SUPPLEMENTAL RCRA FACILITY INVESTIGATION/ MCP PHASE II COMPREHENSIVE SITE ASSESSMENT WORK PLAN INDIAN ORCHARD PLANT

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Monsanto Company

Springfield, Massachusetts

May 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

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6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

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1.0 Introduction

1.1 General

This work plan has been prepared on behalf of the Monsanto Company (Monsanto) by Blasland, Bouck & Lee, Inc. (BB&L) to meet both federal and state regulatory requirements applicable to 14 areas at the Monsanto Indian Orchard Plant in Springfield, Massachusetts. Thirteen of the 14 areas were identified as solid waste management units (SWMUs) or areas of concern (AOCs) by the United States Environmental Protection Agency (USEPA) and fall under the requirements of the Resource Conservation and Recovery Act (RCRA). Twelve of the 14 areas were identified as disposal areas by the Massachusetts Department of Environmental Protection (MA-DEP) and fall under the requirements of the Massachusetts Contingency Plan (MCP). These 14 areas will be identified as SWMU/disposal areas throughout this document. The 14 SWMU/disposal areas are as follows:

SWMU/Disposal Areas	
RCRA SWMU/AOC	MCP Disposal Area
SWMU 35	Solid Waste Disposal Area (SWDA) No. 1
SWMU 36	Solid Waste Disposal Area (SWDA) No. 2
SWMU 34	Liquid Waste Disposal Area (LWDA) No. 1
SWMU 37	Liquid Waste Disposal Area (LWDA) No. 2
SWMU 33	Fiberloid Landfill
SWMU 47	Building 99 Leach Fields
SWMU 38	Burning Pits A
SWMU 39	Burning Pit B
SWMU 40	Burning Pit C
SWMU 41	Burning Pits D
AOC 7	Former Building 44 and Tank Farm E
SWMU 16 Accumulation Area/ East Gelva Area	NA
SWMU 30 336 Drum Storage Area	NA
NA	West Resins Area

NA = Not Applicable

First, this work plan addresses the requirements for a RCRA Facility Investigation (RFI) in response to the Final Draft RCRA Facility Assessment (RFA) Document Number TESV-R01014-ET-CGLS issued by the

USEPA to Monsanto on November 4, 1991. This work plan addresses 12 of the 69 potential SWMUs and one of the 18 potential AOCs identified in the RFA. These 12 SWMUs and one AOC were selected for further investigation, based on the following:

- A known release of wastes/waste constituents has occurred at each of these areas;
- These areas are considered disposal areas by MA-DEP; and/or
- Previous investigations indicated that 6 of the 13 areas potentially impact the environment.

Second, this work plan addresses the conditions set forth per the MCP Waiver Number 1-0184 (waiver), approved by MA-DEP for the disposal areas at the Indian Orchard Plant on November 13, 1991. The 12 areas covered under this waiver are identified above. An MCP waiver is only granted to non-priority sites: sites that have limited access, have no oil or hazardous materials in the ground water or surface water, and have no ground-water contaminants exceeding state or federal standards, or if contaminants are present above standards, the ground water is not used or planned to be used as a water supply. The Indian Orchard Plant is enclosed by a fence; non-aqueous phase liquids (NAPLs) have not been observed in the ground water and surface water; and, although constituents have been detected in the ground water at the site, neither ground water nor surface water is used or potentially used as a water supply within 1.2 miles of the plant.

According to the MCP 310 CMR 40.0000, effective on July 30, 1993 (1993 MCP), Subpart - Transition Provisions, the conditions set forth in the waiver take precedence over the 199[illegible] MCP. The waiver specifies that Monsanto meet the requirements for a Phase II Comprehensive Site Assessment per 310 CMR 40.545 of the MCP, effective June 9, 1989 (1989 MCP). Therefore, this work plan addresses requirements of the 1989 MCP per the conditions set forth in the waiver. Upon review of the 1993 MCP, the work plan also meets the 1993 MCP requirements for an MCP Phase II Comprehensive Site Assessment.

The overall objective of an RFI is consistent with the overall objective of an MCP Phase II Comprehensive Site Assessment, which is to complete a comprehensive, quantitative assessment of site contaminants and environmental conditions. The specific RFI requirements (USEPA, May 1989) and specific 1989 MCP requirements for a Phase II Comprehensive Site Assessment are commensurate with each other and/or encompass each other. Therefore, this work plan will satisfy both the federal and state regulatory requirements for these 14 SWMU/disposal areas.

The USEPA has not yet scheduled involvement for a RFI at the Indian Orchard Plant. In contrast, the MCP waiver requires that the Phase II Comprehensive Site Assessment, as well as subsequent phases involving the development and implementation of remedial response alternatives, be completed by November 1996. Given the differences in the federal and state timetables, this work plan accelerates the RFI process at the Indian Orchard Plant for the 14 SWMU/disposal areas such that the MCP timeframe is met and duplicate investigations are not required in the future.

Many of the RFI and MCP Phase II Comprehensive Site Assessment requirements have been met through the 14 years of remedial action investigations conducted at the Indian Orchard Plant since 1979. During this time period, over 25 investigation reports were completed. This work plan compares the results of these previous remedial action investigations to the RFI and MCP Phase II Comprehensive Site Assessment

requirements. This comparison provides an identification of the data needs to meet the RFI and MCP requirements, which, in turn, provides the justification for the proposed scope of work.

An understanding of the extensive investigations and investigation reports that have been completed at the Indian Orchard Plant is necessary to understand how the data needs and the proposed scope of work were determined for the RFI/MCP Phase II Comprehensive Site Assessment. As such, this work plan is formatted to provide an overview of historic site conditions, current site conditions, and the investigations completed at the site. Section 2, Current and Historic Site Conditions, provides an overview of the plant history, regulatory and investigative history, and environmental setting, while Section 3, Previous Remedial Investigations, provides an overview of the previous investigations conducted at the site. Both Sections 2 and 3 are supported by the numerous investigation reports from which these sections were generated, some of which are also included as work plan appendices. Based on these previous investigations, Section 4, Site Characterization and Identification of Data Needs, sets forth a characterization of each SWMU/disposal area, as well as the associated potential and known migration pathways, potential exposure pathways, and potential receptors. For each of these elements, Section 4 also identifies the data needs to fulfill the RFI and MCP Phase II Comprehensive Site Assessment requirements. Section 5, Supplemental RFI/MCP Scope of Work, sets forth the proposed scope of work to fulfill the identified RFI and MCP data needs. Section 6, Schedule, presents the schedule for the implementation of the proposed scope of work.

2.0 Current and Historic Site Conditions

This section provides an overview of current and historic site conditions at the Monsanto Indian Orchard Plant. First, an overview of the plant history is provided, followed by an overview of the regulatory and investigative history of the plant. The investigative history is provided with the regulatory history to show the interrelationship between the various regulatory requests and Monsanto's responses to these requests in the form of investigations. Detailed descriptions of the investigations conducted at the Indian Orchard Plant are provided in Section 3, Previous Remedial Investigations. Following these historic overviews is a presentation of the environmental setting of the plant. This brief description of the environmental setting is provided to familiarize the reader with general concepts, especially related to site geology and hydrogeology, in preparation for the more detailed discussions in Section 3, Previous Remedial Investigations, and Section 4, Site Characterization and the Identification of Data Needs.

2.1 Plant History

The Monsanto Indian Orchard Plant is located within the Indian Orchard area of the City of Springfield, Hamden County, Massachusetts. The plant was, until 1982, divided into an East Plant and a West Plant (Figure 1).

Manufacturing operations began at the East Plant when the Fiberloid Corporation moved its operations to Springfield from Newbury Port, Massachusetts, in 1904. The Fiberloid Corporation produced mainly nitrocellulose. Monsanto purchased Fiberloid in 1938 and renamed the facility the Springfield Plant. Table 1 lists the major process operations at the East Plant from 1904 to the present.

The West Plant was incorporated as Shawinigan Resins Corporation in 1937 and began operations in 1938. That plant was established under joint ownership of Shawinigan Chemical Limited of Canada and the Fiberloid Corporation of Springfield. Monsanto became the sole owner of Shawinigan Resins Corporation in 1965 and changed the plant name to the Bircham Bend Plant. Table 2 lists the major process operations at the West Plant from 1938 to the present.

Both the East and West Plants disposed of solid and liquid waste materials at 10 areas within the plant boundaries. Materials disposed of on site by the East and West Plants consisted of refuse, including paper, cardboard, wood products, plastics, construction debris, oils, sludges, inks, solvents, and plant transformers. The East Plant disposed of waste materials on-site via landfilling at SWDA No. 1, SWDA No. 2, and the Fiberloid Landfill; by land application at LWDA No. 1 and LWDA No. 2; by open burning at Burning Pits A and B; and by subsurface disposal via the Building 99 Leach Fields.

The West Plant disposed of waste materials on site by land application at LWDA No. 1 and by open burning in Burning Pits C and D. Figure 2 shows the locations of these 10 disposal areas used by the East and West Plants. In 1982, the plants were consolidated as the Indian Orchard Plant. Currently, portions of the Monsanto Indian Orchard Plant are leased to Novacor, Inc. (Novacor) and Masspower.

Additional information on the plant operation history is provided in Appendix A, The History of On-Site Waste Disposal Operations at Monsanto Company - Springfield and Bircham Bend Plants (Monsanto Plastics & Resins Company, December 1982).

2.2 Regulatory and Investigation History

Monsanto has been responsive to regulatory requests and has completed extensive and comprehensive remedial investigations at the Indian Orchard Plant. A chronology of Monsanto's regulatory history and remedial investigations, followed by a discussion, is provided below:

Date	Regulatory and Remedial Investigation History
April 1979	Eckhardt Committee Survey
1980 - 1983	Surface-Water Investigations
1981 - 1983	Preliminary Ground-Water Investigations
April 1984	Consent Order Agreements (COAs) entered into with USEPA and the Massachusetts Department of Environmental Quality Engineering (DEQE)
1984 - 1986	Phase I and Phase II Remedial Investigations (RIs) conducted under the COAs
November 1986	Non-Priority site classification by DEQE
March 1987	Comprehensive Site Assessment submitted to DEQE and USEPA
June 1989	Effective date of the original MCP
November 1991	RFA issued by USEPA
November 1991	MCP waiver issued by MA-DEP
November 1991	MA-DEP COA replaced by MCP waiver
July 1993	Effective date of the revised MCP
1996	Anticipated RFI schedule per the USEPA
November 1996	Waiver deadline for completion of MCP Phases II, III, and IV pursuant to 310 CMR 40.545 through 310 CMR 40.547

In 1979, Monsanto completed the Eckhardt Committee Survey, a National Disposal Site Survey conducted by the United States House of Representatives Oversight and Investigation Subcommittee of the Committee on Interstate and Foreign Commerce. In response to this survey, Monsanto conducted an extensive review of the plant history and performed water quality studies of the Chicopee River and the Bircham Bend Brook from 1980 through 1983. In 1981, Monsanto conducted several ground-water investigations at the plant in cooperation with the DEQE (now known as MA-DEP). In response to the results of these investigations, in April 1984, Monsanto entered into two equivalent but separate COAs with the USEPA and the DEQE to execute an RI and a Feasibility Study (FS) at the Indian Orchard Plant.

The RI was completed in two phases in 1984 through 1986. Phase I work efforts included historical aerial photograph analysis, waste disposal area characterization, an evaluation of the areal limits of nine disposal areas, seismic refraction and magnetometer geophysical investigations, and ground-water collection and analysis. The nine disposal areas include SWDA No. 1, SWDA No. 2, LWDA No. 1, LWDA No. 2, Fiberloid Landfill, and Burning Pits A through D. Phase II work efforts included an evaluation of the subsurface geology and hydrogeology, comprehensive ground-water and soil sampling and analyses program at the nine disposal areas, focused magnetometer and test pit program at four of the nine disposal areas, the identification of chemicals of concern in the environment associated with the past disposal practices, and the assessment of the potential effects of these chemicals of concern. An additional disposal area, Building 99 Leach Fields, was added to the original list of nine disposal areas during the RI.

In November 1986, the DEQE classified the Indian Orchard Plant as a non-priority site, using the criteria identified in 310 CMR 40.545 - Interim Disposal Site Classification System, based on the investigations completed to that date.

In 1986, the RI was completed and reported in the Comprehensive Site Assessment (CSA) (BB&L, March 1987). The CSA also reported the results of all previous investigations and included a proposal for an FS. Since the submittal of the CSA, additional investigations have been initiated by Monsanto at the Indian Orchard Plant and reported to MA-DEP. These investigations have included investigations at specific areas of the plant, as well as annual site-wide ground-water monitoring.

Also, since the submittal of the CSA, the 1989 MCP was promulgated, and Monsanto submitted a waiver application. On November 13, 1991, the application was approved by MA-DEP, and the requirements set forth in the MCP replaced the COA with the MA-DEP. The waiver allows Monsanto to proceed with investigation and remediation without MA-DEP oversight and defers MA-DEP approval upon completion of investigation and remediation activities until the submittal of a completion statement. The waiver conditions require that Monsanto complete Phase II through Phase IV MCP requirements by the waiver's expiration date in November 1996. These MCP phases include:

Phase II - Comprehensive Site Assessment;
Phase III - Development of Remedial Response Alternatives; and
Phase IV - Implementation of Remedial Response Alternative.

On November 4, 1991, the USEPA submitted a Final Draft RFA to Monsanto without conclusions. The next phase of the RCRA process would be the implementation of an RFI, which, per the USEPA's timetable, is not yet scheduled.

2.3 Environmental Setting

This section presents a description of the general topography of the plant; surrounding land use and property lines; and regional and site hydrology, geology, and hydrogeology. [This section briefly summarizes the results from previous investigations and provides a description of the land use surrounding the plant and

the plant property lines that were not completed in previous investigations but are required for RFI and MCP Phase II work plan development.] Further details regarding the environmental setting are provided in the documents referenced and in Section 4, Site Characterization and Identification of Data Needs.

2.3.1 Topography

For reference purposes, the approximately 180-acre site has been divided into two topographic areas - the uplands area and the lowlands area. The uplands area is defined as the southeast area of the plant above the 170-foot contour line. This area, approximately 47 acres in extent, is within the area enclosed by plant grid E4500 to E7000 and N3400 to N4200. Located within this area are SWDA No. 1, LWDA No. 1, and LWDA No. 2. The remainder of the plant is within the lowlands area. The major geologic difference between these two areas is the removal of glacial deposits from the lowlands area by the Chicopee River and, in at least the western half of the plant, the deposition of approximately 15 feet of alluvial sands and gravels.

Figure 2 depicts the general topography of the Indian Orchard Plant.

2.3.2 Surrounding Land Use and Property Lines

Aerial photographs from circa 1930 to present and the MA-DEP MCP (21E) NRS Site Maps were evaluated to assess the historic and current land use in the vicinity of the Indian Orchard Plant. In the 1930s, the area surrounding the plant was mostly undeveloped and vegetated land. The following provides a chronology of land-use changes to the north, south, east, and west of the plant within a one-mile radius.

Historic Land Use

North of the Plant

- In the 1930s, this area was mostly undeveloped with some farmland. A large agricultural area was present approximately 1,500 feet north of the plant center. This area was across the Chicopee River from the plant, between the river and Shawinigan Drive.

- In 1957 aerial photographs, a new facility appeared across the river from the plant in what was previously a partially wooded area, located approximately 2,200 feet north of the plant center. In addition, the Massachusetts Turnpike was noted as a four-lane divided highway approximately 1,800 feet north of the plant center.

- In a 1962 aerial photograph, a trailer park was evident approximately 2,100 feet north of the plant center.

South of the Plant

- In the 1930s, residential areas were present immediately west of Lake Lorraine, along Berkshire Avenue. This area was approximately 4,000 feet southeast of the plant center. Another residential area had developed approximately 3,000 feet southwest of the plant center.

- In a 1970 aerial photograph, a large gravel pit was located approximately 2,500 feet south-southeast of the plant center, or 1,200 feet south of Worcester Street. The present U.S. Postal Service Facility is located to the immediate north of this gravel pit.

- In a 1975 aerial photograph, the U.S. Postal facility was present approximately 300 feet south and upgradient of the Worcester Street plant boundary.

East of the Plant

- In a 1946 aerial photograph, the Indian Orchard residential area limit was approximately 3,700 feet east-northeast of the plant center, or about 900 feet east of the East Gate of the plant.

- In a 1957 aerial photograph, the Indian Orchard residential area had expanded west about 900 feet. This area was about 300 feet south of the East Gate, or about 2,800 feet east-northeast of the plant center.

West of the Plant

- In a 1946 aerial photograph, a sewage treatment plant was noted immediately adjacent to the west side of the plant property, or about 2,000 feet west of the plant center.

- In a 1957 aerial photograph, Bircham Bend Trailer Park was noted approximately 1,000 feet west-southwest of the West Plant Gate, or about 2,500 feet west of the plant center.

Current Land Use

As shown on Figure 3, the area within a one-mile radius of the Indian Orchard Plant is currently used mainly for commercial/industrial and residential purposes. The plant is bounded to the north by the Chicopee River, to the south by Worcester Street, to the east by the Indian Orchard section of the city of Springfield, and to the west by a city of Springfield sewage treatment facility. The southwest corner of the plant is bounded by the Bircham Bend Brook.

Two post-1971 MA-DEP-approved landfills are located within the town of Chicopee, directly across the Chicopee River from the Monsanto Indian Orchard Plant. Three other post-1971 MA-DEP-approved landfills are located further north of the river and the Indian Orchard Plant (two in the town of Chicopee, and one in the town of Ludlow).

Based on available information, there are no ground-water users or water supply zoned areas within a 1.2-mile radius of the plant. A "potentially productive medium yield aquifer" is identified by MA-DEP 1.2 miles south and hydraulically upgradient of the plant site. The nearest municipal well head

protection area is located 4.5 miles north-northwest of the plant and across the Chicopee River, a ground-water divide. The property owners adjacent to the Indian Orchard Plant are identified on Figure 4.

2.3.3 Hydrology

The Monsanto Plant is bordered on the north by the westward flowing Chicopee River. The Chicopee River is a major tributary to the Connecticut River and discharges to the Connecticut, approximately four miles west of the plant site. The average Chicopee river flow is 900 cubic feet per second (cfs). The 7-day, 10-year low flow is 120 cfs. Flood insurance maps were reviewed for the 100-year flood plain along the Chicopee River adjacent to the Monsanto Indian Orchard Plant. The Monsanto Indian Orchard Plant does not lie within a 100-year flood plain per flood insurance maps dated February 1, 1980, No. 2501500005A, City of Springfield, Hamden County, Massachusetts, and September 29, 1978, No. 2501370005A, City of Chicopee, Hamden County, Massachusetts. Additional information on the hydrology of the Chicopee River is presented in Section 4.2.3, Surface-Water Migration Pathways, and in Appendix B, Phase I Remedial Investigation Plan Report (BB&L, August, 1984).

A tributary to the Chicopee River, named Bircham Bend Brook (referred to as "Gagnon's Brook" in previous investigations), flows west along the southwestern plant boundary and then north along the western plant boundary and enters the Chicopee River at a point several hundred yards west of the plant boundary. A brief discussion of the hydraulic relationships between ground-water flow and Bircham Bend Brook and the Chicopee River is presented in Section 2.3.5. Detailed discussions of these hydraulic relationships are presented in Section 4.2.3, Surface-Water Migration Pathways, and Appendix C, CSA (BB&L, March 1987, *Appendix B*).

2.3.4 Geology

Brief descriptions of the regional geology and the site-specific geology, including the major geologic units encountered at the site, are provided below.

Regional Geology

The site is situated within the Connecticut Lowland Section of the New England Maritime Physiographic Province. The Connecticut Lowland is a broad, triangular, generally flat-floored graben (tectonically down dropped block) filled with Upper Triassic and Lower Triassic (approximately 200 million years before present) sandstones and conglomerates. The valley is bordered on the west by the Berkshire Hills and on the east by the New England Central Uplands.

All but the most recent unconsolidated deposits in the Springfield region were deposited between approximately 14,000 and 10,000 years before present (ybp) during the Pleistocene epoch of geologic time. These deposits consist of glacial till and lacustrine (lake) deposits, deltaic and glacial outwash deposits, alluvial (stream and river) deposits, and eolian (wind) deposits.

Site Geology

The site geology comprises the following units in ascending order: bedrock, glacial till deposits, lacustrine deposits, deltaic and outwash deposits, recent alluvial deposits, and fill. The generalized site stratigraphy and a fence diagram is provided in Appendix C, CSA (NN&L, March 1987, *Appendix B, Figures B-3 and B-4*). A discussion of each is presented below.

Bedrock

The deepest geologic unit encountered at the site was sedimentary bedrock in the southeastern portion of the site at a depth of 184 feet. The upper 10 feet of bedrock was identified as red fine-grained arkosic sandstone and siltstone that grades to a hard, well cemented, coarse-grained conglomerate. A 25-foot layer of coarse sand and gravel was observed above bedrock and likely represents the "glaciofluvial sand and gravel" described in the literature.

Glacial Till Deposits

A red, very dense, glacial lower till deposit was found across the entire site. This till deposit overlies the bedrock. Particle grain-size analyses indicate that the glacial till is composed of 30 to 50 percent silt and clay, up to 50 percent sand, and the remainder is embedded fine to coarse gravel. At most locations, the upper 3 to 8 feet of till shows evidence of having been reworked by flowing water. Below the thin veneer of reworked till, the undisturbed till is very dense.

The till thickness was measured in the southeastern portion of the plant at 95 feet. In the southwestern and northeastern portions of the plant, 20 feet and 56 feet, respectively, of till were drilled without encountering bedrock. At most areas at the plant, at least 10 feet of till was encountered. Based upon these observations, it was concluded that the till unit is thick and extends across the entire plant site.

Lacustrine Deposits

Lacustrine deposits overlie the glacial till at portions of the site. The lacustrine deposits are found predominantly in the southern portion of the site, with thin remnants occasionally observed in the northern portion of the site. These deposits are composed of gray varved clays, silts, and fine sands. Grain-size analyses indicate that the typical distribution of the lacustrine deposit is 55 percent silt and clay and 45 percent sand. The average thickness of this deposit is 6.5 feet and ranges from 0 to 18 feet thick.

Deltaic and Outwash Deposits

Above the lacustrine deposits lie the glacial outwash and deltaic deposits, which cover the entire site. These heterogeneous outwash and deltaic units are composed mainly of fine to medium sand with traces of coarse sand and gravel. A typical deltaic deposit is composed of fine to medium sand with up to 25 percent silt and up to 15 percent fine gravel. Within this deltaic and outwash deposit,

locally distributed lenses of silt, silty sands, coarse sand, and sand and gravel are found. Discontinuous layers of glacial till were also encountered within the deltaic deposits, with a maximum reported thickness of 12 feet. The thickness of the outwash and deltaic deposits is related to topographic variations in the underlying till surface and topographic changes due to surficial erosion by the Chicopee River. The thicknesses of these deposits range from 30 to 130 feet. In the lowlands portion of the site, a topographic depression in the till or a trough is present in the western portion of the plant. In this depression, the thickness of the deltaic and outwash deposits is 30 to 70 feet greater than the thickness of these deposits observed in the eastern portion of the plant. In the uplands area, the thickness of these deposits is greater due to the higher elevation of this area.

Alluvial Deposits

Alluvial deposits were observed along the banks of Bircham Bend Brook and the floodplain created by the Chicopee River in the western half of the site. Only a thin layer of alluvial sand and gravel is present to depths of 10 to 12 feet.

Additional information regarding the site geology is presented in Appendix B, Phase I Remedial Investigation Plan Report (BB&L, August 1984) and Appendix C, CSA (BB&L, March 1987, *Appendix B*).

2.3.5 Hydrogeology

Brief descriptions of the regional hydrogeology and the site hydrogeology, including descriptions of the hydrogeologic units present at the site, as well as discussions of ground-water flow rates and directions, and ground-water and surface-water relationships, are provided below.

Regional Hydrogeology

The state of Massachusetts receives an average of approximately 45 inches of precipitation a year. Of this, a majority is returned to the atmosphere by evapotranspiration, which is a combination of direct evaporation, transpiration, and sublimation from snow and ice. The remainder, up to 20 inches per year, becomes either runoff or infiltration to the ground water (Backer & Costa, 1981). Because of the water surplus, water is available to recharge ground water and maintain a base flow for surficial streams. Regionally, ground water in both unconsolidated deposits and bedrock flows toward the Chicopee River. The Chicopee River serves as a regional discharge point.

Site Hydrogeology

Hydrogeologic Units

The hydrogeologic units at the Indian Orchard Plant comprise the geologic units described above. Three hydrogeologic units are present. The bedrock and "glaciofluvial sand and gravel" layer comprise the deepest water-bearing hydrogeologic unit. The glacial till is a confining hydrogeologic

unit between the bedrock and the overlying hydrogeologic unit, comprising the lacustrine deposits, the deltaic and outwash deposits, and the alluvial deposits. This latter unit is the primary water-bearing unit beneath the plant site.

Ground-Water Flow Velocity and Direction

Ground-water flow across the site is to the northwest and discharges to the Chicopee River, Figure 5. The major volume of flow is through the greatest thickness of saturated deltaic and outwash deposits, which are present in the northwest trending trough in the till in the lowlands section of the plant site, Figure 5. In general, ground-water flow is from the topographically high area (the uplands) to the topographically low area (the lowlands) and ultimately discharges to the Chicopee River.

