

* - All values are unit-less