Ground-water flow from bedrock is upward through till and into the overlying deposits. The flow of ground water in bedrock is most likely part of the regional flow system in the Connecticut Lowlands, and the upward gradients indicate the discharge of regional flow to the Chicopee River.

Flow in the deltaic and outwash deposits is hydraulically isolated and separate from the deeper regional flow observed in the till and bedrock. The flow data, coupled with the hydraulic conductivity data for till, show that the till is an effective boundary to the downward migration of the potential contaminants because of its lower hydraulic conductivity, and, more importantly, because it is also a hydraulic boundary between ground water flowing upward from bedrock and ground-water flow in the unconsolidated deposits above the till.

The computed ground-water flow velocities in the deltaic and outwash deposits ranged from 150 feet/year to 3,200 feet/year (Figure 5). Ground-water flow velocity is seasonal, while ground-water flow direction appears to remain fairly constant. The highest ground-water velocities are seen in the spring when recharge and gradients are at a maximum. Conversely, ground-water velocity decreases in the summer and fall when recharge is at a minimum.

Hydraulic Connection With Surface Water

The hydraulic head relationships between the ground water and the Chicopee River indicate that the Chicopee River is the discharge point for both regional and local ground-water flow.

The hydraulic head relationships between ground water and Bircham Bend Brook appear to indicate that, for the section of the brook from Worcester Street to the head of the swampy area, the brook is a source of ground-water recharge, Appendix C, CSA (BB&L, March 1987, *Appendix B, Figure B-6*).

A detailed description of the ground-water migration pathway is provided in Section 4, Site Characterization and Identification of Data Needs. Additional information on site hydrogeology is presented in Appendix C, CSA (BB&L, March 1987, *Appendix B*) and in the report Phase II Remedial Investigation Plan Interim Data Report (BB&L, December 1985).

3.0 Previous Remedial Investigations

This section provides a summary of the previous remedial investigations conducted at the Monsanto Indian Orchard Plant in chronological order. This section sets forth an overview of the investigations completed to date that provide the site characterization information discussed in Section 4, Site Characterization and Identification of Data Needs.

A list of the previous investigation reports is provided in Table 3, Chronology of Previous Investigations. Pertinent data from each of these reports have been extracted and compiled into Appendix D. Appendix D contains a compilation of subsurface boring and monitoring well logs, water level data, hydraulic conductivity data, geotechnical data, and analytical data. Three select relevant reports are provided in the appendices in chronological order, as follows:

- Appendix A, History of On-Site Waste Disposal Operations at Monsanto Company - Springfield and Bircham Bend Plant (Monsanto Plastics & Resins Company, December 1982);
- Appendix B, Phase I Report - Remedial Investigation Plan (BB&L, August 1984); and
- Appendix C, CSA (BB&L, March 1987).

Many of the reports completed after the Phase I Report (BB&L, August 1984) were incorporated into the CSA (BB&L, March 1987). A summary of each remedial investigation report and plan is presented below in the following chronological categories:

- Pre-Consent Order Agreement Investigations;
- Remedial Investigations;
- Comprehensive Site Assessment; and
- Post-Comprehensive Site Assessment Investigations.

3.1 Pre-Consent Order Agreement Investigations

Prior to the April 1984 COAs with the USEPA and the DEQE, Monsanto evaluated historic waste disposal areas at the plant and performed surface-water and ground-water sampling and analysis.

In April 1979, Monsanto participated in the National Waste Disposal Site Survey, also known as the Eckhardt Committee Survey. The survey, completed by Monsanto, initiated an evaluation of the compounds in use or formerly used at the plant and the methods by which plant wastes were disposed. Five types of disposal methods were reported:

- Landfilling of mixed industrial waste;

- Landfilling of drummed waste;
- Disposal in pits/ponds;
- Incineration; and
- Open burning in cages or pits.

Reportedly, of the 1,085 tons of wastes generated between the dates 1938 and 1968, nearly half of this volume was destroyed through open burning. The Eckhardt Committee Survey is provided as an attachment to the report, History of On-Site Waste Disposal Operations and the Monsanto Company Springfield and Bircham Bend Plants (Monsanto Plastic & Resins Company, December 1982), which is presented in Appendix A.

In the spring of 1981, six surface-water samples were obtained from areas south and southwest of the Indian Orchard Plant. Five of these samples were taken from Bircham Bend Brook (referred to as "Gagnon's Brook" in previous investigations), and one sample was obtained from a ditch that discharges to the brook. The samples were analyzed for volatile and semivolatile organic compounds (VOCs and SVOCs) and metals.

Two SVOCs were detected in the surface-water samples. Phenol was detected in the two upstream surface-water locations at a maximum concentration of 87 micrograms per liter (ug/L), and di-n-butylphthalate was detected at all three downstream locations and at one of the two upstream locations below the method quantitation limit of 10 ug/L. Three VOCs were detected in the surface-water samples. Benzene and tetrachloroethene were detected at one of the two upstream locations below the method quantitation limit of 10 ug/L. Toluene was detected in all six surface-water locations below the method quantitation limit of 10 ug/L. The ditch sample contained relatively low metal concentrations. The results are provided in the report, Analysis of Springfield Water Samples for Priority and Select Non-Priority Pollutants (Monsanto Research Corporation, June 1981). These results are provided herein in Appendix C, CSA (BB&L, March 1987, *Appendix C, Table C-2A; sample locations on Figure C-1*). A summary of surface-water analytical data is provided in Tables 4A and 4B, and a compilation of surface-water results are provided in Appendix D.

The report, History of On-Site Waste Disposal Operations at Monsanto Company - Springfield and Bircham Bend Plants, 1938-1972, was prepared in December 1982 by Monsanto. The purpose of this report was to:

- Identify all on-site waste disposal areas;
- Identify disposal practices; and
- Identify the nature and volume of wastes.

A total of ten waste areas were identified in the report. These ten areas included: SWDA No. 1, SWDA No. 2, LWDA 1, Burning Pits A through D, Fiberloid Landfill, and two incinerators. Disposal at these areas was carried out in compliance with applicable state and federal regulations by the practices described above. The types of wastes included products, by-products, and raw materials used for the manufacturing of:

- Various forms of polyvinyls;
- Nitrocellulose;
- Cellulose acetate;
- Phenol/formaldehyde resins;
- Polystyrene;
- Formaldehyde; and
- Melamine and urea resins.

This report is provided in Appendix A.

In September 1982, the plan, Ground-Water Investigation Program, was prepared for Monsanto by O'Brien & Gere Engineers (OBG). The plan was prepared to identify soil types and characteristics beneath and adjacent to waste areas located at the plant, to evaluate the ground-water flow rate and direction, and to assess the type and concentration of chemical constituents that may be present in the ground water.

In February 1983, the document, Field Investigation Report, was prepared for Monsanto by OBG. The report summarized the investigations conducted from July 1982 through September 1982. The field investigations included the installation of 12 test borings with soil screening using either a photoionization detector (PID) or flame ionization detector (FID), and the installation of 11 monitoring wells, MW-1 through MW-11 (Table 5 and Appendix D). Four wells were gamma-ray logged, in-situ permeability tests were conducted at eight wells, and grain-size analyses were performed on 24 soil samples (Appendix D). In addition, ground-water elevations were measured, and ground-water samples were obtained and analyzed. The results set forth in this report are also included in the report discussed below.

In March 1983, the report, Assessment of Hydrogeology and Impact on Water Quality from Past Disposal Practices at the Monsanto Indian Orchard Plant Site, was prepared by Monsanto. This report summarized the investigations conducted from May 1981 through January 1983 and included the OBG Field Investigation Report, prepared in February 1983. Additional investigations were conducted, including the installation of an additional monitoring well MW-12 (Table 5 and Appendix D), the measurement of ground-water elevations between August 1983 and January 1984 (Appendix D), and the preparation of seasonal ground-water flow maps. The report also contained the analytical results of ground-water sampling conducted between August 1982 and January 1983. A summary of ground-water analytical results is provided in Table 6, and a compilation of results is provided in Appendix D.

The following are the findings of this report:

- The site is located over a thick confining unit of glacial till.

- The water table aquifer material consists of fine to medium sands.

- Ground-water elevation measurements indicate that the hydraulic gradient pattern over the site is constant with time and is bounded to the north by the Chicopee River.

- No obvious contamination to the Chicopee River and Bircham Bend Brook has resulted from past disposal practices.

On January 20, 1983, two ground-water samples were obtained from monitoring wells MW-5 and MW-11 and analyzed for total organic carbon (TOC) and for organic compounds using gas chromatography and mass spectrometry (GC/MS). The analytical results were included in the July 27, 1983 report, Analysis of Indian Orchard Water Sampled, prepared by Monsanto. TOC was detected at a concentration of 10.5 milligrams per liter (mg/L) at monitoring wells MW-5 and at a concentration of 23.7 mg/L at monitoring well MW-11. The VOCs, ethylbenzene and xylene, were detected at monitoring well MW-5, and one VOC, toluene, was detected at monitoring well MW-11. No SVOCs were detected. A summary of ground-water analytical results is provided in Table 6, and a compilation of analytical data is provided in Appendix D.

In the fall of 1983, ground-water samples were obtained from monitoring wells MW-1 through MW-12, and surface water was sampled both upstream and downstream of the plant in both Bircham Bend Brook and the Chicopee River. Water samples from monitoring well MW-5 and Bircham Bend Brook were analyzed for VOCs. Water samples from monitoring wells MW-1 through MW-12 and from the Chicopee River and Bircham Bend Brook were analyzed for RCRA metals, TOC, total organic halogens (TOX), phenol, and chlorides. The results were presented in the September 29, 1983 report, Analytical Results for Water Samples from Indian Orchard Plant, prepared by Monsanto. The surface-water results for the parameters analyzed were either below quantitation/detection limits or were consistent between upstream and downstream locations. In the ground water, low levels (less than 0.02 mg/L) of lead and arsenic were detected. These results and the quality assurance procedures are provided in the report, Analytical Results for Water Samples from Indian Orchard Plant (Monsanto Research Corporation, September 1983), and are summarized in Appendix C, CSA (BB&L, March 1987, *Appendix C*). A summary of ground-water analytical results is provided in Tables 6 and 7, and a summary of surface-water analytical results is provided in Table 4. A compilation of analytical data is provided in Appendix D.

In November and December 1983, monitoring wells MW-13, MW-14, MW-15, MW-16, MW-17, and MW-18 (Table 5 and Appendix D) were installed in response to an October 1983 formaldehyde spill near Building 91. Borings were immediately installed to evaluate the extent of the formaldehyde, and two scavenger wells were installed to recover the formaldehyde. After the monitoring wells were installed, additional borings and temporary observation wells were installed. A peroxide injection treatment system was implemented in June 1984, and a ground-water recovery well was installed to prevent off-site migration. This remediation program was terminated in August 1988 when the remedial goals for soil and ground water were achieved. The monitoring wells installed for this program were incorporated into the site-wide ground-water monitoring program at the Indian Orchard Plant.

3.2 Remedial Investigations

From 1984 through 1986, Monsanto implemented a phased-RI pursuant to the requirements of the April 1984 COAs with the USEPA and the DEQE.

The work plan, Remedial Investigation Plan (RIP), dated February 1984, was prepared by Blasland & Bouck Engineers, P.C./Blasland, Bouck & Lee (BB&L) for Monsanto. The objectives for the plan included:

- Definition of the horizontal and vertical limits of the waste sites;
- Evaluation of ground-water flow data;
- Definition of site-specific compounds; and
- Identification of other potential sources of contamination.

This work plan provided the standard operating procedures for the Phase I and Phase II field efforts.

The Phase I investigations were conducted from April 1984 through August 1984. The investigations included:

- A historic topographic review;
- A historic and stereoscopic aerial photograph analysis;
- A magnetometer survey at SWDA No. 1, SWDA No. 2, LWDA No. 1, and Burning Pit C;
- A seismic refraction survey at SWDA No. 1, SWDA No. 2, LWDA No. 1, and Burning Pit A; and
- A ground-water quality assessment.

During the Phase I work efforts, a total of nine waste disposal areas were identified at the Indian Orchard Plant. These areas included: SWDA No. 1, SWDA No. 2, LWDA No. 1, LWDA No. 2, Fiberloid Landfill, and Burning Pits A through D. Each waste disposal area was evaluated with respect to horizontal and vertical limits and potential composition. This detailed characterization information is presented in Section 4.1, SWMU/Disposal Areas Characterization. In addition, a summary of the site geology was obtained, as follows:

- The deltaic deposit is composed of fine to medium sands, the principal water-bearing unit at the site.
- The glacial till serves as a confining unit between the bedrock and the deltaic deposits.

Ground water was sampled on May 8, 1984, at monitoring wells MW-1 through MW-12 and analyzed for pH, conductivity, temperature, total dissolved solids (TDS) and TOC. Ground water was sampled on June 4, 1984, at monitoring wells MW-4, MW-5, and MW-11 and analyzed for priority pollutants. Ethylbenzene, toluene, and nickel were the only priority pollutants detected. Table 6 provides a summary of ground-water analytical results, and a compilation of analytical data is provided in Appendix D.

The Phase I work efforts provided information to locate test borings to further evaluate the site conditions in Phase II. The investigation results were presented in the Phase I Remedial Investigation Plan Report, dated August 1984, prepared by BB&L for Monsanto. This report is provided as Appendix B.

The report, Site-Specific Compound Evaluation, dated October 1984, prepared by BB&L for Monsanto, contained a summary of waste disposal practices at the plant, a summary table listing the major compounds used at the plant, the physical and environmental properties of those compounds, and a recommended list of indicator parameters to be used in future investigations. Based on the evaluation, two major groups of compounds were identified as potential indicator parameters:

Aromatic Solvents and Monomers		Other Indicator Parameters
benzene	ethylbenzene	acrylonitrile
toluene	phenol	allyl alcohol
xylene	hydroquinone	vinyl chloride
styrene		

During the period from August 1984 through November 1984, 33 test borings were drilled, gamma ray logged, and field screened with FIDs and PIDs. Soil samples from those zones showing the highest FID peaks were transmitted to the laboratory for TOC analysis. The geologic findings of this investigation are summarized as follows:

- The deltaic and outwash sand deposits and lacustrine deposits ranged from 13 to 122.7 feet in thickness and were underlain by the lower till; and
- A northwest-southeast trending "swale" is present in the till.

The results of the investigation were presented in the report, Phase II Report Remedial Investigation Plan, Volumes 1 and 2, dated December 1984, prepared by BB&L for Monsanto, and in the report, Addendum Phase II Report Remedial Investigation Plan, dated February 1985, prepared by BB&L. Pertinent data from these reports, including boring logs, monitoring well logs, hydraulic conductivity test results, and grain-size analyses, are provided in Appendix D.

From November 28 to December 4, 1984, a ground-penetrating radar (GPR) survey was completed at SWDA No. 1, SWDA No. 2, LWDA No. 1, and Burning Pit C under the supervision of BB&L. The report, Earth Penetrating Radar Study - Indian Orchard Plant, dated December 13, 1984, was prepared by S. A. Alsup & Associates under subcontract to BB&L and on behalf of Monsanto. The report details the survey methodology and the interpretation of the results. The GPR survey indicated an absence of extensive

deposits of buried drums. Rather, the results indicated the presence of shallow magnetic sources or single strong magnetic sources. One relatively large magnetic anomaly was observed near SWDA No. 1. The results of this study are used in Section 5.2 to justify the placement of soil borings for waste characterization.

Additional Phase II field activities were conducted from December 1984 to September 1985. These field activities include the following:

- Thirty-eight monitoring wells were installed (MW-19 through MW-57 [Figure 2, Table 5, and Appendix D]). Borings for eight of these wells plus one additional soil boring were continuously screened with a PID and FID. Gamma ray logging was performed at each well.

- Grain-size analyses were performed on soil samples from the screened interval of each well.

- All existing wells at the site were developed, and formation hydraulic conductivity values were measured by means of in-situ hydraulic conductivity tests.

- A ground-water flow assessment was performed, based upon both horizontal and vertical gradients measured in the monitoring wells.

- In June 1985, ground-water samples from 15 monitoring wells were analyzed for priority pollutants, and ground-water samples from 23 monitoring wells were analyzed for VOCs.

- In July 1985, priority pollutant plus 40 analyses, including VOCs, base neutrals, acid extractables, PCBs, and metals, were performed on ground-water samples from 14 monitoring wells. In addition, VOC analyses were performed on ground-water samples obtained from 23 monitoring wells.

- From August 28 to September 6, 1985, ground-water samples from 53 monitoring wells were analyzed for temperature, conductivity, pH, TDS, TOC, TOX, acrylonitrile, allyl alcohol, and styrene. Additional samples were obtained and analyzed for VOCs from 33 monitoring wells that were not tested in June or July for these constituents.

The geologic and hydrogeologic findings of these investigations are as follows:

- Geologic units encountered included deltaic and outwash deposits of fine to coarse sands with gravel, underlain by till.

- The "swale" in the till was further evaluated and appeared to be a trough trending from the center of the site northwest toward the Chicopee River.

- Hydraulic conductivity values for medium sands and sands and gravels ranged from 4×10^{-3} cm/sec to 1×10^{-2} cm/sec; for fine sands and silts ranged from 5×10^{-3} cm/sec to 9×10^{-4} cm/sec; and for till 5×10^{-6} cm/sec.

- Strong vertical gradients were observed in the deltaic and outwash deposits.

- Ground-water flow is generally from the southeast to the northwest.
- Ground-water flow from the glacial till is vertically upward into the deltaic and outwash deposits.
- Ground-water discharges to the Chicopee River along the western half of the site via the sands in the trough in the till.
- Due to culverts and dams along Bircham Bend Brook, surface-water recharges the ground-water system.

The following indicator parameters from the Site-Specific Compound Evaluation in October 1984 were detected in the ground-water sample analyses conducted in 1985:

Indicator Parameters

benzene	ethylbenzene
xylene	phenol
toluene	

Other Compounds

bis(2-chloroethyl)ether	1,2-dichloroethene
bis(2-ethylhexyl)phthalate	1,2-dichloropropane
chlorobenzene	methylene chloride
chloroform	1,1,1-trichloroethane
cyanide	tetrachlorobenzene
1,2-dichloroethane	tetrachloroethene

Only chlorobenzene was detected above one mg/L. Phenols were detected at concentrations less than 0.01 ug/L. No pesticides, PCBs, allyl alcohol, or acrylonitrile were detected. Relatively low concentrations of metals were detected in the ground water, including arsenic, chromium, copper, mercury, nickel, and zinc, below federal drinking water standards. Appendix C, CSA (BB&L, March 1987 *Appendix C, Tables C-5C, C-5D, and C-5E*) provides the ground-water analytical results. A summary of the ground-water analytical results is provided in Tables 6 and 7, and a compilation of analytical results is provided in Appendix D.

The investigation results were presented in the report, Phase II Interim Data Report Remedial Investigation Plan, Volume 1 and Volume 2, dated December 1985, prepared by BB&L for Monsanto. The pertinent data from Volume 1 and Volume 2 of this report are presented in Appendix D, including:

- Subsurface Soil Boring Logs
- Monitoring Well Logs
- In-Situ Hydraulic Conductivity Test Results
- Grain-Size Analyses
- Summaries of Analytical Results

In July, 1986, a magnetometer survey and test pit excavations were conducted at SWDA No. 1, SWDA No. 2, and LWDA No. 1. Magnetometer surveys on 10-foot grid spacings were conducted at two locations at SWDA No. 1, two locations at SWDA No. 2, and two locations at LWDA No. 1. All locations were selected based on the magnetic anomalies, GPR targets, and aerial photograph analyses conducted during earlier investigations. Test pits were excavated at two locations at SWDA No. 1, two locations at SWDA No. 2, and one location at LWDA No. 1. At all five test pit locations, approximately 20 to 30 55-gallon crushed drums containing dry trash and scrap plastic were found. No intact full drums were found. Four of the drums were found to contain less than one gallon of liquids. Flash point and Extraction Procedure (EP) Toxicity tests were performed on the contents of these four drums. One sample did not pass the ignitability test, and one exceeded the limit for lead by one part per million (ppm). These results are used in Section 5.2 to justify the placement of soil borings for waste characterization.

In August 1986, surface-water samples and sediment samples were collected from six locations in Bircham Bend Brook. The samples were individually analyzed for the indicator parameters TOC, TOX, arsenic, and lead. Composites of sediment and water samples taken downstream of the Indian Orchard Plant were analyzed for priority pollutants. Arsenic, lead, VOCs, SVOCs, PCBs, pesticides, and metals were not detected above the method quantitation/detection limits in the surface-water samples. A summary of surface-water analytical results is provided in Table 4. VOCs, SVOCs, PCBs, and pesticides were not detected above the quantitation/detection limits in the sediments. Lead concentrations were detected at 20 ppm or less and arsenic at 0.06 ppm or less. A compilation of analytical results are provided in Appendix D, and the results are also presented in Appendix C, CSA (BB&L, March 1987, *Appendix C*).

3.3 Comprehensive Site Assessment

In March 1987, the CSA Report was prepared for Monsanto by BB&L. This report was submitted as a final report for the remedial investigations to satisfy the requirements in the USEPA and MA-DEP COAs. The purpose of the CSA report was to summarize and discuss all field investigations and data collected to date, to characterize the site, and to present an evaluation of existing and future impacts associated with ten disposal areas. The ten disposal areas included: SWDA No. 1; SWDA No. 2; LWDA No. 1; LWDA No. 2; Fiberloid Landfill; Burning Pits A, B, C, and D; and Building 99 Leach Fields.

The CSA concluded the following:

- The waste disposal areas subject to the CSA are having a minimal impact on the environment.
- Five of the ten waste disposal areas evaluated have a potential environmental impact, including SWDA No. 1, LWDA Nos. 1 and 2, Building 99 Leach Fields, and Burning Pit D.
- The only potentially significant environmental form of a release from these waste disposal areas is via the ground water.
- The movement of contaminants in the ground water from these five waste disposal areas is limited.
- Ground-water flow at the plant site is toward and discharge is to the Chicopee River.

- Movement of the soluble, more mobile compounds in the subsurface environment follows the flow of ground water to the Chicopee River.

- Organic compounds have been detected in the ground water adjacent to and immediately downgradient of the five waste disposal areas that have potential for environmental impacts. The concentrations of these compounds, for the most part, are less than one mg/L.

- Metals have not been detected in the ground water above federal drinking water standards.

- Surface-water and sediment sampling and analyses of Bircham Bend Brook did not detect contaminants in either the surface water or sediment from areas of the brook adjacent to the plant site.

- No PCBs, pesticides, or herbicides have been found in any of the ground-water, surface-water, stream sediment, or soil samples collected.

- A preliminary assessment of the impact of the affected ground water on human health and the environment concluded that the releases from these past waste disposal areas have minimal impact on human health and the environment. The primary receptors of any releases from these past waste disposal areas are the indigenous aquatic organisms in the Chicopee River, and the potential for primary and secondary human contact is minimal. The effect of these releases to the primary receptors, aquatic organisms, is minimal because the exposure concentration to these receptors is well below those established for aquatic life. The effect of these releases to the ground water on human health is minimal because both ground waters and surface waters in the area of the Indian Orchard Plant are not used for human consumption.

The CSA is provided as Appendix C.

3.4 Post-Comprehensive Site Assessment Investigations

Since the submittal of the CSA, several area-specific investigations and annual site-wide ground-water monitoring investigations have been conducted at the Monsanto Indian Orchard Plant.

In June 1986, a ground-water study was conducted and presented in a letter report dated January 13, 1987, for Monsanto by BB&L for the hazardous waste storage areas in the southeast portion of the plant. Three soil borings were installed, continuously sampled, and field screened for volatile organics using both a PID and FID. The soil borings were completed as monitoring wells MW-58, MW-59, and MW-60 (Table 5 and Appendix D), and ground water was sampled and analyzed from the wells for priority pollutants. The geologic units encountered included sands, gravels, and silts with till lenses. Dense glacial till was encountered at approximately 30 to 40 feet in depth. Vinyl chloride and chloroform were the only VOCs detected at approximately 20 ug/L or less. Several SVOCs were detected at low concentrations (approximately 5 ug/L or less), including: acenaphthene, fluorene, phenanthrene, di-n-butylphthalate, butylbenzylphthalate, bis(2-ethylhexyl)phthalate, and di-n-octylphthalate. A summary of ground-water

analytical results is provided in Tables 6 and 7, and a compilation of analytical results is provided in Appendix D. The monitoring wells were then incorporated into the site-wide ground-water monitoring program.

In November 1988, a drum spill cleanup was performed by BB&L for Monsanto. A container of PCB oil was encountered during construction excavation within the horizontal limits of the Fiberloid Landfill and east of former Building 44. The cleanup was performed in accordance with Toxic Substances Control Act (TSCA) guidance. A record of the spill cleanup was completed on November 4, 1988, for Monsanto by BB&L.

In October 1989, the Former Building 44 and Tank Farm E Hydrogeologic Investigation was performed for Monsanto by BB&L. This investigation consisted of the installation of four soil borings that were continuously sampled and field screened using a FID. The soil borings were completed as monitoring wells MW-64, MW-65, MW-66, and MW-67 (Table 5 and Appendix D). These monitoring wells were sampled and analyzed for VOCs and SVOCs, plus styrene. The geologic units encountered included sands, gravels, and silts with till lenses; the dense glacial till was not encountered. The VOCs detected included chlorobenzene, 1,2-dichloroethane, ethylbenzene, toluene, and xylenes. The SVOCs detected included phenol and 2,4-dimethylphenol. The ground-water analytical results are provided in Table 7 and Appendix D. These four wells were incorporated into the site-wide ground-water monitoring program.

In September, 1988, 13 soil borings (Appendix D) were installed east of and in the vicinity of Burning Pit D for the wastewater treatment facility construction.

In July 1992, a water sample from a pipe in a manhole north of SWDA No. 2 was collected and analyzed for VOCs. The sample did not contain any VOCs above the quantitation limits. The water sample analytical results were presented to Monsanto by BB&L in a letter dated August 20, 1992, and are included in Appendix D.

On November 30, 1992, a geotechnical investigation report for the vicinity of West Resins Area was prepared by Empire Soils Investigations for Monsanto. The investigation included the installation of four continuously sampled soil borings. Odors were noted in the soil samples. As a result of the odors detected, the West Resins Area was identified to the MA-DEP and incorporated into the waiver. The soil boring logs and a location map are presented in Appendix D.

On December 2, 1992, two monitoring wells, MW-68 and MW-69, were installed to replace two monitoring wells, MW-8 and MW-39, previously abandoned for the construction of a road. These well logs were presented to Monsanto by BB&L in a letter dated January 5, 1993, and are presented in Table 5 and Appendix D.

Annual site-wide ground-water monitoring has been conducted at the Monsanto Indian Orchard Plant from 1985 to 1992. All sampling events included collection of ground-water samples for VOC analysis from all existing monitoring wells, except in June and July 1985, August/September 1985, August 1987, and May 1992. In June and July 1985, ground water from up to 15 monitoring wells was analyzed for priority pollutant compounds. In August 1987, ground water from five monitoring wells was analyzed for Appendix

VIII and IX list compounds. In May 1992, ground water from six monitoring wells was analyzed for Target Compound List (TCL)/Target Analyte List (TAL) compounds. In September 1985, ground water from all existing wells was analyzed for allyl alcohol and acrylonitrile. Table 7 provides the VOCs detected. Table 8 provides the tentatively identified compounds (TICs) reported by the laboratory. A summary of ground-water analytical results is provided in Table 6 and Appendix D.

During each of these sampling events, the integrity of the monitoring wells was examined. As of October 1991, 10 of the 65 existing monitoring wells had been abandoned. These 10 wells are identified on Figure 2. A summary of the well construction details is presented in Table 5.

On December 30, 1993, the SWMU/RCRA Closure of Two Underground Accumulation Tanks Final Report was prepared for Monsanto by Envirocomp. The tanks closed were formerly used in connection with the Building 99 Leach Fields. Storm water accumulated in each of the tanks was tested for Toxicity Characteristics Leaching Procedures (TCLP) constituents, and the results indicated that all constituents were reported below quantitation limits. Approximately 1 to 3 pounds of a pigment that had accumulated in the tanks were also analyzed for TCLP constituents, which were also below quantitation limits.

4.0 Site Characterization and Identification of Data Needs

This section presents a characterization of the 14 SWMU/disposal areas, the known and potential migration pathways associated with these SWMU/disposal areas, as well an identification of data needs for the potential exposure pathways and receptors. Based on the extensive previous investigations conducted at the Monsanto Indian Orchard Plant, detailed physical and chemical characterization information is available for each SWMU/disposal area, as well as for the ground-water and surface-water migration pathways. The air migration pathway has not been evaluated in previous investigations, and utility conduit migration pathways have not been evaluated because ground water is below the utilities at the Indian Orchard Plant. Migration pathways can result in potential exposure pathways; actual exposure pathways result from the presence of a receptor at a known migration pathway. Since the Monsanto Indian Orchard Plant is fenced and there are no ground-water or surface-water users or potential users within 1.2 miles of the site, potential exposure pathways and receptors are limited. This section discusses the potential exposure pathways and receptors that may be present at or adjacent to the site for each SWMU/disposal area.

This Supplemental RFI/MCP Phase II Comprehensive Site Assessment Work Plan contains all the necessary elements for an RFI and an MCP Phase II Comprehensive Site Assessment Work Plan. The requirements for an RFI per the Interim Final RFI Guidance - Development of a Work Plan and General Considerations for an RFI (USEPA, May 1989), are provided in Table 9. The requirements for an MCP Phase II Comprehensive Site Assessment per the 310 CMR 40.545 are provided in Table 10. Tables 9 and 10 have been prepared to show that this work plan has been structured to incorporate the requirements of both an RFI and an MCP Phase II Work Plan. On Tables 9 and 10, each RFI and MCP requirement is assigned a status -- completed, and included in the Work Plan, or additional data needed. If the requirement is met, the table identifies the report, where the requirement has been met, and the location within the work plan where the requirement is provided. If the requirement has not been met, the table identifies the location within this work plan of the proposed work effort that will meet the requirement.

At the end of each characterization section, the information known about the SWMU/disposal area, the ground-water migration pathway, the surface-water migration pathway, the air migration pathway, and the potential exposure pathways and receptors are compared to the RFI requirements (USEPA, May 1989) and the MCP Phase II Comprehensive Site Assessment requirements provided in the 1989 MCP. The data needs to fulfill the regulatory requirements are then identified. Section 5, Supplemental RFI and MCP Phase II Scope of Work, incorporates these data needs into the work efforts presented within the scope of work.

4.1 SWMU/Disposal Area Characterization

The SWMU/disposal areas are located on Figure 2. The horizontal limits of 9 of the 14 SWMU/disposal areas were evaluated during Phase I and Phase II activities. These nine SWMU/disposal areas include: SWDAs No. 1 and No. 2, LWDAs No.1 and No. 2, Fiberloid Landfill, and Burning Pits A through D. The methods used to evaluate the horizontal limits of the SWMU/disposal areas included:

- Topographic survey review;

- Historic topography review;
- Aerial photograph analysis;
- Site reconnaissance;
- Magnetometer survey;
- Seismic refraction survey; and
- Soil boring data.

The Phase I Remedial Investigation Plan Report (BB&L), dated August 1984, documents the procedures used to evaluate the horizontal limits of 9 of the 14 SWMU disposal areas and is provided in Appendix B.

The horizontal limits of the remaining five SWMU/disposal areas, including Building 99 Leach Fields, 336 Drum Storage Area, West Resin Area, Accumulation Area/East Storage Tank Area, and Former Building 44 and Tank Farm E, were based on recently surveyed plant building location maps. The limits of Former Building 44 and Tank Farm E were based on 1989 plant building survey maps, because Building 44 was removed in 1989. The Building 99 Leach Fields were identified during the Phase II investigation and further evaluated during the decommissioning of tanks associated with the leach fields. The limits of the other three areas were based on existing building location maps, as these SWMU/disposal areas are still in operation.

4.1.1 SWMU/Disposal Area History, Physical, and Chemical Characteristics

For each SWMU/disposal area, this section provides a summary of the operation history and the physical characteristics. A summary of the SWMU/disposal areas' operation histories and physical characteristics is provided in Table 11.

SWMU 35/Solid Waste Disposal Area No. 1 (SWDA No. 1)

Operation History

- Operation Period: 1952 to 1970s.
- Received trash, construction debris, scrap plastic and resins, solution resins and syrups, colorants and stabilizers, and transformers. Some material was contained in drums. Operated as a landfill with daily soil cover.

Physical Characteristics

- Location: Southwest corner of property. Bordered to the west by railroad, to the north by LWDA No. 1, to the east by Monsanto access road 2, and to the south by Worcester Street.
- Coordinates: N3350 - N3800, E4900 - E5700.

- Size: 5.8 acres
  - Eight soil borings drilled and continuously sampled to confirm the horizontal extent of SWDA No. 1 (SB-1, SB-2, SB-3, SB-4, SB-5, SB-6, SB-12, and SB-13).
- Average Surface Elevation: 203 feet above mean sea level (AMSL).
- Volume: 220,000 cubic yards (cy).
- Maximum Depth of Fill: 45 feet, based upon 1969 - 1984 topography comparison.
- Approximate Depth to Ground Water: 40 feet.

Chemical Characteristics

Of the eight soil borings continuously sampled and field screened using the FID and PID around the perimeter of SWDA No. 1 (SB-1, SB-3, SB-4, SB-5, SB-6, SB-12 and SB-13), only three soil borings (SB-4, SB-12, and SB-13) had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-13 (22 to 24 feet, approximately 2 feet into water table) downgradient and at the perimeter of the SWDA No. 1. This sample was analyzed for priority pollutant parameters (VOCs, SVOCs, pesticides, PCBs, metals, cyanide and phenols). All parameters were below the detection limits except for low concentrations of the following metals: chromium, copper, lead, nickel, and zinc detected at concentrations ranging from 1.9 to 9.1 mg/kg.

SWMU 36/Solid Waste Disposal Area No. 2 (SWDA No. 2)

Operation History

- Operation Period: 1966 to 1970s.
- Materials similar to SWDA No. 1.

Physical Characteristics

- Location: South-central portion of property. Bordered to the west by Monsanto access road 1, to the north by Building 97, to the east by Burning Pits A and railroad, and to the south by Worcester Street.
- Coordinates: N3300 - N3500, E3400 - E4400.
- Size: 3 acres
  - Five soil borings drilled and continuously sampled to confirm the horizontal extent of SWDA No. 2 (SB-17, SB-18, SB-21, SB-22, and SB-32).
- Average Surface Elevation: 145 feet to 160 feet AMSL.
- Volume: 46,000 cy.
- Maximum Depth of Fill: 10 to 14 feet, based upon 1969 - 1984 topography comparison.
- Approximate Depth to Ground Water: 10 feet
  - Approximately 5,000 cy, 10 percent of total volume, is below water table.
  - Approximately 46,000 cy, 100 percent of total volume, within 10 feet of water table or below.

Chemical Characteristics

Of the five soil borings continuously sampled and field screened using the FID and PID around the perimeter of SWDA No. 2 (SB-17, SB-18, SB-21, SB-22, and SB-32), three soil borings (SB-17, SB-18, and SB-22) had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-22 (12 to 14 feet, approximately 3 feet into water table) downgradient and at the perimeter of the SWDA No. 2. This sample was analyzed for priority pollutant parameters (VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and phenols). All parameters were below the detection limits except for low concentrations of the following metals: arsenic, chromium, copper, lead, mercury, nickel, and zinc detected at concentrations ranging from 0.3 to 62 mg/kg.

SWMU 34/Liquid Waste Disposal Area No. 1 (LWDA No. 1)

Operation History

- Operation Period: 1954 to 1972.
- Received waste solvents, oils, sludges, and latex. Material was discharged from tankers and poured from barrels, then allowed to seep into the ground. Since 1982, this site has received construction debris, soil, concrete, asphalt, blocks, etc., and approximately two-thirds of the original geologic kettle has been filled in.

Physical Characteristics

- Location: Central, bordered to the east by railroad, to the north by coal steam plant, to the west by Monsanto access road 2, and to the south by SWDA No. 1.
- Coordinates: N3880 - N4100, E4700 - E5150.
- Size: 2.7 acres
  - Seven soil borings drilled and continuously sampled to confirm the horizontal extent of LWDA No. 1 (SB-3, SB-4, SB-7, SB-8, SB-9, SB-10, and SB-11).
- Average Surface Elevations: 182 feet AMSL, top of fill, 165 feet AMSL bottom of pit.
- Volume: 58,000 cy, based upon 1935 - 1984 topography comparison.
- Maximum Depth of Fill: 35 feet.
- Depth to Ground Water: 20 to 35 feet

Chemical Characteristics

Of the seven soil borings continuously sampled and field screened using the FID and PID around the perimeter of LWDA No. 1 (SB-3, SB-4, SB-7, SB-8, SB-9, SB-10 and SB-11), only two soil borings (SB-4 and SB-8) had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-10 (72 to 74 feet, approximately 40 feet into water table) downgradient and at the perimeter of the LWDA No. 1. This sample was analyzed for priority pollutant parameters (VOCs, SVOCs, pesticides, PCBs, metals, cyanide and phenols). All parameters were below the detection limits except for chlorobenzene at 150 ug/kg and low concentrations of the following metals: arsenic, chromium, copper, lead, and zinc detected at concentrations ranging from 1.7 to 12.8 mg/kg.

SWMU 37/Liquid Waste Disposal Area No. 2 (LWDA NO. 2)

Operation History

- Operational in 1960s.
- History is generally unknown. This site was observed in a 1960s aerial photograph, which showed two tankers discharging liquids into a shallow depression. The north edge of this area was exposed, revealing layers of hardened plastic.

Physical Characteristics

- Location: Approximately 125 feet west of SWDA No. 1.
- Coordinates: N3500 - E4700.
- Size: Unknown. Estimated at 0.2 acres
  - Two soil borings drilled and continuously sampled to confirm location and extent of LWDA No. 2 (SB-14 and SB-15).
- Average Surface Elevation: 190 feet AMSL.
- Volume: Estimated at 7,400 cy.
- Maximum Depth of Fill: Estimated at 15 to 20 feet.
- Depth to Ground Water: 35 feet. Entire fill is at least 10 feet above ground water.

Chemical Characteristics

Of the two soil borings continuously sampled and field screened using the FID and PID around the perimeter and within LWDA No. 2 (SB-14, and SB-15), both soil borings had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments at SB-14 and elevated PID and FID concentrations at SB-15.

No subsurface soil samples were selected for analysis at LWDA No. 2.

SWMU 33/Fiberloid Landfill

Operation History

- The oldest of the fill areas that was operational between 1935 and 1940. Received soil, construction debris, ash from coal plants, and general plant waste. Plant was small compared to present and produced cellulose acetate and cellulose nitrate.

Physical Characteristics

- Location: North boundary of plant. Bordered to the north by Chicopee River, to the south by Grochmal Avenue.
- Coordinates: N5150 - N5600, E4650 - E5500.
- Size: 7 acres
  - Three soil borings drilled and continuously sampled to confirm horizontal extent of Fiberloid Landfill (SB-29, SB-31, and SB-33) [Note: Limited soil borings drilled due to the nature of the materials in Fiberloid Landfill].
- Average Surface Elevation: 135 to 140 feet AMSL.
- Volume: 225,000 cy estimated.
- Maximum Depth of Fill: 20 feet.
- Approximate Depth to Ground Water: 8 feet.

Chemical Characteristics

Of the three soil borings continuously sampled and field screened using FID and PID around the perimeter of LWDA No. 1 (SB-29, SB-31, and SB-33), two soil borings (SB-31, and SB-33) had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-31 (25 to 27 feet, approximately 1 foot into water table) downgradient and at the perimeter of the Fiberloid Landfill. This sample was analyzed for priority pollutant parameters (VOCs, SVOCs, pesticides, PCBs, metals, cyanide and phenols). All parameters were below the detection limits except for benzene at 30 ug/kg and toluene at 25 ug/kg and low concentrations of the following metals: arsenic, chromium, copper, nickel, and zinc detected at concentrations ranging from 3.4 to 27 mg/kg.

SWMU 47/Building 99 Leach Fields

Operation History

- Operation Period: 1972 to 1975.
- Saflex Building (Building 99) began operation in 1969. Overflow and floor drains led to a "separation pit," where floating solvents were presumably recovered and water was drained to two leach fields. The leach fields received blue-green ink for dying windshields, toluene, and dimethyl formamide (DMF).

Physical Characteristics

- Location: Two leach fields west of Building 99, the Saflex Building.
- Coordinates: N4030 - E3670, N3680 - E3670.
- Size: 0.25-acre at each leach field area; piping at each leach field consists of 105 feet of 12-inch diameter ceramic

- Two soil borings at northern leach field to confirm horizontal extent of Building 99 Leach Fields (SB-19 and SB-20).
- Average Surface Elevation: 143 feet AMSL.
- Maximum Depth of Fill: Not Applicable.
- Volume of Fill: Not Applicable.
- Approximate Depth to Ground Water: 15 to 20 feet.

Chemical Characteristics

Of the two soil borings continuously sampled and field screened using the FID and PID around the perimeter of Building 99 Leach Field (SB-19, and SB-20), both soil borings had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments at SB-20 and elevated PID and FID concentrations at SB-19.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-20 (30 to 32 feet, approximately 17 feet into water table) downgradient of the leach fields and also downgradient of LWDA No. 1. This sample was analyzed for priority pollutant parameters (VOCs, SVOCs, pesticides, PCBs, metals, cyanide and phenols). All parameters were below the detection limits except for chlorobenzene at 90 ug/kg and benzene at 15 ug/kg and low concentrations of the following metals: chromium, copper, lead, nickel and zinc detected at concentrations ranging from 2.5 to 9.5 mg/kg.

SWMU 38/Burning Pits A

Operation History

- Operation Period: 1950 to 1966.
- Received solid wastes, cardboard, and off-product plastics.

Physical Characteristics

- Location: South-central portion of site, on eastern edge of SWDA No. 2. Bordered to the north by Building 97, to the south by Worcester Street, and to the east by railroad.
- Coordinates: N3500 - E4340.
- Size: Approximately 0.05 acre; two small pits 15 by 15 feet
  - One soil boring drilled and continuously sampled to confirm location of Burning Pits A (SB-16).
- Average Surface Elevation: 145 feet to 160 feet AMSL.
- Volume: Approximately 14,600 tons of wastes were burned.
- Maximum Depth of Fill: Estimated 10 feet.
- Approximate Depth to Ground Water: 18 feet.

Chemical Characterization

Of the one soil borings continuously sampled and field screened using FID and PID downgradient and on the perimeter of Burning Pit A (SB-16), none of the soil samples had FID and PID detections above the water table.

No subsurface soil samples were selected for analysis for Burning Pits A.

SWMU 39/Burning Pit B

Operation History

- Operation Period: 1960 to 1968.
- Received approximately 2,900 tons of combustible trash.
- Burning Pit B was an aboveground wire cage that operated between 1966 and 1968. The site is now covered by Building 99, the Saflex Building. See Building 99 Leach Fields for further descriptions.

Physical Characteristics

- Location: Beneath the west side of Building 99, Saflex Building, and between the Building 99 Leach Fields.
- Coordinates: N3970 - E3770.
- Size: Approximately 0.01 acre
  - No soil borings drilled at Burning Pit B, beneath Building 99
  - One soil boring drilled and continuously sampled downgradient of Burning Pit B (SB-20).
- Average Surface Elevation: 143 feet AMSL.
- Maximum Depth of Fill: Estimated 10 feet.
- Volume of Fill: Unknown; 2,900 tons of combustible trash were burned.
- Approximate Depth to Ground Water: 10 to 15 feet.

Chemical Characteristics

Of the one soil borings continuously sampled and field screened using the FID and PID downgradient Burning Pit B, Building 99 Leach Fields and LWDA No. 1 (SB-20), one soil sample had FID and PID detections above the water table.

No subsurface soil samples were selected for analysis for Burning Pit B.

SWMU 40/Burning Pit C

Operation History

- Operation Period: 1960 to 1968.

- Received fiber barrels with metal rings, plant trash, wood, paper, and plastic scraps. The pit was filled in and leveled in preparation for future construction.

Physical Characteristics

- Location: West edge of plant. Bordered to the north by a barrel storage area.
- Coordinates: N4260 - N4400.
- Size: Approximately 0.01 acre; one pit approximately 15 by 15 feet
  - Two soil borings drilled and continuously sampled to confirm location and horizontal extent of Burning Pit C (SB-23 and SB-24).
- Average Surface Elevation: 142 feet AMSL.
- Volume: 4,300 cy estimated.
- Maximum Depth of Fill: 20 feet.
- Approximate Depth to Ground Water: 18 feet.

Chemical Characteristics

Of the two soil borings continuously sampled and field screened using the FID downgradient and on the perimeter of Burning Pit C (SB-23 and SB-24), both soil borings had FID detections above the water table at concentrations slightly above the detection level of the FID instruments for SB-24 and elevated FID concentrations at SB-23.

No subsurface soil samples were selected for analysis for Burning Pits C.

SWMU 41/Burning Pits D

Operation History

- Operation Period: 1939 to 1961.
- Received fiber barrels, trash, and scrap plastic.

Physical Characteristics

- Location: Northwest corner of plant. Bordered to the north by Chicopee River and to the south by Grochmal Avenue.
- Coordinates: N5000 - E3000.
- Size: Approximately 0.5 acres; two pits were observed in historic aerial photographs. Plant drawings indicate each pit was approximately 50 feet by 150 feet
  - Two soil borings drilled and continuously sampled to confirm the location and horizontal extent of Burning Pits D (SB-27 and SB-28).
- Average Surface Elevation: 135 to 139 feet AMSL.
- Volumes: Approximately 4,000 and 7,000 cy estimated per pit.
- Maximum Depth of Fill: 25 feet.
- Approximate Depth to Ground Water: 15 to 20 feet.

Chemical Characteristics

Of the two soil borings continuously sampled and field screened using the FID and PID around the perimeter of SWDA No. 1 (SB-27 and SB-28), one soil boring (SB-27) had FID and PID detections above the water table at concentrations slightly above the detection level of the FID and PID instruments.

A subsurface soil sample was selected for analysis, based on elevated PID/FID field screening at SB-27 (58 to 60 feet, approximately 37 feet into water table) downgradient of Burning Pits D, and 336 Drum Storage Area. This sample was analyzed for priority pollutant parameters (VOCs, pesticides, PCBs, metals, cyanide, and phenols). All parameters were below the detection limits except for chlorobenzene at 240 ug/kg and low concentrations of the following metals: arsenic, chromium, copper, lead, nickel, and zinc detected at concentrations ranging from 1.3 to 10.4 mg/kg.

AOC 7/Former Building 44 and Tank Farm E

Operation History

- Operation Period: Unknown to 1989.
- Building 44 was demolished, and the adjacent aboveground Tank Farm E was abandoned in 1989.

Physical Characteristics

- Location: Northern-central portion of plant. Bordered to the north by Chicopee River and to the south by Grochmal Avenue.
- Coordinates: N5120 - N4920, E4880 - E5280.
- Size: Approximately 3 acres
  - Four wells drilled and continuously sampled to confirm horizontal extent (MW-64 through MW-67).
- Average Surface Elevation: 142 to 145 feet AMSL.
- Volume of Fill: Not applicable.
- Maximum Depth of Fill: Not applicable.
- Approximate Depth to Ground Water: 7 to 10 feet.

Chemical Characteristics

From the four soil borings continuously sampled and field screened using FID around the perimeter of Building 44 and Tank Farm E (MW-64, MW-65, MW-66, and MW-67), three soil borings (MW-65, MW-66 and MW-67) had FID detections above the water table at concentrations slightly above the detection level of the FID instruments.

No subsurface soil samples were selected for analysis at Building 44 and Tank Farm E.

SWMU 16/Accumulation Area/East Gelva Area

Operation History

- Operation Period: Unknown to present.
- Accumulation area for filter wastes, waste ignitable resin solution, ethyl alcohol, ethyl acetate, polyvinyl formal/acetic acid solutions, and toluene.
- Wastes accumulated are from gelva process.
- Wastes are transported and stored at a hazardous waste storage area for subsequent disposal off site.

Physical Characteristics

- Location: Northern portion of plant outside of Building 117. Bordered by Grochmal Avenue to the south and the Chicopee River to the north. Outside underlain by asphalt.
- Coordinates: N4920 - E4180.
- Size: Information unknown at this time; area contains a 6,000-gallon aboveground tank and 55-gallon drums
  - No soil borings at this area.
- Average Surface Elevation: Estimated at 135 to 139 feet AMSL.
- Volume of fill: Not Applicable.
- Maximum Depth of Fill: Not Applicable.
- Approximate Depth to Ground Water: Estimated at 15 to 20 feet.

Chemical Characteristics

This site was recently identified as a SWMU and a potential disposal area, and no previous investigations have been conducted at this area.

SWMU 30/336 Drum Storage Area

Operation History

- Operation Period: Late 1920s to present.
- Receives 55-gallon drums for storage; maximum capacity 1,024 55-gallon drums or 56,320 gallons.
- Source of wastes are from Building 117 (Gelva), Building 110, South Butvar, and Pilot plant.

Physical Characteristics

- Location: Northwest corner of plant between Burning Pits D. Bordered to the north by Chicopee River and to the south by Grochmal Avenue.
- Coordinates: N4980 - E3070.

- Size: Estimated 0.2 acres; 50-foot by 100-foot asphalt pad
  - No additional soil borings at this area, active storage area, extent unknown; at Burning Pits D area.
- Average Surface Elevation: 135 to 139 feet AMSL.
- Maximum Depth of Fill: Not Applicable.
- Approximate Depth to Ground Water: 15 to 20 feet.

Chemical Characteristics

See Burning Pits D.

Not identified as a SWMU/West Resins Area

Operation History

- Operation Period: Unknown to present.

Physical Characteristics

- Location: Northern portion of plant between Buildings 106 and 107. Bordered by Grochmal Avenue to the south and Chicopee River to the north. Underlain by asphalt.
- Coordinates: N5020 - E4330.
- Size: Information unknown at this time
  - Four soil borings drilled and continuously sampled confirmed the location of West Resins Area (Empire,November 1992).
- Average Surface Elevation: Estimated at 135 to 139 feet MSL.
- Maximum Depth of Fill: Not Applicable.
- Approximate Depth to Ground Water: Estimated at 15 to 20 feet.

Chemical Characteristics

This site was recently identified as a potential disposal area, and no previous investigations have been conducted at this area except for four construction soil borings which identified this area as a potential disposal area.

4.1.2 SWMU/Disposal Area Characterization Data Needs

As set forth in Section 4.1.1, there is extensive information available for each SWMU/disposal area that meets the requirements of an RFI (USEPA, May 1989) and an MCP Phase II Comprehensive Site Assessment. This available information meets the following RFI and MCP requirements:

- Location information (location of SWMUs and the location of sources relative to other sources);

- Historic information (history of disposal methods, dates of disposal, identification and amounts of materials, and evaluation of waste management records); and

- Physical dimensions (estimated volume of materials, quantities of waste, and horizontal extent of wastes).

The RFI and MCP requirements that have not been met in previous investigations and that are necessary to fully characterize the SWMU/disposal areas include:

- Chemical characterization of actual waste materials; and

- Confirmation by direct methods (i.e., borings and soil analyses) of the vertical extent of waste materials.

Although there are extensive soil and ground-water screening and analytical data around the perimeter of each SWMU/disposal area that would indicate that the waste materials are not adversely impacting the environment, actual waste materials have not been collected and analyzed during the previous investigations.

The horizontal extent of the SWMU/disposal areas has been extensively delineated by indirect methods (i.e., historic aerial photographs and maps and geophysics). The horizontal extent evaluations of the historical aerial photographs, historic topographic comparisons, magnetometer survey, seismic refraction survey, are provided in Appendix B - Phase I Report - Remedial Investigation Plan (BB&L, August 1984). The historic aerial photographs are provided in Appendix B (*Page 18, Figure 11, Appendix F - Airphoto Interpretation, Dr. Liang*) The historic topographic comparisons are found in Appendix B (*Page 16, Figures 8 through 10*). The magnetometer survey is presented in Appendix B (*Page 27, Figures 12, 13, and 14*). The seismic refraction survey results are presented in Appendix B (*Page 33, Figures 15 and 16*). The horizontal extent of most areas has also been confirmed through the extensive perimeter soil boring programs conducted during previous investigations. The location of each of these soil borings is provided on Figure 2 (SB-1 through SB-35 and the soil borings for monitoring wells MW-1 through MW-69). Conversely, the vertical extent of the SWMU/disposal areas has only been evaluated by indirect methods.

Therefore, the following are considered the general data needs necessary to meet the RFI and MCP requirements for source characterization:

- Analytical data for waste materials from each SWMU/disposal area; and

- Direct method observations, including soil borings and laboratory analyses, of the vertical extent of the SWMU/disposal areas to confirm indirect estimates of the vertical extent and waste volume at each SWMU/disposal area.

In addition, the following are SWMU/disposal area specific data needs:

- The horizontal extent of SWDA No. 2 needs further delineation on the southwest side near Bircham Bend Brook.
- The horizontal extent of the Building 99 Leach Fields needs further delineation.
- The horizontal extent of Burning Pits D needs further delineation on the eastern side.

These data needs can be met through a focused soil boring and analysis program at each SWMU/disposal area that includes field screening, waste analyses (if present), as well as surface and subsurface soil analyses.

4.2 Known and Potential Migration Pathways

The known and potential pathways associated with the SWMU/disposal areas include the ground-water migration pathway, surface-water migration pathway, utility conduit migration pathway, and air migration pathway. Each of these migration pathways is discussed below, followed by an identification of data needs. Previous investigations have evaluated the ground-water and surface-water migration pathways. The utility conduit pathway was not evaluated in previous investigations because the utilities at the Indian Orchard Plant are located above the ground-water table. The air migration pathway has not been evaluated in previous investigations, although air monitoring for health and safety purposes was conducted.

4.2.1 Ground-Water Migration Pathways

The previous investigations have provided extensive physical and chemical ground-water data to characterize the ground-water migration pathway at each individual SWMU/disposal area, as well as site-wide ground-water characteristics. The physical characteristics of the ground-water migration pathways were introduced in Sections 2.3.4 and 2.3.5, and the ground-water quality characteristics were discussed throughout Section 3, Previous Remedial Investigations. This section provides a detailed description of the physical geologic and hydrogeologic characteristics at each SWMU/disposal area and the entire plant site, as well as a chemical characterization of the ground water at each SWMU/disposal area and an overall site-wide chemical characterization.

Physical Characterization

SWMU/Disposal Area Hydrogeologic Setting

For each SWMU/disposal area, this section provides a summary of the hydrogeologic setting.

SWMU 35/SWDA No. 1

- Natural kettlehole, underlain by fine deltaic and outwash sands, with lenses of coarse sand and gravel and thin (5-foot) discontinuous layers of till.
- Depth to Dense Till: Approximately 125 feet.
- Depth to Bedrock: 184 feet.
- Approximate Depth to Ground Water: 40 feet.
- Ground-Water Flow Direction: West-northwest.

- Saturated Thickness: 40 to 70 feet.
- Ground-Water Flow Rate: 60 to 300 feet/year.

SWMU 36/SWDA No. 2

- Border between lowland alluvial sediments and upland deltaic deposits, underlain by fine to medium sands with lenses and layers. Coarse sand and gravel with thin (5-foot) till layers along eastern border.
- Depth to Till: Approximately 70 feet.
- Depth to Bedrock: Estimated at 125 feet.
- Approximate Depth to Ground Water: 10 feet.
- Ground-Water Flow Direction: West-northwest.
- Saturated Thickness: 25 to 60 feet.
- Ground-Water Flow Rate: 460 to 900 feet/year.

SWMU 34/LWDA No. 1

- Natural kettlehole, underlain by fine deltaic and outwash sands, with lenses of coarse sand and gravel and thin (5-foot) discontinuous layers of till.
- Depth to Dense Till: 100 feet.
- Depth to Bedrock: Estimated at 170 feet.
- Approximate Depth to Water: 20 to 35 feet.
- Ground-Water Flow Direction: Northwest.
- Saturated Thickness: 65 to 75 feet.
- Ground-Water Flow Rate: 800 to 1,500 feet/year.

SWMU 37/LWDA No. 2

- Deltaic sands and gravels, with discontinuous thin till layers.
- Depth to Dense Till: 130 feet.
- Depth to Bedrock: Estimated at 165 feet.
- Approximate Depth to Ground Water: 35 feet.
- Ground-Water Flow Direction: West.
- Saturated Thickness: 80 feet.
- Ground-Water Flow Rate: 460 to 900 feet/year.

SWMU 33/Fiberloid Landfill

- Flood plain/alluvial deposits, a filled in channel or meander; underlain by till, silt, sand, and gravel.
- Depth to Dense Till: 30 feet.
- Depth to Bedrock: Old plant borings suggest 60 feet. Estimated at 120 feet.
- Approximate Depth to Ground Water: 10 feet.
- Ground-Water Flow Direction: North-northeast.

- Saturated Thickness: 10 to 20 feet.
- Ground-Water Flow Rate: 1,500 to 1,600 feet/year.

SWMU 47/Building 99 Leach Fields

- Flood plain/alluvial deposits, overlying deltaic and lacustrine sand and gravel over fine sands and silts.
- Depth to Dense Till: 60 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 10 to 15 feet.
- Ground-Water Flow Direction: Northwest.
- Saturated Thickness: 35 to 55 feet.
- Ground Water Flow Rate: 190 to 1,150 feet/year.

SWMU 38/Burning Pits A

- Border between lowland alluvial sediments and upland deltaic deposits, underlain by fine to medium sands with lenses and layers. Coarse sand and gravel, with thin (5-foot) till layers along eastern border.
- Depth to Till: Approximately 70 feet.
- Depth to Bedrock: Estimated at 165 feet.
- Approximate Depth to Ground Water: 18 feet.
- Ground-Water Flow Direction: West.
- Saturated Thickness: 60 feet.
- Ground-Water Flow Rate: 460 to 900 feet/year.

SWMU 39/Burning Pit B

- Flood plain/alluvial deposits, overlying deltaic and lacustrine sand and gravel over fine sands and silts.
- Depth to Dense Till: 60 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 10 to 15 feet.
- Ground-Water Flow Direction: Northwest.
- Saturated Thickness: 60 feet.
- Ground Water Flow Rate: 190 to 1,150 feet/year.

SWMU 40/Burning Pit C

- Flood plain/alluvial deposits. Formerly mined for sand and gravel. Underlain by deltaic sand and gravel and fine sand.
- Depth to Dense Till: 80 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 18 feet.

- Ground-Water Flow Direction: Northwest.
- Saturated Thickness: 50 feet.
- Ground-Water Flow Rate: 200 to 390 feet/year.

SWMU 41/Burning Pits D

- Flood plain/alluvial deposits, underlain by deltaic sand and gravel.
- Depth to Dense Till: 80 to 100 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 15 to 20 feet.
- Ground-Water Flow Direction: North.
- Saturated Thickness: 40 to 60 feet.
- Ground-Water Flow Rate: 1,600 to 3,200 feet/year.

AOC 7/Former Building 44 and Tank Farm E

- Sand fill, underlain by deltaic and outwash sands.
- Depth to Dense Till: Approximately 20 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 7 to 10 feet.
- Ground-Water Flow Direction: North.
- Saturated Thickness: 20 to 30 feet.
- Ground-Water Flow Rate: 1,500 to 1,600 feet.

SWMU 16/Accumulation Area/East Gelva Area

- Flood plain/alluvial deposits, underlain by till.
- Depth to Dense Till: Approximately 30 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: Estimated at 15 to 20 feet.
- Ground-Water Flow Direction: North.
- Saturated Thickness: 20 to 30 feet.
- Ground-Water Flow Direction: 450 to 800 feet/year.

SWMU 30/336 Drum Storage Area

- Flood plain/alluvial deposits, underlain by deltaic sands and gravels.
- Depth to Dense Till: 80 to 100 feet.
- Depth to Bedrock: Estimated at 120 feet
- Approximate Depth to Ground Water: 15 to 20 feet.
- Ground-Water Flow Direction: North.
- Saturated Thickness: 40 to 60 feet.
- Ground-Water Flow Rate: 1,600 to 3,200 feet/year.

Not Identified as a SWMU/West Resins Area

- Flood plain/alluvial deposits, underlain by till.
- Depth to Dense Till: Approximately 30 feet.
- Depth to Bedrock: Estimated at 120 feet.
- Approximate Depth to Ground Water: 15 to 20 feet.
- Ground-Water Flow Direction: North.
- Saturated Thickness: 20 to 30 feet.
- Ground-Water Flow Rate: 450 to 800 feet/year.

Overall Site Hydrogeologic Setting

As set forth in Sections 2.3.5 and 3, Previous Remedial Investigations, the hydrogeologic unit, comprising the glacial outwash, deltaic, lacustrine, and alluvial deposits, is the primary water-bearing unit at the plant site. The lower boundary of this hydrogeologic unit is the lower dense glacial till, which acts as a confining unit between the unconsolidated deposits and the bedrock. Because the hydraulic conductivity of the till, 5×10^{-6} centimeters/second (cm/sec), is approximately three orders of magnitude lower than the permeability of the overlying formations, and because the till is both thick and extensive, it functions as an effective physical boundary to flow between the primary hydrogeologic unit above the till and the bedrock below the till. Ground-water flow through this unit comprises the ground-water migration pathway at the site. In general, ground water flows from southeast to northwest beneath the plant and discharges to the Chicopee River. The physical characteristics of this pathway are discussed in detail below.

Ground-water recharge to the primary hydrogeologic unit, comprising the unconsolidated geologic deposits described above, occurs in the uplands topographic area of the site, as well as in other regional recharge areas further upgradient of the Indian Orchard Plant (e.g., near Plastics Park Pond). In these recharge areas, ground-water flow is vertically downward. At the edge of the upland area, the ground-water flow gradient shifts vertically upwards. Toward the Chicopee River, the gradient gradually shifts to horizontal flow, with a slight downward component.

Several methods were used to calculate ground-water flow directions and velocities at the Indian Orchard Plant. The primary method used was a digital computer program based upon the BTETRA program (Pinder and Abriola, 1982). This method was selected over conventional contouring due to the strong vertical gradients observed within the primary hydrogeologic unit. When strong gradients are observed, conventional contouring can give erroneous results due to the fact that the hydraulic head surfaces are no longer perpendicular to the ground surface. The head value measured at a well, therefore, is dependent on both the areal and vertical location of the well screen. The second advantage of this method is that a three-dimensional picture of ground-water flow is calculated. The program provides a gradient for x, y, and z directions based upon interpolation of heads between four wells. These gradients are then used with hydraulic conductivity values and porosity values in the Darcy formula to compute a flow velocity. A more complete discussion of the method is provided in the report, Phase II Interim Data Report, Remedial Investigation Plan (BB&L, December 1985).

The ground-water flow directions calculated from this program were from the southeast, originating from the uplands area, to the west-northwest, as shown on Figure 5 - Saturated Thicknesses and Flowlines for June 27, 1985. Along the northern edge of the uplands area, the flow directions are primarily northwest, while along the western edge of the uplands area the flow directions are initially west and then change to the northwest, west of Building 99. Ground-water flow patterns appear to be relatively constant over time. These ground-water flow patterns are influenced by the trough in the till, which controls the major volume of ground-water flow at the site and ground-water discharge from the site.

Ground-water flow velocities were computed across the site for each of the dates when water level measurements were obtained (Appendix D). The highest ground-water velocities (June 1985) were calculated using an assumed porosity value of 0.2, a horizontal hydraulic conductivity range of 5×10^{-3} cm/sec to 1×10^{-2} cm/sec for the x and y directions, and an assumed vertical hydraulic conductivity range of 5×10^{-4} cm/sec to 1×10^{-3} cm/sec for the z direction. These values were based upon the high ranges of hydraulic conductivity calculated from the in-situ hydraulic conductivity tests and upon the assumption that in stratified sands and silts, such as those observed at the site, the vertical hydraulic conductivity would be at least one order of magnitude less than horizontal hydraulic conductivity.

The computed ground-water flow velocities ranged from 150 feet/year to 3,200 feet/year. The highest flow velocities were seen along the Chicopee River, a discharge area where gradients sharply steepen. The ground-water velocities within the trough were generally lower than elsewhere on site. These velocities were generally on the order of 200 feet/year to 400 feet/year. Ground-water velocities outside the above two areas were on the order of 600 feet/year to 1,200 feet/year. When the average hydraulic conductivity value of 5×10^{-3} is substituted for the maximum of 1×10^{-2} cm/sec, the computed ground-water velocities across the site fall to the range of 50 to 2,000 feet per year. The lowest flow velocities were seen in August 1985, when flow velocities were approximately half of those computed for June 1985.

Ground-water discharges to the Chicopee River primarily along the western third of the plant boundary, as calculated from the computer program. To compute the volume of ground-water flow discharging from the site to the Chicopee, it was conservatively assumed that ground-water discharges to the river through the full saturated thickness of the hydrogeologic unit described above measured along the 3,000 foot plant boundary to the river, as opposed to the westernmost third of the plant boundary. Using a cross section area of 90,800 square feet along the river, a hydraulic conductivity range of 5×10^{-3} to 1×10^{2} cm/sec, and a gradient range of 0.03 (the average) to 0.06 (the maximum) observed on site, the estimated maximum discharge rate of ground water to the Chicopee River ranges from 1.4 gpd/ft^2 to 12.7 gpd/ft^2 (0.2 cfs to 1.8 cfs).

Chemical Characterization

SWMU/Disposal Area Ground-Water Quality

This section discusses the existing ground-water quality data at each SWMU/disposal area.

SWMU 35/SWDA No. 1

Eight downgradient monitoring wells (MW-3, MW-30, MW-31, MW-32, MW-33, MW-35, MW-51, and MW-52) and two upgradient monitoring wells (MW-4 and MW-23) are located along the perimeter of SWDA No. 1. The VOCs, benzene, chlorobenzene, ethylbenzene, tetrachloroethene, toluene, 1,1,1-trichloroethane, and xylenes, were consistently detected at low concentrations ranging from 2 to 410 ug/L in the downgradient ground water. Low concentrations of the SVOC, phenol, and the metals, arsenic, copper, and zinc, were also detected. The highest VOC concentrations were detected at monitoring well MW-31, which is located west of this area, with xylene ranging from non-detect to 410 ug/L and chlorobenzene ranging from 40 to 180 ug/L (Table 7). The upgradient monitoring well, MW-4, was inadvertently destroyed in 1989.

SWMU 36/SWDA No. 2

Four downgradient monitoring wells (MW-6, MW-7, MW-47, and MW-48) are located along the perimeter of SWDA No. 2. Only low concentrations of a few VOCs were detected sporadically at monitoring wells MW-6, MW-7, and MW-8, ranging from non-detect to 3 ug/L. Further, VOCs have not been detected at two monitoring wells (MW-21 and MW-22), located 200 feet south of SWDA No. 2 along Bircham Bend Brook.

SWMU 34/LWDA No. 1

Twelve monitoring wells (MW-3, MW-12, MW-13, MW-33, MW-36, MW-37, MW-38, MW-40, MW-41, MW-53, MW-68, and MW-69) are located near LWDA No. 1. The VOCs, benzene and chlorobenzene, and the SVOC, bis(2-chloroethyl)ether, were consistently detected in the ground water downgradient of this area. Low concentrations of other SVOCs and the metals, arsenic, barium, and zinc, were also detected. [Note: Elevated concentrations of iron, magnesium, and manganese were detected; however, these metals are likely natural constituents within the ground-water flow system.] The highest VOC concentrations were detected at monitoring wells MW-33, MW-36, MW-37, MW-41, and MW-53, with chlorobenzene ranging from 310 to 4,500 ug/L and benzene ranging from 2 to 67 ug/L (Table 7). Those monitoring wells are located along the hydraulically downgradient perimeter of this area and 300 feet northwest of this area.

SWMU 37/LWDA No. 2

Two monitoring wells (MW-5 and MW-34) are located along the perimeter of LWDA No. 2. The VOCs, chlorobenzene, methylene chloride, and xylenes, and the SVOC, bis(2-ethylhexyl)phthalate, were sporadically detected, as were low concentrations of several metals, including barium, chromium, lead, mercury, and zinc. The highest VOC concentrations were detected at monitoring well MW-5, with xylene ranging from non-detect to 1,000 ug/L and methylene chloride ranging from non-detect to 21 ug/L (Table 7). Monitoring well MW-5 is located along the southwestern edge of this area.

SWMU 33/Fiberloid Landfill

Three downgradient monitoring wells (MW-54, MW-55, and MW-56) are located along the northern edge of the Fiberloid Landfill. Only low concentrations of VOCs were detected sporadically in these wells, including toluene ranging from non-detect to 25 ug/L and dichloroethane ranging from non-detect to 2 ug/L (Table 7). [Note: SVOCs, pesticides/PCBs, and metals were not analyzed for in the ground water from these wells.] Three monitoring wells, MW-9, MW-10, and MW-64, are located upgradient of the Fiberloid Landfill. VOCs have not been detected at these wells.

SWMU 47/Building 99 Leach Fields

Five monitoring wells (MW-24, MW-25, MW-26, MW-28, and MW-29) are located near/within the Building 99 Leach Fields. The VOCs, benzene, chlorobenzene, 1,1,1-trichloroethane, and xylenes, and the SVOC (2-chloroethyl)ether, were consistently detected in the ground water. Low concentrations of other VOCs and the metals, arsenic, aluminum, barium, copper, and zinc, were also detected. The highest VOC concentrations were detected at monitoring wells MW-25, MW-26, and MW-28 with chlorobenzene ranging from 0.017 to 2,600 ug/L, benzene ranging from non-detect to 90ug/L and xylene ranging from non-detect to 95 ug/L. These monitoring wells are located near the leach fields and hydraulically downgradient.

SWMU 38/Burning Pits A

Refer to SWDA No. 2.

SWMU 39/Burning Pit B

Refer to Building 99 Leach Fields.

SWMU 40/Burning Pit C

Three monitoring wells (MW-49, MW-50, and MW-57) are located near Burning Pit C. Only low concentrations of the VOCs, benzene, 1,2-dichloroethane, 1,2-dichloroethene, and trichloroethene, were sporadically detected in the ground water at this location ranging from non-detect to 13 ug/L. SVOCs, pesticides/PCBs, and metals have not been detected in the ground water near this area.

SWMU 41/Burning Pits D

Two monitoring wells (MW-43 and MW-44) are located hydraulically downgradient of the western-most burning pit. The VOCs, benzene and chlorobenzene, were consistently detected at monitoring well MW-43 with chlorobenzene ranging from 500 to 1,700 ug/L and benzene ranging from non-detect to 47 ug/L. SVOC TICs were also detected at monitoring well MW-43 (Table 8). Low concentrations of the metals, arsenic, barium, copper, mercury, silver, and zinc, were also detected at monitoring well MW-43 (Table 8).

VOCs have not been detected at monitoring well MW-42, which is located 300 feet west of Burning Pits D.

AOC 7/Former Building 44 and Tank Farm E

Three monitoring wells (MW-65, MW-66, and MW-67) are located hydraulically downgradient of former Building 44 and Tank Farm E. The VOCs, chlorobenzene, ethylbenzene, and xylenes, were consistently detected in the ground water near this area. The SVOCs, phenol and 2,4-dimethylphenol, and four SVOC TICs were also detected. In addition, low concentrations of the metals, arsenic, barium, copper, iron, and zinc, were detected. The highest concentrations of VOCs were detected at monitoring wells MW-65 and MW-67, with chlorobenzene ranging from 13 to 6,300 ug/L, ethylbenzene ranging from 30 to 430 ug/L, and xylene ranging from non-detect to 47 ug/L. These two monitoring wells are located to the east and northeast of this area.

SWMU 16/Accumulation Area/East Gelva Area

There are no ground-water analytical data available for the Gelva Area.

SWMU 30/336 Drum Storage Area

Refer to Burning Pits D.

West Resins Area

There are no ground-water analytical data available for the West Resins Area.

Overall Site-Wide Ground-Water Quality

The constituents detected in ground water during previous remedial investigations include VOCs, SVOCs, and metals.

The VOCs detected at the plant include:

acetone	ethylbenzene	vinyl chloride
benzene	methylene chloride	xylenes
carbon disulfide	tetrachloroethene	tetrachlorobenzene
chloroform	toluene	1,2-dichloropropane
1,2-dichloroethane	1,1,1-trichloroethane	2-butanone
1,2-dichloroethene	trichloroethene	

Of these VOCs, chlorobenzene has been detected at relatively higher concentrations (over one ppm) and at a greater relative frequency then the other VOCs detected at the site.

The SVOCs detected at the plant include:

acenaphthene	di-n-octyl phthalate
bis(2-chloroethyl)ether	2,4-dimethylphenol
bis(2-ethylhexyl)phthalate	1,4-dichlorobenzene
butylbenzylphthalate	fluorene
2-chlorophenol	phenanthrene
di-n-butylphthalate	phenol

Of these SVOCs, bis(2-chloroethyl) ether and bis(2-ethylhexyl)phthalate were detected at relatively higher concentrations, but were still less than one ppm.

The metals detected at the site in the ground water include:

aluminum	cyanide	mercury
arsenic	iron	potassium
barium	lead	silver
calcium	magnesium	sodium
chromium	manganese	zinc
copper		

None of these metals have been detected at concentrations above federal drinking water standards.

Total VOC concentrations from October 1991, comprised primarily of chlorobenzene, are represented and contoured on Figures 6 and 7.

Figures 6 and 7 present two interpretations of the horizontal distribution of total VOCs. VOC concentration contours in the southern, southwestern, and northwestern areas of the Indian Orchard Plant can be interpreted in two ways:

1. As presented in Figure 6, a single plume originating from a single source area (LWDA No.1 or SWDA No. 1); or

2. As presented in Figure 9, as three individual plumes originating from three potential source areas (LWDA No. 1, Building 99 Leach Fields, and Burning Pits D/336 Drum Storage Area).

4.2.2 Ground-Water Migration Pathway Data Needs

As set forth in Section 4.2.1, there is extensive physical and chemical characterization information available for each SWMU/disposal area that meets the requirements of an RFI (USEPA, May 1989) and an MCP Phase II Comprehensive Site Assessment. This available information meets the following RFI and MCP requirements:

- Characterization of hydrogeologic conditions; and

- Characterization of the nature (constituents and concentrations) and extent of contaminant plume and extent of potential migration.

The hydrogeologic conditions at the Indian Orchard Plant are well defined, as are, for the most part, the chemical characteristics of the site-wide ground-water quality. From the description of the water quality at each SWMU/disposal area, a few data needs were identified at certain SWMU/disposal areas that would refine the chemical characterization of the ground water in those areas or provide initial chemical characterization information near select SWMU/disposal area with no previous ground-water monitoring information.

Based on the results of previous investigations, the following SWMU/disposal areas contribute constituents to the ground-water migration pathway:

SWDA No. 1
LWDA No. 1
LWDA No. 2
Building 99 Leach Fields
Burning Pits D
Building 44 and Tank Farm E

Of these areas, the existing monitoring well network is sufficient to characterize the chemical quality of the ground water adjacent to and downgradient, except for the latter three SWMU/disposal areas. The specific needs for these areas are as follows:

- Additional water quality monitoring points near the Building 99 Leach Fields to supplement previous data (also covers Burning Pit B);
  - One well at each of the Building 99 Leach Fields.

- Additional water quality monitoring points east of Burning Pits D to provide water quality data near the eastern-most burning pit (also covers 336 Drum Storage Area);
  - One well near each burning pit.

- Additional water quality monitoring points hydraulically downgradient of Former Building 44 and Tank Farm E;
  - One well near former monitoring well MW-67.

Based on the results of previous investigations, the following SWMU/disposal areas do not contribute or contribute relatively low concentrations of constituents to the ground-water migration pathway:

SWDA No.2	Burning Pits A
Fiberloid Landfill	Burning Pit C

Therefore, the ground-water monitoring network present at each of these areas is sufficient to characterize the water quality.

Ground-water quality has not been evaluated near the Accumulation Area/East Gelva Area or the West Resins area. Therefore, ground-water quality monitoring points may be necessary at these locations depending on the waste characterization data obtained from these SWMU/disposal areas. One well, for monitoring site-wide ground-water quality discharging into the Chicopee River, is also proposed downgradient of Accumulation Area/East Gelva Area. However, an alternative location of this well or an additional monitoring well may be required based on soil boring/waste characterization data from the West Resins Area. Based on the results from previous investigations, the West Resins Area is not expected to have any impact on soil or ground water.

In addition to refining the information available on the ground-water quality near the SWMU/disposal areas described above, there are a few data needs to evaluate the presence of one plume or two plumes of impacted ground water at the plant, as described under Overall Site-Wide Ground-Water Quality. The specific needs to differentiate between the plumes in the ground water are as follows:

- Additional water quality monitoring points between LWDA No. 1 and the Building 99 Leach Fields;
  - One well located between Buildings 99 and 97.

- Additional water quality monitoring points between the Building 99 Leach Fields and Burning Pits D;
  - One well located near Grochmal Avenue.

- Additional water quality monitoring points along the Chicopee River;
  - One east of Burning Pit D/336 Drum Storage Area;
  - One downgradient of Burning Pit D/336 Drum Storage Area;
  - One downgradient of East Gelva Area and/or West Resins Area; and
  - One downgradient of Fiberloid Landfill and Former Building 44 and Tank Farm E.

A new background upgradient well is needed to replace the abandoned well, MW-4, to monitor background ground-water quality in the primary water-bearing unit (deltaic and outwash deposits).

These ground-water data needs can be met through a focused monitoring well installation and ground-water sampling and analysis program.

Although the previous ground-water analytical data collected to date are sound and valid, the RFI and MCP Phase II Comprehensive Site Assessment would be enhanced with a current comprehensive site-wide ground-water sampling and analysis program that incorporates the standard regulatory parameters (e.g., TCL/TAL) with full data documentation and validation.

4.2.3 Surface-Water Migration Pathways

The previous investigations have provided both physical and chemical ground-water data to characterize the surface-water migration pathways in Bircham Bend Brook and the Chicopee River. The physical characteristics of the surface-water migration pathways were discussed in Sections 2.3.3 and 2.3.5, and the surface-water quality characteristics were discussed throughout Section 3, Previous Remedial

Investigations. This section reviews the physical, hydraulic, and chemical characteristics of these two surface-water migration pathways.

Bircham Bend Brook

Physical Characterization

- Location: Borders Indian Orchard Plant property along the southwest corner. Trends east-southeast to west-northwest.
- Size: Approximately 10 feet across from bank to bank.
- Surface-Water Elevation: Approximately 145 to 140 feet AMSL.
- Volume of Water: Estimated at 5 to 35 cfs.
- Flow Direction: Flows from southeast to northwest.
- River Bed Description: Sands and silts.

Hydraulic Characterization

- An evaluation of the hydraulic connection between the Bircham Bend Brook and the ground water indicated that the brook is a source of ground-water recharge from stream reference point (SRP) 6 to SRP 8, from Worcester Street to the head of the swampy area. This conclusion was based on seven ground-water and surface-water elevation monitoring events. During these events, consistently higher water elevations were observed at the brook versus the ground-water elevations from the monitoring wells between May 1985 to September 1985. A series of dams and culverts along this section of the brook appear to artificially raise the brook elevation above that of a naturally incised stream and would account for the observed head relationships.

Chemical Characterization

An evaluation of the surface-water data indicates that there is little difference in surface-water quality from Bircham Bend Brook between upstream and downstream locations of the site.

- In June 1981, the surface water from three downstream and two upstream locations were sampled and analyzed for VOCs, SVOCs, priority and non-priority metals, and TOC at Bircham Bend Brook. Relatively low concentrations of acetone, methylene chloride, toluene, di-n-butyl phthalate, cadmium, zinc, magnesium, barium, and aluminum were detected in the five upstream and downstream locations. There also was little difference between TOC concentrations upstream and downstream of the site. Cyanide was the only compound detected in one downstream location at 5 ug/L.

- In September 1983, surface water from an upstream and a downstream location was sampled and analyzed for specific VOCs, SVOCs, metals, TOC, and TOX. The VOCs and SVOCs were not detected above the method quantitation limits and, for metals, TOC, and TOX, there were no significant differences between upstream and downstream concentrations.

- In August 1986, surface water and sediment from two upstream and three downstream locations were sampled and analyzed for TOX, TOC, arsenic, and lead, and composites of the upstream and downstream locations were analyzed for priority pollutants, including VOCs, SVOCs, PCBs, pesticides, and metals. For surface-water samples, all priority pollutant parameters, arsenic, and lead were below the method quantitation/detection limits. For the sediment samples, all priority pollutant parameters and arsenic were below quantitation/detection limits. The metals, lead, arsenic, copper, mercury, zinc, and nickel, were detected in the sediment samples. Lead and arsenic were detected in the upstream sediment sample. There was no significant difference between upstream and downstream concentrations of surface water and sediment TOC and TOX.

- From 1985 to 1991, the ground water was sampled and analyzed annually for VOCs at all existing monitoring wells. From the four monitoring wells adjacent to the Bircham Bend Brook, MW-19, MW-20, MW-21, and MW-22, no VOCs have been detected. Of the two monitoring wells located over 100 feet from the Bircham Bend Brook near SWDA No. 2, MW-47 and MW-48, only MW-48 has intermittently contained xylenes and chlorobenzene at concentrations less than 3 ug/L.

Chicopee River

Physical Characterization

- Location: Borders the Indian Orchard Plant on the north. Trends east-west. .
- Size: Approximately 200 feet across.
- Surface-Water Elevation: 120 feet AMSL.
- Volume of Water: Estimated at 300 to 1,000 cfs.
- Flow Direction: From east to west.
- River Bed Description: Fine to coarse gravel and cobbles.

Hydraulic Characterization

- An evaluation of the hydraulic connection between the Chicopee River and the ground water indicated that the Chicopee River is the discharge point for both regional and local ground-water flow. This conclusion was based on seven ground-water and surface-water elevation monitoring events, where consistently higher ground-water elevations in the wells adjacent to the river were observed than the surface-water elevations in the river between May 1985 to September 1985.

Chemical Characterization

An evaluation of the surface-water data indicates that there is little difference in the surface-water quality of the Chicopee River between upstream and downstream locations of the site.

- In October 1980, surface-water samples from the Chicopee River were analyzed for oil and grease, pentachlorophenol (PCP), PCBs, and trichloroethene (TCE). PCBs and PCP were not detected above method quantitation limits. There was little difference between the upstream and downstream concentration of oil and grease and slightly elevated concentration of TCE upstream.

Both oil and grease and TCE were detected at low concentrations slightly above the method quantitation limits.

- In September 1983, surface water from Chicopee River from an upstream and a downstream location were sampled and analyzed for specific VOCs, SVOCs, metals, TOC, and TOX. VOCs and SVOCs were not detected above the method quantitation limits and, for metals, TOC and TOX, there were no significant differences between upstream and downstream concentrations.

- From 1985 to 1991, the ground water was sampled and analyzed annually for VOCs at all existing monitoring wells. Of the six monitoring wells located adjacent to the Chicopee River, MW-42, MW-43, MW-44, MW-54, MW-55, and MW-56, no VOCs were detected at monitoring MW-42. At three monitoring wells, MW-44, MW-54, and MW-56, relatively low concentrations of VOCs were intermittently detected. At monitoring well MW-43 in the vicinity of Burning Pits D, the VOCs benzene (12 to 47 ug/L) and chlorobenzene (500 to 1,700 ug/L) were consistently detected.

4.2.4 Surface-Water Migration Pathway Data Needs

As set forth in Section 4.2.3, Bircham Bend Brook is not believed to represent a pathway for constituent migration from the Indian Orchard Plant. Therefore, no additional data needs are required to meet the requirements of the RFI (USEPA, 1989) and an MCP Phase II Comprehensive Site Assessment.

Conversely, the Chicopee River represents a potential surface-water migration pathway for site-related constituents due to ground-water discharge into the river at the northern boundary of the plant. Previous investigations have concluded that the constituents discharging from the ground water to the surface water do not adversely affect the water quality of the Chicopee River. As set forth in Section 4.2.2, additional water quality monitoring points are required along the Chicopee River to characterize the ground-water migration pathway. The additional ground-water quality data obtained will, through USEPA and MA-DEP-approved modelling procedures, be used to further evaluate the water quality in the Chicopee River and re-evaluate previous investigation conclusions that the river is not adversely affected by the site.

4.2.5 Air Migration Pathways

Air migration pathways from the SWMU/disposal area have not been evaluated during previous investigations, except for using PID monitoring for health and safety purposes. Air migration pathways have not been addressed in the past because the SWMU/disposal areas are either covered by asphalt or estimated to be covered by 1 to 10 feet of native sand fill. During previous investigations, the total VOCs detected using a PID during the field activities at 12 of the 14 SWMU/disposal areas ranged from not detectable above the instrument detection limits to approximately one ppm. These 12 SWMU/disposal areas include SWDA No. 1, SWDA No. 2, LWDA No. 1, LWDA No. 2, Fiberloid Landfill, Burning Pits A through D, Former Building 44 and Tank Farm E, 336 Drum Storage Area, and Building 99 Leach Fields. The remaining two SWMU/disposal areas have not been investigated.

Monsanto continuously monitors wind speed and direction 24 hours per day at the Indian Orchard Plant and the data is available.

4.2.6 Air Migration Pathway Data Needs

To meet RFI and MCP requirements, a desktop air pathway assessment (APA) is needed to characterize the potential exposure associated with potential emissions of VOCs and respirable particulates.

To perform an APA, the following specific data needs are required:

- Soil boring data in the waste areas to characterize (type and amount) the cover material above each of the SWMU/disposal areas;
- Surface soil samples from each of the SWMU/disposal areas not covered by a building or asphalt; and
- Sufficient background surface soil data to identify naturally occurring constituents, such as metals.

4.2.7 Potential Exposure Pathways and Receptors

Migration pathways can result in the following exposure pathways: dermal contact, ingestion, and inhalation. Exposure implies a receptor is, or could be, present. Therefore, not all migration pathways result in definitive exposure pathways. In general, given the present use and location of the site, both on-site and off-site exposure could occur.

Existing Information

On-Site Receptors

The Indian Orchard Plant is currently owned by Monsanto. The entire site is fenced; however, Monsanto leases property to Novacor and Masspower. Hypothetically, personnel from Monsanto, Novacor, and Masspower and/or other individuals (e.g., contractors) could come in dermal contact with, or incidentally ingest by hand-to-mouth contact, constituents in wastes and/or soils at the ground surface. In addition, individuals at the site could inhale contaminated dust or VOCs from surface or subsurface soils.

Site personnel, contractors, and/or other personnel that may be involved with the subsurface activities, such as utility workers, geotechnical workers, excavation contractors, etc., could potentially come in dermal contact with, or incidentally ingest, wastes/waste constituents present in subsurface soils and/or in the ground water. Inhalation exposure of subsurface workers to VOCs and other chemical constituents in dust could also occur, depending on the composition of the wastes.

Off-Site Receptors

In the ground-water migration pathway, exposure to off-site receptors could occur via incidental ingestion, dermal contact, and/or inhalation of VOCs if the ground water is used as a drinking (or other) water supply. There are no known ground-water users or water supply zones within a 1.2-mile radius of the site. Further, the nearest potential aquifer is located hydraulically upgradient of the plant site.

Human and biotic exposure pathways are both potentially present in the Chicopee River. Humans could be potentially exposed to chemical constituents in the river via the ingestion of surface water. However, the Chicopee River is not used as the water supply in the vicinity of the site, and the city of Springfield and surrounding areas obtain their water supply from a municipal water supply system originating from Cobble Mountain Reservoir, Quabbin Reservoir, or Springfield Reservoir at distances ranging from 6 to 20 miles hydraulically upgradient of the plant. Monsanto or site personnel, as well as recreational users of the Chicopee River, such as swimmers or anglers, could also come in direct contact with chemical constituents, if present. Aquatic organisms and wildlife could contact and ingest chemical constituents from the water column, sediments, and/or other biota.

4.2.8 Potential Exposure Pathway and Receptor Data Needs

The primary data needs associated with the identification of potential exposure pathways and receptors are:

- Surface and subsurface soil data to evaluate potential on-site exposures;
- An evaluation of recreational uses of the Chicopee River, if any;
- A desktop assessment of indigenous aquatic organisms and/or wildlife; and
- The presence and concentrations of constituents in the ground water that discharge to the surface water.

5.0 Supplemental RFI and MCP Phase II Scope of Work

The previous section presented a site characterization that was based on the extensive previous investigations. This characterization set forth the known information on each of the 14 SWMU/disposal areas, the potential and known migration pathways, the potential exposure pathways and receptors, and the data needs to complete a characterization based on RFI and MCP requirements. This section addresses the identified data needs for the proposed scope of work.

The objectives of this supplemental scope of work are to:

- Provide chemical characterization data within the SWMU/disposal areas and further define the vertical limits of the SWMU/disposal areas to develop subsequent remedial alternatives, as needed;
- Obtain additional refining information on site-wide ground-water conditions; and
- Evaluate potential site-wide exposure pathways.

This scope of work consists of a focused field investigation of surface soils, subsurface soils, and ground water. Work efforts include the drilling of 27 soil borings for the collection of 20 surface soil samples and 20 subsurface soil/waste samples to enhance the soil/waste database for waste characterization and risk evaluations, and the installation of ten new monitoring wells to enhance the characterization of the ground-water migration pathway. In addition, 14 contingency subsurface soil samples may be obtained to further evaluate the migration of wastes/waste constituents from the SWMU/disposal areas, if necessary.

The proposed scope of work is divided into seven tasks, as follows:

- Task 1 - Coordination, Scheduling, and Preliminary Survey
- Task 2 - Soil Borings for Surface Soil and Subsurface Soil/Waste Sampling and Analysis
- Task 3 - Existing Monitoring Well Inspection
- Task 4 - Soil Boring/Monitoring Well Installations
- Task 5 - Ground-Water Sampling and Analysis
- Task 6 - Final Survey
- Task 7 - Reporting

All tasks will be performed in accordance with the standard operating procedures (SOPs), provided in the Quality Assurance Project Plan (QAPP), and with the Health and Safety Plan (HASP). A description of each task is provided below.

5.1 Task 1 - Coordination, Scheduling, and Preliminary Survey

Task 1 will include coordinating and scheduling with Monsanto, the analytical laboratory, and the drilling subcontractor to implement the proposed field work. This task will also include a review of existing Monsanto plant utility maps for preliminary drilling clearance and final soil boring and well location placement. This review will be followed by a preliminary field survey to locate and stake 9 of the 17 proposed borings to the existing Monsanto plant grid system. This preliminary field survey is necessary to locate the proposed borings and wells in the areas of the plant where the land surface has been altered and benchmarks have possibly been removed (primarily the southern portion of the plant near SWDA No. 1, SWDA No. 2, LWDA No. 1, and LWDA No. 2).

5.2 Task 2 - Soil Borings for Surface Soil and Subsurface Soil/Waste Sampling and Analysis

Task 2 includes the drilling of 21 soil borings for the collection and analysis of 20 surface soil samples and 20 subsurface soil/waste samples, using USEPA, and MA-DEP-approved SOPs. The purposes of these borings are to:

- Characterize the quality of surface soils at each SWMU/disposal area not covered by pavement;
- Characterize the quality of subsurface soils/wastes at each SWMU/disposal area; and
- Further evaluate the vertical limits of each SWMU/disposal area through direct field methods.

5.2.1 Soil Boring Installation

Seventeen of the soil borings are proposed for the collection of samples only, and four of the soil borings are proposed for well installation as well as sample collection (two at the Building 99 Leach Fields, one at Burning Pits D, and one background location near Building 34). The 21 soil boring locations are shown on Figure 8 - Proposed Soil Boring, Monitoring Well, and Sample Location Map.

The justification for these locations is based on a review of the previous investigation results set forth in Sections 3 and 4. Due to the relatively larger horizontal extent of certain SWMU/disposal areas, SWDA No. 1, SWDA No. 2, and LWDA No.1, a detailed review of key previous investigations was completed to select optimal soil boring locations. Optimal locations were selected from areas within these SWMU/disposal areas most likely to encounter waste materials so that samples of wastes could be chemically characterized. The other 11 SWMU/disposal areas are relatively smaller in horizontal extent, or access to the area is limited due to buildings or overhead utilities. Soil boring locations at the 11 other SWMU/disposal areas were selected to be within the horizontal limits of the area so that wastes, if present, would be encountered. The previous investigation data evaluated included: historical information, aerial photograph analyses, geophysical surveys, and soil borings and monitoring well analytical results. The soil boring selection rationale within SWDA No. 1, SWDA No. 2, and LWDA No. 1 is presented below.

Extensive investigations have been conducted to characterize the SWMU/disposal areas of SWDA No. 1, SWDA No. 2, and LWDA No. 1. Investigative methods used at these three SWMU/disposal areas included: historic topographic comparisons; historical aerial photograph interpretation; seismic refraction, magnetometry, and GPR surveys; installation of soil borings and monitoring wells; and test pit excavations, as set forth in Sections 3.1 and 3.2. These previous investigations were reviewed in detail to select optimal soil boring locations within these SWMU/disposal areas.

The following provides a summary of the selection rationale for proposed soil boring locations in SWDA No. 1, SWDA No. 2, and LWDA No. 1.

SWMU/Disposal Area	Site Coordinates	Selection Rationale
SWDA No. 1		
Southwestern Section	N3500, E4940	This boring is located adjacent to (approximately 30 feet west and downgradient) a large linear magnetic anomaly and a test pit located within this anomaly, which contained crushed drums, large metallic target approximately 13 feet deep near test pit location. Boring is located within 5 feet of fill based on topographic comparison.
South-Central Section	N3500, E5300	This boring is located adjacent to (approximately 120 feet north-northwest and downgradient) a magnetic anomaly. Boring is located in thickest area of SWDA No. 1, where fill thickness >45 feet based on topographic comparison.
Central Section	N3575, E5150	This boring is located adjacent to (approximately 150 feet north-northwest and downgradient) a central large linear magnetic anomaly. A test pit located within this anomaly contained crushed drums. Several GPR point targets confirmed the drums identified in a 1970 aerial photograph. Boring is located within 30 to 35 feet of fill based on topographic comparison.

SWMU/Disposal Area	Site Coordinates	Selection Rationale
SWDA No. 2		
Western Section	N3500, E3450	This boring is located outside area of geophysical survey, but within fill thickness of 5 to 10 feet based on topographic comparison. Soil boring is located to confirm the horizontal extent of SWDA No. 2 to the west.
Central Section	N3400, E3800	This boring is located adjacent to (approximately 65 feet northwest and downgradient) a linear magnetic anomaly and a test pit located within the anomaly containing crushed 55-gallon drums. The GPR detected a point target 35 feet west of the boring location at 8 feet deep. The boring is located within a fill thickness of 5 feet, based on topographic comparison.
East-Central Section	N3440, E3950	This boring is located adjacent to (approximately 110 northwest and downgradient) a linear magnetic anomaly and a test pit located within the anomaly containing crushed 55-gallon drums. GPR point targets were also identified in the anomaly area and confirmed the drums identified near anomaly on 1966 aerial photograph. The boring is located within a fill thickness of 5 to 10 feet based on topographic comparison.
LWDA No. 1		
Northern Section	N4025, E4950	This boring is located adjacent to (approximately 25 feet north and downgradient) a large magnetic anomaly and a strong GPR point target. The boring is located within fill approximately 10 to 15 feet thick based on topographic comparison.
Central Section	N3950, E4875	This boring is located adjacent to (approximately 30 feet north and downgradient) a large magnetic anomaly and GPR shallow point target. The boring is located in the thickest part of LWDA No. 1 fill (> 30 feet thick) based on topographic comparison.

A total of 21 soil borings will be drilled by either driven-casing or mud-rotary methods where running sands are likely to be encountered (such as at the background soil boring location), and by the hollow-stem auger method at all other locations. The soil borings will be continuously sampled with 2-inch diameter split spoons and field screened with a PID and a FID to field characterize the samples and assess the vertical extent of total volatile organic vapors in the SWMU/disposal areas. The PID screening will also provide for health and safety monitoring during the installation of the soil borings. Soil samples will be visually described using the Unified Soil Classification System (USCS). Twenty of the 21 soil borings will be drilled through the SWMU/disposal area to the top of the original grade beneath the SWMU/disposal area and, if necessary, into water table until encountering the original grade. These 20 soil borings will be drilled to determine the vertical extent of the SWMU/disposal area and to collect a subsurface soil/waste sample representative of the materials in the SWMU/disposal area, as further described in Section 5.2.3. If the SWMU/disposal area original grade is found above the water table, the soil boring will continue until encountering the water table to evaluate impacted soils beneath the original grade and to collect a contingency subsurface soil sample further described in Section 5.2.3. One of the 21 soil borings will be installed to collect a background subsurface soil sample from a location upgradient of the SWMU/disposal areas near Building 34, as shown on Figure 8. Upon completion and during the removal of the drilling casing or augers, each soil boring will be sealed with bentonite cement grout from the total depth of the boring to ground surface, unless the soil boring is to be completed as a monitoring well. Additional health and safety procedures are provided in the HASP. Soil boring procedures, including field logging, PID/FID monitoring and screening, and field documentation, are provided in the QAPP.

Drilling and sampling equipment will be cleaned prior to initiating the soil borings, in between each soil boring, and at the completion of all boring activities. Rinse waters from cleaning will be contained in drums at a designated location, as described in the QAPP.

Based on procedures established previously at the Indian Orchard Plant, the soil cuttings will be contained in drums. The drums will be staged at a designated location until the laboratory results have been received and evaluated. Upon transmittal of the laboratory results, Monsanto will dispose of the drummed cuttings appropriately.

5.2.2 Surface Soil Sampling and Analysis

A total of 20 surface soil samples will be collected to evaluate potential exposures through direct contact or the air migration pathway. Seventeen samples will be collected near the locations of the 21 soil borings. The remaining three surface soil samples will be collected in the vicinity of the background soil boring. Sample collection procedures, including Quality Assurance/Quality Control (QA/QC) procedures, are provided in the QAPP. The surface soil samples will be collected from the SWMU/disposal areas and background areas, as follows:

SWMU/Disposal Areas	Number of Surface Soil Samples	Number of Soil Borings
SWDA No. 1 (SWMU 35)	3	3
SWDA No. 2 (SWMU 36)	3	3
LWDA No. 1 (SWMU 34)	2	2
LWDA No. 2 (SWMU 37)	1	1
Fiberloid Landfill (SWMU 33)	2	1
Building 99 Leach Fields (SWMU 47)	2	2
Burning Pits A (SWMU 38)	1	1
Burning Pit B (SWMU 39)	0	0
Burning Pit C (SWMU 40)	1	1
Burning Pits D (SWMU 41)	1	2
Former Building 44 & Tank Farm E	1	1
Accumulation Area/ Gelva East Storage Tank (SWMU 16)	0	1
336 Drum Storage Area (SWMU 30)	0	1
West Resins Area	0	1
Background	3	1
TOTAL	**20**	**21**

The rationale for selecting 17 of the 20 surface soil samples for analysis will be based on the potential for dermal contact, incidental ingestion, and inhalation via air pathways at each SWMU/disposal area. At least one surface soil sample will be collected from each SWMU/disposal area, except at SWMU/disposal areas covered by asphalt and/or buildings. Surface soil samples from SWMU/disposal areas that have limited cover material will be collected from 0 to 6 inches below the grade. Surface soil samples from SWMU/disposal areas that have cover material greater than 10 feet will be collected from the cover material itself. Per RFI and MCP Phase II requirements and the quality assurance objectives (QAO) set forth in the QAPP, the 17 surface soil samples obtained at the SWMU/disposal areas will be analyzed for the following parameters: TCL VOCs and SVOCs, as well as TAL metals and cyanide, using EPA SW-846 methods. In addition, surface soil samples obtained from SWDA No. 1, SWDA No. 2, and the Fiberloid Landfill will be analyzed for PCBs, due to reported PCB disposal in these SWMU/disposal areas.

Three of the 20 surface soil samples will be collected to establish background surface soil conditions. These samples will then be used to evaluate the variance of TCL/TAL parameters between surface soil collected from disposal areas and the background area. The background surface soil samples will be collected from 0 to 6 inches below grade and will be collected from locations undisturbed by activities at the plant. The approximate background locations are shown on Figure 8. One of the background surface soil samples will be analyzed for the following parameters: TCL VOCs, SVOCs, and PCBs, as well as TAL metals and cyanide, using EPA SW-846 methods. The remaining two background samples will be analyzed for TAL metals only. Soil samples will be identified, handled, packaged, and shipped to the analytical laboratory using chain-of-custody procedures provided in the QAPP. QA/QC for the field sampling procedures and the laboratory procedures are also provided in the QAPP.

The analytical laboratory will provide a complete data documentation package as described in the QAPP, and the laboratory data will be validated according to relevant USEPA and MA-DEP procedures.

5.2.3 Subsurface Soil Sampling and Analysis

A total of 20 subsurface soil/waste samples will be collected to evaluate the chemical constituents associated with the SWMU/disposal areas and to assess background conditions. Sample collection procedures, including QA/QC procedures, are provided in the QAPP. Nineteen samples will be collected from each of the soil borings, and one sample will be collected from the upgradient soil boring. The 20 subsurface soil/waste samples will be collected from the SWMU/disposal and background areas, as follows:

SWMU/Disposal Areas	Number of Subsurface Soil/Waste Samples	Number of Contingency Subsurface Soil Samples	Number of Soil Borings
SWDA No. 1 (SWMU 35)	3	1	3
SWDA No. 2 (SWMU 36)	2	2	3
LWDA No. 1 (SWMU 34)	2	1	2
LWDA No. 2 (SWMU 37)	1	1	1
Fiberloid Landfill (SWMU 33)	1	1	1
Building 99 Leach Fields (SWMU 47)	2	1	2
Burning Pits A (SWMU 38)	1	1	1
Burning Pit B (SWMU 39)	0	0	0
Burning Pit C (SWMU 40)	1	1	1
Burning Pits D (SWMU 41)	2	1	2
Former Building 44 & Tank Farm	1	1	1
Accumulation Area/ Gelva East Storage Tank (SWMU 16)	1	1	1
336 Drum Storage Area (SWMU 30)	1	1	1
West Resins Area	1	1	1
Background	1	0	1
TOTAL	**20**	**14**	**21**

At least one subsurface soil/waste sample will be collected from within each of the 14 SWMU/disposal areas within the unsaturated zone, except from Burning Pit B. Burning Pit B will not be sampled because the former location of this SWMU/disposal area is now beneath Building 99.

Contingency subsurface soil samples may be collected from the SWMU/disposal areas, as presented above. Thirteen of the 14 contingency subsurface soil samples may be collected, one from each of the 14 disposal areas (except Burning Pit B), if wastes are encountered and the vertical extent of wastes lies within the unsaturated zone above the water table. The additional subsurface soil samples will be collected beneath

the waste materials of the SWMU/disposal area in the unsaturated zone above the water table. These additional subsurface soil samples will be collected to evaluate the vertical migration of the wastes/waste constituents from the SWMU/disposal areas to the ground water.

The remaining contingency sample will be a subsurface soil/waste sample, which may be collected from the third soil boring at SWDA No. 2. This additional subsurface soil/waste sample will be collected if wastes are encountered or PID/FID field screening measurements are elevated during the soil boring program at SWDA No. 2.

Subsurface soil/waste samples selected for laboratory analysis will be based on the PID/FID field screening results. This selection rationale is based on a review of the plant processes, past disposal practices, and past investigation results, which indicate that waste materials would consist of mixtures of VOCs, SVOCs, and inorganics. Thus, the presence of VOCs (as measured with a PID/FID) would be an indication of the presence of waste materials. The soil sample with the highest VOC concentration detected with the PID/FID (excluding methane) from each SWMU/disposal area will be submitted for laboratory analysis for the following parameters: TCL VOCs and SVOCs, as well as TAL metals and cyanide, using EPA SW-846 methods. If no VOCs are detected after PID/FID field screening, a sample will be selected based on visual observations, such as stained soils, waste/fill materials, and/or otherwise disturbed soils.

In addition, all subsurface soil samples obtained from SWDA No. 1, SWDA No. 2, and the Fiberloid Landfill will be analyzed for PCBs, due to reported PCB disposal in these SWMU/disposal areas.

The background subsurface soil sample collected for analysis will be collected from undisturbed soils above the water table. This sample will be analyzed for TCL VOCs and SVOCs, PCBs, and TAL metals and cyanide to provide a background concentration for all parameters analyzed at the site.

Pesticides will not be required for laboratory analysis since these compounds were not used at the site and have not been detected in previous investigations.

Soil samples will be identified, packaged, and shipped to the analytical laboratory using chain-of-custody procedures provided in the QAPP. QA/QC for the field sampling procedures are also provided in the QAPP.

RFI quality assurance requirements will be followed (USEPA, May 1989). The quality assurance requirements and documentation are set forth in the QAPP and will include the following field-related QA:

- Duplicate samples;
- Trip blanks (aqueous samples only);
- Matrix spikes;
- Matrix spike duplicates; and

- Field rinsate blanks (only if non-dedicated equipment used).

The analytical laboratory will provide a complete data documentation package as described in the QAPP, and the laboratory data will be validated according to relevant USEPA and MA-DEP procedures.

5.3 Task 3 - Existing Monitoring Well Inspection

Existing monitoring wells will be inspected to determine whether a representative ground-water sample can be collected. The procedures for inspecting the existing monitoring wells are provided in the QAPP.

Existing data on well specifications will be reviewed to determine the construction details. A field inspection of the existing wells will also be conducted, which will consist of evaluating the following:

- The condition of the protective casing, cap, and lock;
- The condition of the surface seal surrounding the protective casing;
- The presence of depressions or standing water around the casing; and
- The presence of grout between the riser and outer protective casing and the presence of a drain hole in the protective casing.

In addition, the depth of each well will be measured to determine whether siltation of the well has occurred. If siltation has occurred, the well(s) will be redeveloped as described in the QAPP. Any existing wells that appear to have compromised seals or casings may require replacement following the procedures for new well installation set forth in the QAPP.

5.4 Task 4 - Soil Borings for Monitoring Well Installations

Task 4 includes the installation of six additional soil borings for completion as monitoring wells, and the completion of four of the 21 soil borings described in Task 2 as monitoring wells, using EPA and MA-DEP approved procedures for a total of ten new monitoring wells. The purposes of these additional monitoring well installations are to provide additional monitoring points near SWMU/disposal areas where further ground-water characterization is needed; to provide monitoring points between SWMU/disposal areas; to provide monitoring points between the entire plant site and the Chicopee River (the known ground-water discharge area); and to provide an hydraulically upgradient background ground-water monitoring point. The ten monitoring well locations are shown on Figure 8.

Six monitoring wells will be located as described below:

- Two monitoring wells will be installed to monitor the site-wide ground-water quality along the Chicopee River: one in the vicinity of the Fiberloid Landfill, and the second hydraulically downgradient of the Accumulation Area/Gelva East Storage Tank.

- One monitoring well will be installed east of Burning Pits D to evaluate the horizontal extent of the ground-water volatile organic plume in the vicinity of Burning Pits D. This monitoring well will also be used to evaluate site-wide ground-water quality along the Chicopee River.

- One monitoring well will be located hydraulically downgradient of LWDA No. 1 and upgradient of the Building 99 Leach Fields to evaluate the horizontal extent of the ground-water volatile organic plume in the vicinity of LWDA No. 1. This well will be located between Buildings 99 and 97.

- One monitoring well will be located hydraulically downgradient of Building 99 Leach Fields and upgradient of Burning Pits D to evaluate the horizontal extent of the ground-water volatile organic plume in the vicinity of the Building 99 Leach Fields. This well will be located between Buildings 136 and 144.

- One monitoring well will be located hydraulically downgradient of Former Building 44 and Tank Farm E Area and hydraulically upgradient of the Fiberloid Landfill to evaluate the ground-water quality between these two areas.

Prior to monitoring well installation, the six additional soil borings will be continuously sampled with 2-inch diameter split spoons and field screened with a PID/FID. Soil samples will be visually classified according to the USCS. A representative soil sample within the well screen interval in each well will be selected for grain-size analyses. Procedures for the completion of the soil borings, including soil sampling, field screening and QA/QC procedures, are provided in the QAPP. Soils generated during drilling will be placed in drums and disposed of by Monsanto. Health and safety procedures are provided in the HASP.

The locations of the 4 of 21 Task 2 soil borings that were drilled for the collection of subsurface soil/waste samples and that will be completed as monitoring wells are described below:

- The two soil borings drilled at the Building 99 Leach Fields will be completed as monitoring wells to monitor the ground-water quality in the vicinity of the Building 99 Leach Fields.

- The background soil boring will be completed as a monitoring well to monitor site-wide background and hydraulically upgradient ground-water conditions.

- The soil boring located adjacent and hydraulically downgradient of Burning Pits D will be completed as a well point or monitoring well to monitor site-wide ground-water quality along the Chicopee River.

Monitoring wells will be installed in each of the ten soil borings. Construction of the monitoring wells will be compatible with the existing monitoring well network, which consists of 5- to 10-foot long, 0.02-inch or 0.010-inch slot PVC well screens, and Schedule 40 PVC risers. Well screen placement will be based on:

- Hydrogeologic information obtained during the drilling of the soil boring;

- Intervals where the highest total volatile organic concentrations were detected during the PID/FID field screening; and

- Depths of other existing shallow monitoring wells installed near the additional wells.

All drilling equipment and well materials will be cleaned prior to the initiation of well installation activities. In addition, drilling equipment will be cleaned between well locations and at the end of the monitoring well installation program. Rinse water from cleaning will be contained in DOT approved 55-gallon drums at a designated location, as described in the QAPP.

The monitoring wells will be developed until clear of visible sediment by the drilling subcontractor.

The water generated during well development will be discarded to the ground surface adjacent to each well developed. The procedures for well development are provided in the QAPP. In-situ hydraulic conductivity tests will be performed to evaluate the hydraulic conductivity of the unconsolidated deposits. The procedures for in-situ hydraulic conductivity tests are provided in the QAPP.

5.5 Task 5 - Ground-Water Sampling and Analysis

This task includes the sampling and analysis of ground water, using EPA and MA-DEP-approved protocols, from a total of 65 monitoring wells, which includes the 55 existing monitoring wells and the ten new monitoring wells.

Ground-water samples will be obtained from the monitoring wells in a predetermined order based on known or suspected contamination, in accordance with the procedures provided in the QAPP. Prior to sampling, ground-water elevations will be measured at each monitoring well. At least three well volumes will be purged prior to collecting a sample at each monitoring well. Most monitoring wells will be purged and sampled by bailing with dedicated disposable bailers; nine wells will be purged using a pump, and then sampled using disposable bailers. The purged ground water will be discarded to the ground surface adjacent to each well sampled. A representative ground-water sample from each monitoring well will be collected in the field and measured for temperature, conductivity, and pH. The procedures for measuring these parameters, including QA/QC procedures, are presented in the QAPP.

The ground water from all 65 monitoring wells will be analyzed using SW-846 methods for TCL VOCs, because VOCs, based on previous investigations, are the known indicator parameters for the site. The VOC analytical data from the 65 ground-water samples will be used to evaluate the horizontal extent of impacted ground water at the site. The ground water from 32 of the 65 monitoring wells will also be analyzed using SW-846 methods for TCL SVOCs and TAL metals and cyanide. The remaining 33 monitoring wells will not be analyzed for TCL SVOCs, TAL metals, and cyanide. Of these 33 monitoring wells, VOCs have not been detected at 29 of the monitoring wells and only low sporadic concentrations of VOCs (less than 10 ug/L) have been detected at four of the monitoring wells.

The rationale for the monitoring wells selected for TCL SVOCs and TAL parameters is based on the following criteria:

- The new background monitoring well was selected to evaluate background ground-water quality conditions for these TCL/TAL parameters.

- Ten monitoring wells bordering the Chicopee River were selected to evaluate the ground-water quality discharging to the Chicopee River. These wells are MW-42, MW-43, MW-44, MW-54, MW-55, MW-56, and four new wells.

- Eleven monitoring wells, which have contained relatively elevated VOC concentrations in previous sampling events, were selected to further evaluate the ground-water quality for these TCL/TAL parameters. These wells are MW-3, MW-5, MW-25, MW-26, MW-28, MW-31, MW-36, MW-37, MW-41, MW-53, and MW-65.

- Two monitoring wells were selected so that at least one monitoring well at each SWMU/disposal area would be evaluated for TCL/TAL parameters. Based on the rationale provided above, at least one monitoring well downgradient of each SWMU/disposal area has been selected for TCL/TAL parameter analysis, except for SWDA No. 2/Burning Pits A and Burning Pit C. The wells selected to monitor the ground water downgradient of these three SWMU/disposal areas are MW-48 and MW-50.

- Three monitoring wells were selected to evaluate the ground-water quality in central and eastern portions of the site for the TCL/TAL parameters. These monitoring wells are MW-10, MW-46, and MW-58.

- The remaining five new wells were selected to provide ground-water quality data for these TCL/TAL parameters.

The ground water from 13 monitoring wells will also be analyzed for PCBs using SW-846 methods. The rational for the monitoring wells selected for PCB analysis is based on the following criteria:

- Twelve of the 13 monitoring wells were selected because they are hydraulically downgradient of three disposal areas where PCBs were reportedly disposed, including SWDA No. 1, SWDA No.2, and Fiberloid Landfill. These wells are: MW-35, MW-32, MW-31, MW-6, MW-7, MW-36, MW-37, MW-38, MW-47, MW-48, MW-56, and one new monitoring well.

- The new background monitoring well was selected to evaluate background ground-water quality conditions for PCBs.

Ground water will not be analyzed for pesticides because pesticides have not been detected during previous investigations and pesticides were not used or manufactured at the site.

The ground-water samples will be identified, handled, packaged, and shipped using the chain-of-custody procedures provided in the QAPP. The QA/QC for both field and laboratory procedures is also provided in the QAPP.

The laboratory data report will include the QA/QC elements described in Task 2 and detailed in the QAPP. The laboratory report will include a complete documentation package. All laboratory data will be validated using appropriate USEPA and MA-DEP procedures as set forth in the QAPP.

5.6 Task 6 - Final Survey

A final survey will be completed to determine the elevations and locate the 17 soil borings, the 20 surface soil locations, and 10 new monitoring wells (Figure 8) installed/sampled in this supplemental investigation. The surveyors will use the existing Monsanto Plant grid system for horizontal control, and elevation benchmarks, based on National Geodetic Vertical Datum (NGVD) of 1929, for vertical control. The existing Indian Orchard Plant site map prepared by BB&L will be revised using the survey data.

5.7 Task 7 - Supplemental RFI/MCP Phase II Comprehensive Site Assessment Report

A report of the Supplemental RFI/MCP Phase II Comprehensive Site Assessment will be prepared in accordance with USEPA-RFI and MA-DEP 310 CMR 40.545 - Phase II Comprehensive Site Assessment guidelines.

A draft outline of the report is presented below. The report will be organized to include the following sections: Introduction, Implementation Methodology, Results, Evaluation, and Conclusions and Recommendations.

Introduction

The introduction section of the report will include:

- A description of the RFI/MCP Phase II scope of work and objectives; and
- An identification of any work activities completed differently than as described in the work plan.

The introduction section will also include a summary of the results and conclusions.

Implementation Methodology

The methodologies used to complete the work plan will be documented. Documentation will also be provided for any difference between proposed work plan methodologies and actual methodologies, along with justification for any variations in methodologies.

Results

Subsurface Soil/Waste Characterization Data

The report will include for the subsurface soil/waste samples collected, a presentation of the soil boring FID/PID field screening results, grain-size analyses, subsurface soil/waste analytical data, and a sample location map.

Surface Soil Analytical Data

The report will include a presentation of the surface soil analytical data, grain-size analyses, and a sample location map.

Ground Water

The report will include a presentation of the soil boring FID/PID field screening results, grain-size analyses, ground-water analytical data, the ground-water/surface-water elevation data, and a monitoring well location map.

Flood Plain

The report will also include a 100-year flood plain map based on city of Springfield and city of Chicopee, Hamden County flood insurance maps.

The report will also include the following appendices: analytical data summary tables, laboratory data reports, quality assurance analytical data, boring logs, summary table of surface-water and ground-water level data, monitoring well logs, and monitoring well construction details.

Evaluation of Results

The evaluation portion of the report will present the information to fulfill the data needs identified in Section 5.0.

A description of evaluations for each of the data needs are as follows:

SWMU/Disposal Area Physical and Chemical Characterization

For each SWMU/disposal area, a physical and chemical characterization evaluation and an initial assessment of the environmental fate and transport of the potential constituents will be completed. The report will provide a re-assessment of the vertical extent of each SWMU/disposal area, which will also be depicted in cross sections to show depth relationships to ground water and geologic units.

Ground-Water Physical and Chemical Characterization

A refined ground-water total VOC concentration contour will be prepared to evaluate the ground-water migration pathways and to evaluate ground-water quality discharging to the Chicopee River. The ground-water quality adjacent to the Chicopee River will also be used to evaluate impacts, if any, to the surface-water quality in the Chicopee River in the risk assessment.

Vertical gradients from water elevation data collected during ground-water sampling and well inspection will be re-evaluated and compared to the vertical gradient assessment completed for the CSA, (BB&L, March 1987) to confirm the previously observed vertical hydraulic gradients and the hydraulic relationships to surface water bodies (i.e., Bircham Bend Brook and Chicopee River).

Conclusions and Recommendations

Conclusions and Recommendations for future actions will be presented in the report.

6.0 - Schedule

This section presents the schedule for implementing the Supplemental RFI/MCP Phase II Comprehensive Site Assessment Scope of Work on a task-by-task basis. A schedule of the work efforts is provided on Figure 9.

Task 1, Coordination, Scheduling and Preliminary Survey, will be initiated upon Monsanto's approval of the work plan and upon final selection of a drilling contractor. We anticipate that Task 1 will be initiated in mid-May and will take two to three weeks to complete the coordination and preliminary survey. Implementation of Task 1 will include BB&L coordination with Monsanto, the drilling contractor, and the laboratory to prepare for the drilling of soil borings and the collection of surface soil and subsurface soil/waste samples. During this time frame, BB&L will also locate and stake the soil boring locations at SWDA No. 1, SWDA No. 2, LWDA No. 1, and LWDA No. 2 using the existing Monsanto plant grid system.

Tasks 2, 3, and 4 will be conducted simultaneously and will take a total of approximately six weeks. Task 2 will be conducted in approximately three to four weeks and will include soil boring drilling for the collection of surface soil and subsurface soil/waste samples. Task 4 will be conducted in approximately two to three weeks and will include soil boring drilling for monitoring well installation. Task 3, monitoring well inspection of existing wells, will be conducted intermittently during Tasks 2 and 4. The well inspections will be completed prior to finishing Task 4, in the event any monitoring wells require replacement. Task 6, Final Survey, will also be completed at the completion of Task 4.

Tasks 5 and 6 will also be completed simultaneously. Task 5, Ground-Water Sampling and Analysis, will be initiated two weeks following the installation and development of the new monitoring wells. The ground water will be sampled and submitted to IEA Corporation for analysis. Approximately one week is scheduled for the collection of ground-water samples and the measurement of water elevations. Prior to mobilizing to the Indian Orchard Plant for ground-water sampling activities, the sampling containers will be pre-labeled and organized per SWMU/disposal area to facilitate the efficient acquisition of ground-water samples.

For Task 7, Reporting, the data for the report will be compiled and tabulated upon retrieval from the field and laboratory. We anticipate completing the data review approximately four weeks after receiving the analytical data from the laboratory.

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TABLES

Table 1
East Plant Production History
Monsanto Company
Indian Orchard Plant

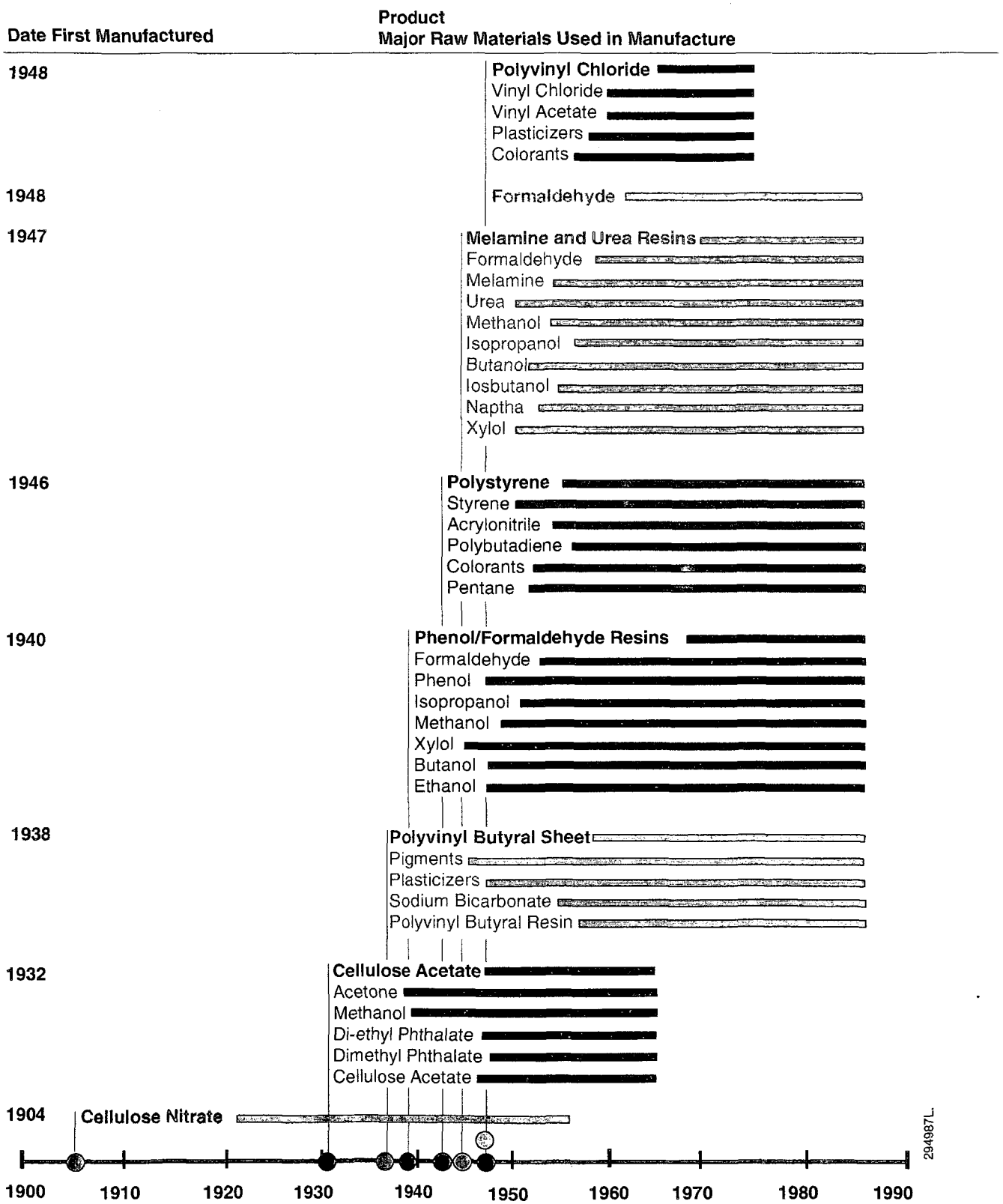

Table 2
West Plant Production History
Monsanto Company
Indian Orchard Plant

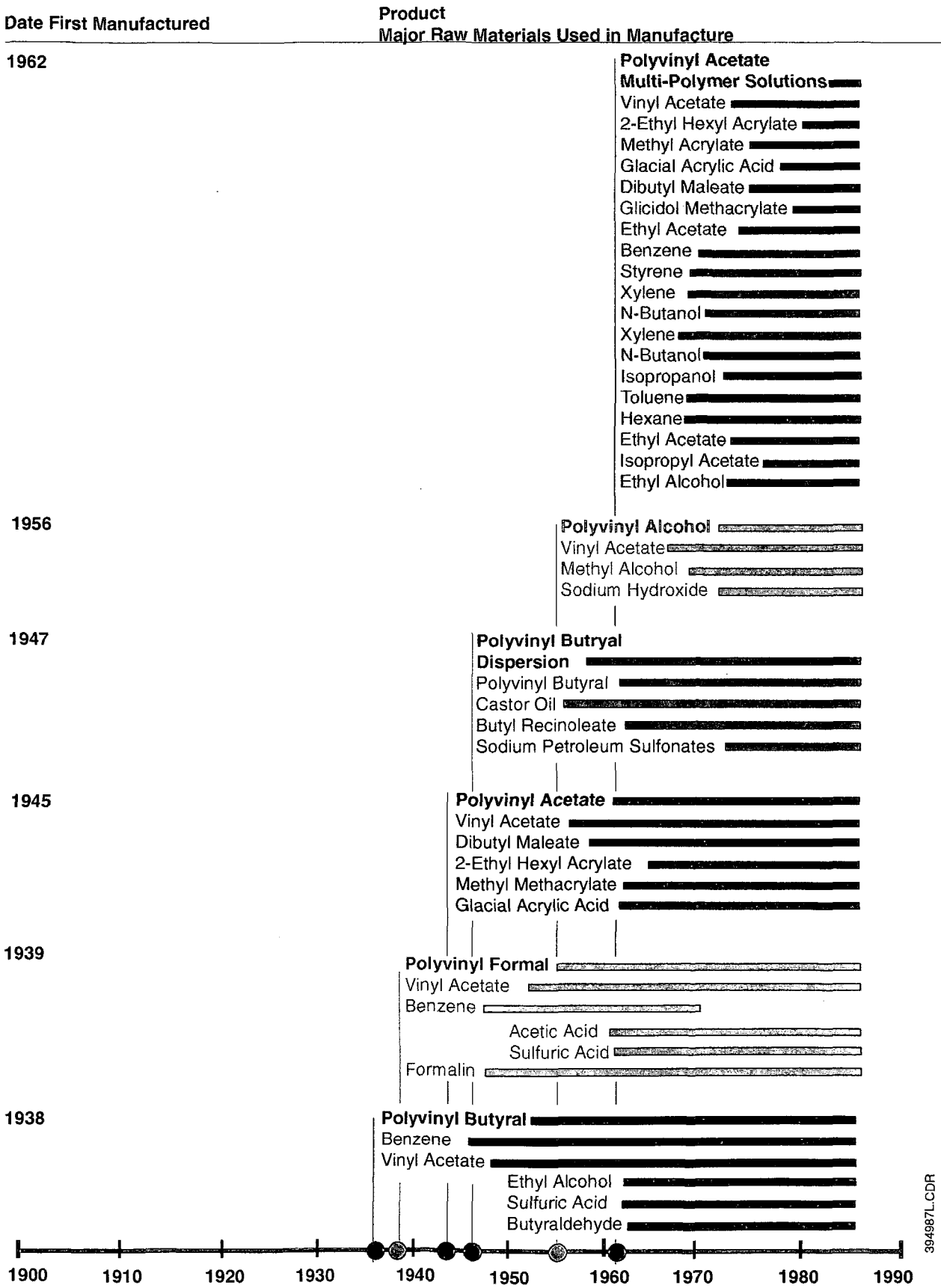

Table 3

Chronology of Previous Investigations
Monsanto Company
Indian Orchard Plant

Date	Author	Title
April 1979	Monsanto Research Corp.	Eckhardt Committee Survey Report
October 1980	Monsanto Research Corp.	Chicopee River Surface Water Analyses
June 10 1981	Monsanto Research Corp.	Analysis of Springfield Surface Water Sample for Priority and Select Non-Pollutants
September 1982	O'Brien & Gere Engineers, Inc.	Ground-Water Investigation Program Plan
December 1982	Monsanto Plastics & Resins Co.	History of On-Site Waste Disposal Operations at Monsanto Company - Springfield and Bircham Bend Plant 1938.
February 1983	O'Brien & Gere Engineers, Inc.	Field Investigation Report
March 10, 1983	Monsanto Research Corp.	Assessment of Hydrogeology and Impact on Water Quality from Past Disposal Practices at the Monsanto Indian Orchard Plant Site
July 27, 1983	Monsanto Research Corp.	Analysis of Indian Orchard Water Sampled
September 29, 1983	Monsanto Research Corp.	Analytical Results for Water Samples from Indian Orchard Plant
February 1984	Blasland & Bouck Engineers	Remedial Investigation Plan
August 1984	Blasland & Bouck Engineers	Phase I Report - Remedial Investigation Plan
October 1984	Blasland & Bouck Engineers	Site Specific Compound Evaluation
December 1984	Blasland & Bouck Engineers	Phase II Report - Remedial Investigation Plan
December 13, 1984	A.S. Alsup & Associates	Earth Penetrating Radar Study - Indian Orchard Plant
February 1985	Blasland & Bouck Engineers	Phase II Report - Remedial Investigation Plan Addendum
September 1986	Blasland & Bouck Engineers	Magnetometer and Test Pit Program in Waste Disposal Areas
January 1987	Blasland & Bouck Engineers	Hazardous Waste Storage Area Investigation, letter report

Table 3

Chronology of Previous Investigations
Monsanto Company
Indian Orchard Plant

Date	Author	Title
March 1987	Blasland & Bouck Engineers	Comprehensive Site Assessment Report
September 20, 1988	Blasland & Bouck Engineers	Waste Water Equalization Facility Tank Foundation Assessment, letter report
October 1988	Blasland & Bouck Engineers	Polysar UST Area Hydrogeologic Investigation Report
November 1988	Blasland & Bouck Engineers	Drum Spill Cleanup Record
October 1989	Blasland & Bouck Engineers	Former Building 44 Hydrogeologic Investigation
August 20, 1992	Blasland & Bouck Engineers	Environmental Sampling Analytical Results, letter report
November 1992	Monsanto Chemical Company/Empire Soils	Geotechnical Investigation Proposed Tanks and Pipe Bridge, Monsanto Indian Orchard Plant
January 5, 1993	Blasland & Bouck Engineers	Monitoring Well Replacement, letter report
1985 to 1992	Blasland & Bouck Engineers	Annual Site-Wide Ground-Water Monitoring
December 30, 1993	Envirox Company	SWMU/RCRA Closures of Two Underground Accumulation Tanks

Table 4A
Summary of Chicopee River Surface-Water Analytical Results

Monsanto Company
Indian Orchard Plant

Compounds Detected	1980 - 1989 Concentrations (ug/L)	No. of Events Detected/ No. of Events Sampled	Analytical Methods
Volatile Organic Compounds			EPA Method 601/602
Chloroform	2 - 3	1/2	
Ethylbenzene	BDL - 2	1/2	
Styrene	BDL - 2	1/2	
Trichloroethene	10	1/3 (Concentrations higher in upstream samples)	EPA Method 624
Semi-Volatile Organic Compounds	Not Monitored		
Phenol	BDL	0/1	
Pentachlorophenol	BDL	0/1	
Inorganic Compounds (Pesticides, PCBs, and Metals)			
PCBs	BDL	0/1	EPA Method 8080
Pesticides	Not Monitored	0/0	
Chloride	10	0/1	
Oil and Grease	5	1/1 (in both upstream and downstream samples)	

Notes:

BDL - Below detection limit.
ug/L = Micrograms per liter.

Table 4B
Summary of Bircham Bend Brook Surface-Water Analytical Results

Monsanto Company
Indian Orchard Plant

Compounds Detected	1981 to 1986 Concentrations (ug/L)	No. of Events Detected/ No. of Events Sampled	Analytical Methods
Volatile Organic Compounds			EPA Method 624
Acetone	BDL - 11	1/2	
Methylene Chloride	BDL - 70	1/2	
Trichloroethane	BDL - 10	1/2	
Xylene	BDL - 4	1/2	
Semi-Volatile Organic Compounds			EPA Method 625
Phenol	BDL - 87	1/2	
Inorganic Compounds (Pesticides, PCBs, and Metals)	(mg/L)		EPA Method 608, 808, 200 series
Arsenic	0.009 - 0.01	2/2	
Beryllium	BDL - 0.0045	1/2	
Cadmium	0.01 - 0.013	2/2	
Chromium	0.02 - 0.094	2/2	
Copper	0.191	1/1	
Nickel	0.107	1/1	
Zinc	0.118	1/1	
Aluminum	0.898	1/1	
Barium	0.221	1/1	
Boron	0.037	1/1	
Iron	1.33 - 10.5	2/2	
Magnesium	10.6	1/1	
Manganese	0.34 - 5.75	2/2	
Cyanide	0.005	1/1	
Pesticides/PCBs	BDL	0/1	
Chloride	50	1/1	

Notes:

BDL - Below detection limit.
ug/L = Micrograms per liter.
mg/L = Milligrams per liter.

Table 4C
Summary of Bircham Bend Brook Sediment Analytical Results

Monsanto Company
Indian Orchard Plant

Compounds Detected	1986 Concentrations (mg/kg)	No. of Events Detected/ No. of Events Sampled	Analytical Methods
Volatile Organic Compounds			Modified EPA Method 624
None Detected	BDL	0/1	
Semi-Volatile Organic Compounds			Modified EPA Method 625
None Detected	BDL	0/1	
Inorganic Compounds (Pesticides, PCBs, and Metals)			Modified EPA Method 608, 808, 200 series
Arsenic	0.06	1/1	
Lead	20	1/1	
Copper	7	1/1	
Mercury	0.16	1/1	
Nickel	6	1/1	
Zinc	36	1/1	
Pesticides/PCBs	BDL	1/1	

Notes:

BDL - Below detection limit.
mg/L = Milligrams per liter.

TABLE 5
Well Construction Details
Monsanto Company
Indian Orchard Plant

Well No.	Installation Date	Development Date	Site Coordinates N	Site Coordinates E	Formation Screened	Well Material	Casing Elevation (ft.)	Ground Elevation (ft.)	Well Stickup (ft.)	Well Diameter (in.)	Well Depth (ft.)	Screen Length (ft.)	Screen Slot (in.)
MW-1	7/13/82	5/85	4217	4906	Medium to coarse sand	SS	167.41	162.80	4.61	2	76.50	3	0.02
MW-2	7/14/82	5/85	4223	4914	Silt	SS	164.42	162.50	1.92	2	22.50	3	0.02
MW-3	7/15/82	5/20/85	3850	4582	Medium sand	SS	176.65	174.20	2.86	2	31.00	3	0.02
MW-4	7/16/82	5/30/85	3512	5926	Fine sand and silt	SS	203.00	201.90	1.45	2	54.00	3	0.02
MW-5	7/20/82	5/20/85	3428	4590	Medium sand	SS	189.32	186.30	2.97	2	47.50	3	0.02
MW-6	7/26/82	5/23/85	3498	3712	Fine sand	SS	149.04	144.30	4.66	2	39.50	3	0.02
MW-7	7/27/82	5/23/85	3497	3722	Fine sand	SS	149.30	144.60	4.93	2	19.50	3	0.02
MW-8	8/25/82	5/21/85	4259	5302	Fine to medium sand and silt	SS	158.89	155.10	3.00	2	24.00	3	0.02
MW-9	8/26/82	5/22/85	4665	4918	Fine to medium sand	SS	163.77	160.50	3.01	2	61.00	3	0.02
MW-10	8/27/82	5/22/85	4670	4924	Fine to medium sand	SS	165.36	160.40	4.00	2	30.00	3	0.02
MW-11	8/31/82	5/85	4237	4173	Fine to medium sand	SS	158.71	154.70	3.00	2	27.00	3	0.02
MW-12	12/13/82	5/23/85	4119	4448	Brown fine to medium sand	SS	162.44	159.50	2.87	2	26.50	3	0.02
MW-13	11/29/83	5/85	4285	4520	Brown-gray fine sand and silt	PVC	163.05	162.20	1.00	2	29.00	10	0.02
MW-14	12/1/83	5/85	4331	4238	Brown-gray fine sand	SS	163.90	162.10	1.00	2	29.00	10	0.02
MW-15	12/1/83	5/85	4327	4271	Gray fine sand	SS	164.04	162.00	1.99	2	29.00	10	0.02
MW-16	12/19/83	5/85	4502	4251	Gray-brown fine sand	SS	163.51	162.00	1.63	2	29.00	3	0.02
MW-17	12/18/84	5/30/85	4360	4242	Gray fine to medium sand and red silt	SS	166.03	162.00	4.03	2	71.00	25	0.02
MW-18	12/19/84	5/85	4346	4284	Gray fine to medium sand and red silt	SS	164.56	161.90	2.66	2	72.00	25	0.02
MW-19	12/28/84	5/28/85	3808	2798	Brown medium to very coarse sand	PVC	139.53	137.10	2.60	2	24.00	5	0.01
MW-20	1/2/85	5/28/85	3812	2798	Brown medium to coarse sand	PVC	139.80	137.20	2.62	2	17.00	5	0.01
MW-21	1/3/85	5/29/85	3111	3681	Gray fine sand	PVC	143.85	141.40	2.65	2	26.50	5	0.006
MW-22	1/4/85	5/29/85	3115	3683	Gray fine to very coarse sand	PVC	144.23	141.60	2.60	2	15.10	5	0.006
MW-23	5/8/85	5/30/85	3525	5879	Red Arkose bedrock	PVC	207.39	204.30	3.09	2	225.50	20	0.02
MW-24	2/7/85	5/25/85	3894	3599	Red fine to coarse sand	PVC	146.45	143.90	2.75	2	70.00	5	0.006
MW-25	2/8/85	5/25/85	3894	3602	Gray-brown fine to medium sand	PVC	146.27	143.80	2.43	2	39.00	5	0.006
MW-26	2/11/85	5/25/85	3890	3600	Gray fine to medium sand	PVC	146.25	143.80	2.55	2	24.00	5	0.01
MW-27	Not Installed												
MW-28	2/13/85	5/29/85	4114	3281	Gray fine sand	PVC	145.20	142.70	2.65	2	46.00	5	0.006
MW-29	2/14/85	5/29/85	4114	3285	Brown fine sand	PVC	145.19	142.80	2.55	2	23.00	5	0.01
MW-30	2/15/85	5/20/85	3650	4913	Brown fine sand	PVC	174.62	172.00	2.70	2	85.50	5	0.006
MW-31	2/18/85	5/20/85	3651	4918	Brown-gray fine to medium sand	PVC	174.94	172.20	2.90	2	24.85	5	0.01
MW-32	2/21/85	5/16/85	3750	5499	Brown fine sand	PVC	206.21	203.10	3.30	2	61.00	5	0.006
MW-33	2/26/85	5/20/85	3877	4625	Brown fine to medium sand	PVC	176.71	174.20	2.68	2	94.00	5	0.006
MW-34	2/28/85	5/20/85	3423	4599	Brown medium sand	PVC	188.56	186.20	2.54	2	75.80	5	0.006
MW-35	3/4/85	5/16/85	3753	5494	Brown fine to medium sand	PVC	206.11	203.20	3.04	2	106.25	5	0.01

See Notes on Page 2.

TABLE 5
Well Construction Details
Monsanto Company
Indian Orchard Plant

Well No.	Installation Date	Development Date	Site Coordinates N	Site Coordinates E	Formation Screened	Well Material	Casing Elevation (ft.)	Ground Elevation (ft.)	Well Stickup (ft.)	Well Diameter (in.)	Well Depth (ft.)	Screen Length (ft.)	Screen Slot (in.)
MW-36	3/11/85	5/17/85	3946	5164	Gray fine sand	PVC	191.46	189.40	3.50	2	101.20	5	0.006
MW-37	3/13/85	5/17/85	3941	5164	Brown fine to medium sand	PVC	191.67	189.50	2.40	2	48.00	5	0.006
MW-38	3/18/85	5/17/85	3943	5160	Red silt	PVC	192.07	189.30	2.75	2	135.30	5	0.006
MW-39	3/20/85	5/21/85	4258	5306	Brown fine to coarse sand	PVC	157.25	154.90	2.58	2	68.00	5	0.006
MW-40	3/21/85	5/21/85	4090	4842	Brown fine sand	PVC	176.07	173.80	2.45	2	47.50	5	0.006
MW-41	3/25/85	5/21/85	4086	4842	Mottled coarse sand and gravel	PVC	176.56	173.70	3.01	2	75.30	5	0.02
MW-42	3/27/85	5/23/85	4994	2814	Gray-green fine to medium sand	PVC	136.87	134.20	2.82	2	64.00	5	0.02
MW-43	4/2/85	5/23/85	4994	3071	Gray-brown fine to medium sand	PVC	141.27	139.50	1.94	2	62.10	5	0.006
MW-44	4/4/85	5/23/85	4990	3067	Brown medium to coarse sand	PVC	141.59	139.50	2.18	2	26.00	5	0.006
MW-45	4/8/85	5/29/85	4688	3741	Red fine to coarse sand and gravel	PVC	146.80	144.32	2.48	2	35.00	5	0.006
MW-46	4/10/85	5/29/85	4688	3737	Green-brown fine to medium sand	PVC	146.86	144.15	2.71	2	25.00	5	0.006
MW-47	4/11/85	5/24/85	3480	3478	Gray fine to medium sand	PVC	144.00	141.50	2.45	2	34.00	5	0.006
MW-48	4/12/85	5/24/85	3483	3482	Brown medium to coarse sand	PVC	144.27	141.60	2.69	2	17.00	5	0.006
MW-49	4/18/85	5/28/85	4414	2905	Gray fine sand and silt	PVC	144.94	143.00	2.16	2	72.20	5	0.006
MW-50	4/22/85	5/28/85	4510	2904	Gray fine to medium sand	PVC	145.00	143.00	2.23	2	30.20	5	0.006
MW-51	4/24/85	5/29/85	3646	4318	Brown medium to coarse sand	PVC	159.26	157.00	2.42	2	70.30	5	0.01
MW-52	4/25/85	5/30/85	3646	4315	Brown-gray fine to medium sand	PVC	159.33	157.00	2.38	2	34.00	5	0.006
MW-53	4/30/85	5/23/85	4114	4445	Gray-green fine to coarse sand	PVC	161.87	159.30	2.71	2	77.90	5	0.006
MW-54	5/3/85	5/22/85	5254	4562	Red silt	PVC	148.42	145.80	2.59	2	52.00	5	0.006
MW-55	5/6/85	5/22/85	5251	4562	Red silt	PVC	148.26	145.90	2.34	2	35.00	5	0.006
MW-56	5/9/85	5/22/85	5485	5138	Red silt	PVC	136.09	133.60	2.63	2	20.30	5	0.006
MW-57	2/22/85	NA	4360	2955	Red silt	NA	143.44	141.90	1.69	2	NA	NA	NA
MW-58	6/19/86	6/25/86	4781	6516	Fine sand, trace silt	PVC	142.61	140.60	2.01	2	23.00	10	0.01
MW-59	6/19/86	6/25/86	4588	6889	Fine to coarse sand	PVC	145.48	143.40	2.08	2	27.00	10	0.01
MW-60	6/20/86	6/25/86	4183	6193	Silt and fine sand, trace coarse sand	PVC	145.28	143.20	2.08	2	20.00	10	0.01
MW-61	7/12/88	7/12/88	5300	6039	Coarse sand and gravel, to fine sand and silt	PVC	142.59	140.60	1.99	2	22.25	5	0.01
MW-62	7/12/88	7/12/88	5464	6035	Fine to coarse sand; red silt, glacial till	PVC	136.40	136.75	-0.35	2	21.15	15	0.01
MW-63	7/13/88	7/13/88	5454	5988	Silt, to sand, silt and gravel	PVC	134.85	135.37	-0.52	2	21.94	15	0.01
MW-64	6/13/89	6/15/89	5010	5135	Sand, some silt	PVC	141.58	141.92	-0.34	2	19.00	5	0.01
MW-65	6/14/89	6/15/89	5178	5121	Fine to medium sand, little silt	PVC	144.49	144.46	0.03	2	20.00	15	0.01
MW-66	6/14/89	6/15/89	5229	5049	Ash/sand fill; coarse sand to fine silty sand	PVC	144.66	144.90	-0.24	2	20.00	15	0.01
MW-67	6/15/89	6/15/89	5235	4918	Fine to coarse sand, to silty sand	PVC	144.15	144.40	-0.25	2	20.00	15	0.01
MW-68	12/12/92	NA	4244	5255	Silt, little fine sand	PVC	154.62	152.90	1.72	2	55.00	5	0.01
MW-69	12/12/92	NA	4242	5251	Fine sand, some silt	PVC	154.80	152.90	1.90	2	24.00	5	0.01

Notes:

SS = Stainless steel.
PVC = Polyvinyl chloride.
NA = Not available.

Table 6— XXV

Summary of Ground–Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
August 1982	Metals, chloride, fluoride, total phenol, sulfate, TOC, TOX	SWDA #1 & LWDA #1	MW–1, MW–2, MW–3, MW–8, through MW–12	PHENOL, CHLORIDE
		LWDA #2	MW–5	PHENOL
		SWDA #2	MW–6, MW–7	PHENOL
				CHROMIUM, LEAD, BARIUM, CADMIUM
	Organic compounds	SWDA #1 & LWDA # 1	MW–11	METHYLPHENOL (ISOMER)
		LWDA #2	MW–5	ETHYLBENZENE, DIMETHLYBENZENE, DIMETHYL PHENOL
September 1983	RCRA metals, TOC, TOX, phenol, chlorides	SWDA #1 & LWDA #1	MW–1 through MW–3 MW–8 through MW–12	ARSENIC, BARIUM, CADMIUM, LEAD, IRON, MANGANESE, SODIUM, SILVER, SELENIUM, PHENOL, CHLORIDE
		Upgradient of Disposal Area	MW–4	BARIUM, CADMIUM, IRON, MANGANESE, SODIUM, SILVER, PHENOL, CHLORIDE
		SWDA #2	MW–6	BARIUM, CADMIUM, IRON, LEAD, MANGANESE, SODIUM, SELENIUM, PHENOL, CHLORIDE
	RCRA metals, TOC, TOX, phenol, chlorides & VOCs (EPA Method 624)	LWDA #2	MW–5	BARIUM, CADMIUM, IRON, LEAD, MANGANESE, SODIUM, SELENIUM, XYLENE
January 1983	Organic compounds	SWDA #1 & LWDA # 1	MW–11	TOLUENE
		LWDA #2	MW–5	ETHYLBENZENE, XYLENE
April 1983, May 1984, and September 1985	pH, total suspended solids, TOC, TOX	SWDA #1 & LWDA #1	MW–1, MW–2, MW–3, MW–8, through MW–12	Not Applicable
		LWDA #2	MW–5	Not Applicable
		SWDA #2	MW–6, MW–7	Not Applicable
May 9, 1984	TOC, TOX, TDS	Upgradient of Disposal Areas	MW–4	Not Applicable
		SWDA #1 & LWDA #1	MW–1, MW–2, MW–3, MW–8, through MW–12	Not Applicable
		LWDA #2	MW–5	Not Applicable
		SWDA #2	MW–6, MW–7	Not Applicable
June 4, 1984	Priority pollutant + 40 (purgeable aromatics and halocarbons, SVOCs, PCBs, pesticides, metals, phenols, cyanide, TOC) (Methods 624, 625, 608, 335.2, 200 series)	Upgradient of Disposal Areas	MW–4	ND
		SWDA #1 & LWDA #1	MW–11	NICKEL
		LWDA #2	MW–5	TOLUENE, ETHYLBENZENE
May 29, 1985	Purgeable aromatics and halocarbons, acrolein and acrylonitrile (Methods 601,602 & 603)	SWDA #1	MW–30, MW–31,	ND
		LWDA #1	MW–40, MW–41	BENZENE, CHLOROBENZENE, XYLENE
		SWDA #1 & LWDA #1	MW–11, MW–53	METHYLENE CHLORIDE, 1,2 – DICHOROPROPANE, ETHLYBENZENE, BENZENE
		LWDA #2	MW–5	XYLENE
		SWDA #2	MW–21, MW–47	ND
		Building 99 Leach Fields/Burning Pit B	MW–24, MW–26	BENZENE, CHLOROBENZENE, TOLUENE, XYLENE
		Burning Pit C	MW–49, MW–50	TRICHLOROBENZENE, BENZENE
		Burning Pit D	MW–44	ND
		Fiberloid Landfill	MW–55	CHLOROFORM

Table 6
Summary of Ground-Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
June 24, 1985 through June 27, 1985	Purgeables (Method 624)			
		SWDA #1	MW-32	TETRACHLORETHENE
		LWDA #1	MW-41	BENZENE, CHLOROBENZENE, XYLENE
		SWDA #1 & LWDA #1	MW-9, MW-10	ND
		Building 99 Leach Fields/Burning Pit B	MW-25	BENZENE, CHLOROBENZENE
		Burning Pit D	MW-43	BENZENE, CHLOROBENZENE
		Fiberloid Landfill	MW-56	ND
	Priority pollutants (Method 624, 625, 608, 335.2, 200 series)			
		Upgradient of Site	MW-4	ND
		SWDA #1	MW-6, MW-31	BENZENE, CHLOROBENZENE, XYLENE, VINYL CHLORIDE
		LWDA #1	MW-36, MW-40	1,2-DICHLOROETHANE, BENZENE, CHLOROBENZENE, XYLENE
		SWDA #1 & LWDA #1	MW-11, MW-46	ND
		LWDA #2	MW-5	METHYLENE CHLORIDE, XYLENE
		SWDA #2	MW-47	ND
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-26	BENZENE, CHLOROBENZENE, XYLENE
		Burning Pit C	MW-49	ND
		Burning Pit D	MW-43, MW-44	BENZENE, CHLOROBENZENE
July 15, 1985 through July 22, 1985	Purgeables (Method 624)			
		Upgradient of Site	MW-4, MW-23	ND
		SWDA #1	MW-6, MW-31, MW-32, MW-39	TETRACHLOROETHENE, 1,2 - DICHLOROETHANE, BENZENE, CHLOROBENZENE
		LWDA #1	MW-40, MW-41, MW-36	BENZENE, CHLOROBENZENE, 1,2-DICHLOROPROPANE
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-46, MW-53	BENZENE, CHLOROBENZENE, ETHYLBENZENE
		LWDA #2	MW-5	METHYLENE CHLORIDE, XYLENE
		SWDA #2	MW-47,	ND
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26	BENZENE, CHLOROBENZENE, XYLENE
		Burning Pit C	MW-49	ND
		Burning Pit D	MW-43, MW-44	BENZENE, CHLOROBENZENE
		Fiberloid Landfill	MW-56	ND

Table 6
Summary of Ground-Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
July 15, 1985 through July 22, 1985	SVOCs, Pesticides, Metals, Cyanide, Phenols. (Method 625, 608, 604, 335.2 200 series)	Upgradient of Site	MW-4	ND
		SWDA #1	MW-31, MW-36	ND
		LWDA #1	MW-40	ND
		SWDA #1 & LWDA #1	MW-11	ND
		LWDA #2	MW-5	ND
		SWDA #2	MW-47	ND
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-26	ND
		Burning Pit C	MW-49	ND
		Burning Pit D	MW-43, MW-44	ND
August 30, 1985 through Sept. 6, 1985	Purgeables, Styrene, Allyl Alcohol Allyl Alcohol, Acrylonitrile, TOX, TOC, TDS (Method 601, 602, 603, 415.1, 450.1, 160.1)			
		Upgradient of Site	MW-4, MW-23	ND
		SWDA #1	MW-8, MW-30, MW-31, MW-32, MW-35	ND
		LWDA #1	MW-36, MW-37, MW-38, MW-39	ND
			MW-3, MW-33, MW-40, MW-41	ND
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-12, MW-13	ND
			MW-45, MW-46, MW-53	ND
		LWDA #2	MW-5, MW-34, MW-51, MW-52	ND
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21	ND
			MW-22, MW-47, MW-48	ND
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26, MW-28, MW-29	ND
		Burning Pit C	MW-49, MW-50, MW-57	ND
		Burning Pit D	MW-42, MW-43, MW-44	ND
		Fiberloid Landfill	MW-54, MW-55, MW-56	ND
		Formaldehyde	MW-14, MW-15, MW-17, MW-18	ND
	Purgeables (Method 601/602)			
		Upgradient of Site	MW-23	ND
		SWDA #1	MW-30, MW-35	1,1,1 - TRICHLOROETHANE,
		LWDA #1	MW-37, MW-38, MW-39	1,2 - DICHLOROPROPANE, TETRACHLOROETHENE
			MW-3, MW-33	BENZENE, CHLOROBENZENE
		SWDA #1 & LWDA #1	MW-9, MW-12, MW-13	ND
			MW-45, MW-53	MW-53 ONLY; BENZENE, CHLOROBENZENE
		LWDA #2	MW-34, MW-51, MW-52	ND
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21	TOLUENE, XYLENE, MW-7 ONLY;CHLOROBENZENE
			MW-22, MW-48	MW-19 ONLY; 1,1,1 - TRICHLOROETHANE,
		Building 99 Leach Fields/Burning Pit B	MW-28, MW-29	MW-28 ONLY; BENZENE, CHLOROBENZENE
		Burning Pit C	MW-50	1,2 - DICHLOROETHANE, 1,1,1 - TRICHLOROETHANE
		Burning Pit D	MW-42	ND
		Fiberloid Landfill	MW-54, MW-55	CHLOROFORM, MW-55 ONLY; TOLUENE
August 25, 1987	Appendix XIII & IX Compounds			
	Pesticides (Method 8080)	Upgradient of Site	MW-4	ND
	Organophosphorus Pest. (Method 8140)	LWDA #1	MW-41	ACETONE, CHLOROBENZENE
	Herbicides (Method 8150)			2-CHLOROPHENOL, BIS(2-CHLOROETHYL)ETHER
	Metals (Method 6010)			Library search (isomers) : benzene, chloro-, 1,4-oxathiane, butane,1,1'-[methylenebis(oxy)]
	Phenols, total			*bis-,4h-1,3-benzodioxin,butane,t-propoxy-.*
	Semivolatiles (Method 8270)			ARSENIC, BARIUM
	Volatiles (Method 8240)			
	Sulfides & fluorides, totals			
	Cyanide, total			

Table 6
Summary of Ground-Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
August 25, 1987	See preceding page	LWDA #2	MW-5	CARBON DISULFIDE, METHLYENE CHLORIDE, XYLENE Library search : unknown, silane,(fluoromethyl)trimethyl; alkane, propane,1,1'-oxybis[2-methyl; unknown, vanadium, (ETA.7cycloheptatrienylium) BIS(2-ETHYLHEXYL)PHTHALATE Library search ; benzene methyl-; CHROMIUM, SILVER
		Building 99 Leach Fields/Burning Pit B	MW-25	ACETONE, BENZENE, CHLOROBENZENE BIS(2-CHLOROETHYL)ETHER Library search (isomers) : benzene, chloro-; butane,1,1'-[methylenebis(oxy)]; butane,1,-propoxy- CYANIDE ARSENIC, BARIUM, CHROMIUM, LEAD
		Burning Pit D	MW-43	CHLOROBENZENE, BIS(2-CHLOROETHYL)ETHER Library search eight TICs CYANIDE ARSENIC, BARIUM, SILVER
Aug. 14, 1987 through Aug. 28, 1987	Purgeables, plus styrene (Method 601/602)			
		Upgradient of Site	MW-4, MW-23	See Table 7
		SWDA #1	MW-30, MW-31, MW-32, MW-35	See Table 7
		LWDA #1	MW-36, MW-37, MW-38, MW-39 MW-3, MW-8, MW-33, MW-40, MW-41	See Table 7
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-12, MW-13 MW-45, MW-46, MW-53	See Table 7
		LWDA #2	MW-5, MW-34, MW-51, MW-52	
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21 MW-22, MW-47, MW-48	See Table 7
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26, MW-28, MW-29	See Table 7
		Burning Pit C	MW-49, MW-50, MW-57	See Table 7
		Burning Pit D	MW-42, MW-43, MW-44	See Table 7
		Fiberloid Landfill	MW-54, MW-55, MW-56	See Table 7
		Formaldehyde	MW-14, MW-15, MW,-16, MW-17, MW-18	See Table 7
Feb. 8, 1988	Purgeables plus styrene (Method 601/602)			
		Upgradient of Site	MW-4	See Table 7
		SWDA #1	MW-30, MW-31	See Table 7
		SWDA #2	MW-47	See Table 7
		LWDA #1	MW-36, MW-41, MW-53	See Table 7
		LWDA #2	MW-5	See Table 7
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26	See Table 7
		Burning Pit C	MW-49, MW-50	See Table 7
		Burning Pit D	MW-44	See Table 7
		Former Drum Storage Area	MW-58, MW-59	See Table 7

Table 6
Summary of Ground-Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
March 21, 1989	Purgeables plus styrene (Method 601/602)			
		Upgradient of Site	MW-4, MW-23	See Table 7
		SWDA #1	MW-30, MW-31, MW-32, MW-35	See Table 7
		LWDA #1	MW-36, MW-37, MW-38, MW-39	See Table 7
			MW-3, MW-8, MW-33, MW-40, MW-41	
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-12, MW-13	See Table 7
			MW-45, MW-46, MW-53	
		LWDA #2	MW-5, MW-34, MW-51, MW-52	See Table 7
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21	See Table 7
			MW-22, MW-47, MW-48	
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26, MW-28, MW-29	See Table 7
		Burning Pit C	MW-49, MW-50, MW-57	See Table 7
		Burning Pit D	MW-42, MW-43, MW-44	See Table 7
		Fiberloid Landfill	MW-54, MW-55, MW-56	See Table 7
		Formaldehyde	MW-14, MW-15, MW-17, MW-18	See Table 7
		Former Drum Storage Area	MW-58, MW-59	See Table 7
		Polysar UST Area	MW-61, MW-62, MW-63	See Table 7
December 1990	Purgeables plus styrene (Method 601/602)			
		Upgradient of Site	MW-4, MW-23	See Table 7
		SWDA #1	MW-31, MW-32, MW-35	See Table 7
		LWDA #1	MW-36, MW-37, MW-38, MW-39	See Table 7
			MW-3, MW-8, MW-33, MW-40, MW-41	
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-12, MW-13	See Table 7
			MW-45, MW-46, MW-53	
		LWDA #2	MW-5, MW-34, MW-51, MW-52	See Table 7
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21	See Table 7
			MW-22, MW-47, MW-48	
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26, MW-28, MW-29	See Table 7
		Burning Pit C	MW-49, MW-50, MW-57	See Table 7
		Burning Pit D	MW-42, MW-43, MW-44	See Table 7
		Fiberloid Landfill	MW-54, MW-55, MW-56	See Table 7
		Formaldehyde	MW-14, MW-15, MW-17, MW-18	See Table 7
		Former Drum Storage Area	MW-58, MW-59	See Table 7
		Polysar UST Area	MW-61, MW-63	See Table 7
		Former Building 44 Area and Tank Farm E	MW-65, MW-64	See Table 7
October 1991	Purgeables plus styrene (Method 601/602)			
		Upgradient of Site	MW-4, MW-23	See Table 7
		SWDA #1	MW-31, MW-32, MW-35	See Table 7
		LWDA #1	MW-36, MW-37, MW-38, MW-39	See Table 7
			MW-3, MW-8, MW-40, MW-41	
		SWDA #1 & LWDA #1	MW-9, MW-10, MW-11, MW-12, MW-13	See Table 7
			MW-45, MW-46, MW-53	
		LWDA #2	MW-5, MW-34, MW-51, MW-52	See Table 7
		SWDA #2	MW-6, MW-7, MW-19, MW-20, MW-21	See Table 7
			MW-22, MW-47, MW-48	
		Building 99 Leach Fields/Burning Pit B	MW-24, MW-25, MW-26, MW-28, MW-29	See Table 7
		Burning Pit C	MW-49, MW-50, MW-57	See Table 7
		Burning Pit D	MW-42, MW-43, MW-44	See Table 7
		Fiberloid Landfill	MW-54, MW-55, MW-56	See Table 7
		Formaldehyde	MW-14, MW-15, MW-17, MW-18	See Table 7
		Former Drum Storage Area	MW-58, MW-59, MW-60	See Table 7
		Polysar UST Area	MW-61, MW-62, MW-63	See Table 7
		Former Building 44 Area and Tank Farm E	MW-65, MW-64	See Table 7

Table 6
Summary of Ground-Water Quality Monitoring

Monsanto Company
Indian Orchard Plant

Dates Sampled	Parameters Analyzed	Location	Wells Sampled	Summary of Compounds Detected *
May 12, 1992	TCL/TAL Compounds Pesticides Method 8080 Metals Method 6010 Semivolatiles Method 8270 Volatiles Method 8240			
		Upgradient of Site	MW-23	2-BUTANONE, TETRAHYDROFURAN, BIS(2-ETHYLHEXYL)PHTHALATE 8 UNKNOWN TICS
		LWDA #1	MW-41	CHLOROBENZENE BIS(2-CHLOROETHYL)ETHER, BIS(2-ETHYLHEXYL)PHTHALATE Library search (isomers) : benzene, chloro-, butane,1,1'-[methylenbis(oxy)] bis- , 15 unknowns. ARSENIC, BARIUM,
		LWDA #2	MW-5	CHLOROBENZENE Library search : propane,1,1'-oxybis[2-methyl; N-butyl ether; BIS(2-ETHYLHEXYL)PHTHALATE Library search ; butane,1,1'-(methylenebisoxy)bis- ;14 unknowns.
		Building 99 Leach Fields/Burning Pit B	MW-25	CHLOROBENZENE BIS(2-CHLOROETHYL)ETHER, 2-CHLOROPHENOL, Library search (isomers): chlorobenzene; benzene; butane,1,1'-[methylenebis(oxy)] bis-; 18 unknowns. ARSENIC, BARIUM, ALUMINUM
		Burning Pits D	MW-43	CHLOROBENZENE, BIS(2-CHLOROETHYL)ETHER Library search: 1,4-OXATHIANE; CHLOROBENZENE, 19 UNKNOWNS. ARSENIC, BARIUM
		Former Building 44 and Tank Farm E	MW-65	CHLOROBENZENE, ETHYLBENZENE, 1,4-DICHLOROBENZENE, Library search: chlorobenzene(isomer), dibutoxymethanol, benzene(isomer), 6 unknowns. ARSENIC, ALUMINUM

Notes:

TOTAL ORGANIC CARBON (TOC)
TOTAL DISSOLVED SOLIDS (TDS)
TOTAL ORGANIC HALOGEN (TOX)
purgeables - PURGEABLE VOLATILE ORGANICS
Priority Pollutants - purgeable aromatics and halocarbons, acid extractables/base neutrals, PCBs, pesticides, metals, phenols, cyanide.
TCL/TAL - Target Compound List and Target Analyte List.
TICs - Tentatively Identified Compounds
ND - Not detected.

* Compounds listed were detected in one or more of the monitoring wells located down gradient of the given plant area.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results In ug/L								
SWMU/Disposal Area	Monitoring Well No.	Parameter	June 1985	July 1985	Aug. 1985	Aug. 1987	Feb. 1988	Mar. 1989	Dec. 1990	Oct. 1991	May 1992
SWMU 35/Solid Waste Disposal Area No. 1	31 S	Benzene	2	o	---	8	6	5	6 (8)	o	---
		Chlorobenzene	44	o	---	86	130	100	65 (77)	180	---
		Ethylbenzene	10	o	---	170	o	o	o (o)	o	---
		Vinyl Chloride	o	o	---	o	o	o	2 (2)	o	---
		Xylenes	410	o	---	3	220	400	120 (140)	o	---
	30 D	Tetrachloroethene	---	---	1	o	o	o	---	---	---
	32 S	Tetrachloroethene	4	2	---	2	---	2	o	o	---
	35 D	1,1,1-Trichloroethane	---	---	2	1	---	2	1	1	---
		Toluene	---	---	1	o	---	o	o	o	---
	23 R	2-Butanone	o	o	o	o	---	o	o	o	[48]
		Tetrahydrofuran	o	o	o	o	---	o	o	o	[160]
		Toluene	o	o	o	o	---	1	3	2 (2)	o
	52 S	Chlorobenzene	---	---	---	o	---	3	o	7	---
		Methylene Chloride	---	---	o	3	---	o	o	o	---
SWMU 36/Solid Waste Disposal Area No. 2	7 S	Chlorobenzene	---	---	3	o	---	o	3	3	---
		Xylenes	---	---	2	o	---	o	o	o	---
	48 S	Chlorobenzene	---	---	o	o	---	o	1	o	---
		Xylenes	---	---	2	o	---	3	o	o	---
	6 D	Methylene Chloride	---	---	o	o	---	o	1	o	---
		Toluene	---	---	o	o	---	1 (o)	o	o	---

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results in ug/L								
SWMU/Disposal Area	Monitoring Well No.	Parameter	June 1985	July 1985	Aug. 1985	Aug. 1987	Feb. 1988	Mar. 1989	Dec. 1990	Oct. 1991	May 1992
SWMU 34/Liquid Waste Disposal Area No. 1	41 D	Benzene	67	47	---	26	43	35	o	11 (10)	o
		Chlorobenzene	4400	3000	---	2200	3800	3200	1700	2300 (2000)	1300
		Ethylbenzene	o	o	---	o	o	o	o	o	o
		Xylenes	12	o	---	o	o	o	o	o	o
	3 S	Benzene	---	---	o	o	---	o	o	3	---
		Chlorobenzene	---	---	2	o	---	6	o	97	---
	33 D	Benzene	---	---	13	2 (3)	---	---	4	---	---
		Chlorobenzene	---	---	1100	140 (310)	---	---	330	---	---
		Chloroform	---	---	o	2 (1)	---	---	o	---	---
	12 S	Chlorobenzene	---	---	o	11	---	o	40	45	---
	53 D	Benzene	27	19	25	30	18	14	o (o)	o	---
		Chlorobenzene	2500	1700	2500	3000	4400	4500	2700 (2300)	2600	---
	38 T	Chlorobenzene	---	---	o	o	o	o	4	o	---
	37 S	1,2-Dichloropropane	---	---	9	16 (28)	---	2	2	1	---
		Tetrachloroethene	---	---	310	230 (260)	---	270	100	120	---
	36 D	Benzene	16	14	---	7 (6)	6	5	3	9	---
		Chlorobenzene	660	660	---	630 (550)	590	520	430	690	---
		1,2-Dichloroethane	3	o	---	o	o	o	o	o	---
		1,2-Dichloropropane	o	2	---	o	o	o	o	o	---
		Xylene	2	o	---	2(2)	o	o	o	o	---
	8 S	Chlorobenzene	2	o	---	3	---	1	o	o	---

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results in ug/L								
SWMU/Disposal Area	Monitoring Well No.	Parameter	June 1985	July 1985	Aug. 1985	Aug. 1987	Feb. 1988	Mar. 1989	Dec. 1990	Oct. 1991	May 1992
SWMU 37/Liquid Waste Area No. 2	5 S	Benzene	o	o	---	o	o	o	1	o	---
		Chlorobenzene	o	o	---	o	o	o	1	8	---
		Methylene Chloride	21	14	---	o	o	o	o	o	9
		Xylenes	1000	320	---	620	660	230	o	o	---
SWMU 33/ Fiberloid Landfill	55 S	Chloroform	---	---	1	o	---	o	o	o	---
		Dichloroethane	---	---	o	2	---	o	2	1	---
		Toluene	---	---	25	o	---	o	o	o	---
		1,1,1-Trichloroethane	---	---	o	o	---	o	2	o	---
	54 D	Chloroform	---	---	8	o	---	o	o	o	---
		1,1-Dichloroethane	---	---	o	o	---	o	o	1	---
	56 S	Benzene	o	o	---	o	---	1	o	o	---
		Chlorobenzene	o	o	---	4	---	o	o	o	---
		Tetrachloroethene	1	o	---	o	---	o	o	o	---
SWMU 47/ Building 99 Leach Fields	26 S	Benzene	58	52	---	o(2)	3	3	o	o	o
		Chlorobenzene	520	490	---	o(330)	360	450	380	510	830
		Xylenes	65	57	---	4(10)	4	5	o	o	o
	25 D	Benzene	90	110	---	40	98	3	o	o	o
		Chlorobenzene	1400	1200	---	1700	2900	140	2000	2600 (2400)	1400
		Xylenes	o	46	---	31	95	o	o	o	o

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results In ug/L								
SWMU/Disposal Area	**Monitoring Well No.**	**Parameter**	**June 1985**	**July 1985**	**Aug. 1985**	**Aug. 1987**	**Feb. 1988**	**Mar. 1989**	**Dec. 1990**	**Oct. 1991**	**May 1992**
SWMU 47/ Building 99 Leach Fields	28 D	Benzene	---	---	34	°(3)	---	2	14(13)	10(9°)	---
		Chlorobenzene	---	---	700	17(150)	---	87	720(660)	600(550)	---
		Xylenes	---	---	14	2(3)	---	°	°(°)	°	---
	19 D	Benzene	---	---	°	°	°	°	1	°	---
		Chlorobenzene	---	---	°	5	°	°	°	°	---
		Xylenes	---	---	3	3	°	2	2	3	---
SWMU 38/ Burning Pits A	See SWMU 36/Solid Waste Disposal Area No. 2.										
SWMU 39/ Burning Pit B	See SWMU 47/Building 99 Leach Fields.										
SWMU 40/ Burning Pit C	50 S	Benzene	---	---	4	°	13	10	13	6	---
		Chlorobenzene	---	---	1	°	°	°	°	°	---
		1,2-Dichloroethane	---	---	2	2	1	°	°	°	---
		t-1,2 Dichloroethene	---	---	3	3	3	2	°	°	---
		Toluene	---	---	1	°	°	°	°	°	---
		1,1,1-Trichloroethane	---	---	8	°	°	°	°	°	---
		Trichloroethene	---	---	°	3	5	3	2	°	---
	49 D	Chlorobenzene	---	---	°	°	°	°	1	°	---
SWMU 41/ Burning Pits D and SWMU 30/ 336 Drum Storage Area	44 S	Chlorobenzene	°	°	---	2	°	°	°	°	---
		1,1-Dichloroethane	°	°	---	°	°	°	°	1	---
		1,1,1-Trichloroethane	°	°	---	°	°	°	°	6	---
	43 D	Benzene	47	43	---	12	---	°	16 (16)	21 (21)	---
		Chlorobenzene	1100	1300	---	720	---	500 (530)	1100 (1100)	1600 (1700)	---

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results In ug/L								
SWMU/Disposal Area	Monitoring Well No.	Parameter	June 1985	July 1985	Aug. 1985	Aug. 1987	Feb. 1988	Mar. 1989	Dec. 1990	Oct. 1991	May 1992
AOC7/ Former Building 44 and Tank Farm E	65 S							(June 1989)*			
		Benzene	***	***	***	***	***	o	27	o	o
		Chlorobenzene	***	***	***	***	***	13	2000	2300 (2100)	2600 (2200)
		1,2-Dichloroethane	***	***	***	***	***	4	o	o	o
		Ethylbenzene	***	***	***	***	***	65	30	100(100)	230(420)
		Toluene	***	***	***	***	***	6	o	o	o
		Xylene	***	***	***	***	***	38	47	o	o
								(June 1989)*			
	67 S	Chlorobenzene	***	***	***	***	***	6,300	---	---	---
Former Drum Storage Area	58 S	Vinyl Chloride	---	---	---	16(17)	12	11	10	5	---
	59 S	Methylene Chloride	---	---	---	2	o	o	o	o	---
Formaldehyde Area	14 S	Chlorobenzene	---	---	5	3	---	o	o	o	---
		Xylene	---	---	1	1	---	o	o	o	---
		Toluene	---	---	4	o	---	2	1	o	---
	15 S	Chloroform	---	---	o	1	---	o	o	o	---
		Chlorobenzene	---	---	13	3	---	o	o	o	---
		Toluene	---	---	1	o	---	7	2	o	---
	18 D	Benzene	---	---	o	210	---	o	o	o	---
		Chlorobenzene	---	---	o	31	---	o	o	o	---
		t-1,2 Dichloroethene	---	---	o	o	---	1	o	o	---

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

			Analytical Results in ug/L								
SWMU/Disposal Area	Monitoring Well No.	Parameter	June 1985	July 1985	Aug. 1985	Aug. 1987	Feb. 1988	Mar. 1989	Dec. 1990	Oct. 1991	May 1992
Formaldehyde Area	18 D	1,2 Dichloropropane	---	---	o	o	---	4	o	o	---
		Ethylbenzene	---	---	o	230	---	o	o	o	---
		Toluene	---	---	1	o	---	o	o	o	---
		Trichloroethene	---	---	o	o	---	3	o	o	---
	17 D	Chlorobenzene	---	---	17	o	---	o	o	o	---
		1,2 Dichloropropane	---	---	o	4	---	o	o	o	---
		Toluene	---	---	1	3	---	o	o	o	---
		Xylene	---	---	o	2	---	o	o	o	---
	16 S	Methylene Chloride	---	---	---	1	---	---	o (o)	o	---
		Chloroform	---	---	---	12	---	---	o (o)	o	---
Novacor (formerly Polysar UST Area)	63 S						(July 1988)*	(Mar. 1989)*			
		Chloroform	***	***	***	***	6	36	o	o	---
		Ethylbenzene	***	***	***	***	360	2,700	o	1500	840
		Styrene	***	***	***	***	4	290	o	o	o
		Toluene	***	***	***	***	18	62	o	o	o
	62 S						(July 1988)*	(Mar. 1989)*			
		Ethylbenzene	***	***	***	***	o	o	---	49,000	50,000 (38,000)
		Styrene	***	***	***	***	o	o	---	26,000	95,000 (76,000)

See Additional Notes on Page 7

*Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.

TABLE 7

Summary of Ground-Water Analytical Results - Volatile Organic Compounds Detected*
Monsanto Company
Indian Orchard Plant

NOTES: *Analytical results from wells in which all volatile organic compounds were below detection limits are not included in table.
Compounds are shown only when found at greater than detection levels.
All ground-water samples were analyzed using EPA Method 601/602 for volatile organics, and styrene, except June 1985, July 1985, August 1987, and May 1992 that were analyzed using EPA Method 8240.

KEY:

June 85	= Samples collected June 19 to June 27, 1985, analyzed by OBG Laboratories.
July 85	= Samples collected July 15 to July 22, 1985, analyzed by OBG Laboratories.
August 85	= Samples collected August 28 to September 6, 1985, analyzed by OBG Laboratories.
August 87	= Samples collected August 18 to August 27, 1987, analyzed by OBG Laboratories.
February 88	= Samples collected February 8 to February 10, 1988, analyzed by OBG Laboratories.
(July 88)	= Samples collected July 27, 1988, analyzed by Upstate Laboratories, Inc.
March 89	= Samples collected March 12 to March 29, 1989, analyzed by OBG Laboratories.
(March 89)	= Samples collected March 20, 1989, analyzed by Upstate Laboratories.
(June 89)	= Samples collected June 29, 1989, at Former Building 44 Area only, analyzed by Upstate Laboratories.
December 90	= Samples collected November 27 through December 4, 1990, analyzed by OBG Laboratories.
October 91	= Samples collected October 15 through October 17, 1991, analyzed by OBG Laboratories.
May 92	= Samples collected May 12 and 13, 1992, analyzed by OBG Laboratories.

ug/L	= Micrograms per liter.
S	= Shallow well of cluster.
D	= Deep well of cluster.
T	= Till well of cluster.
R	= Bedrock well of cluster.

---	= No analysis performed.
"0"	= Below detection limit.
( )	= Value found in duplicate sample vial.
***	= No analysis performed, monitoring well not installed yet.
*	= Date sampled not part of site-wide annual monitoring program but included in this table to monitor trends.
@	= Concentration less than detection limits - reported as an approximate concentration.
[ ]	= Compound and value suspect - may be due to repair of well.

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

AUGUST 27, 1987(1) APPENDIX IX		MAY 12, 1992(2) TCL/TAL	
MW-4(3)		MW-23	
Volatile Organics (ug/L) Method 8240			
	BDL	2-butanone	48
Volatile Organic TICs (ug/L)			
	BDL	tetrahydrofuran	160J
Semivolatile Organics (ug/L) Method 8270			
	BDL	bis(2-ethylhexyl)-phthalate	11
Semivolatile Organic TICs (ug/L)			
	BDL	8 Unknowns	164J*
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Herbicides/Pesticides (ug/L) Method 8140, 8150			
	BDL	NA	
Metals (mg/L)			
Method SW-846, 6000 Series		**Method SW-846, 7000 Series**	
aluminum, totals	<0.057	aluminum, totals	3.6
barium, totals	0.031	barium, totals	<0.1
cadmium, totals	0.0047	cadmium, totals	<0.01
calcium, totals	24.5	calcium, totals	9
copper, totals	<0.003	copper, totals	0.02
iron, totals	0.132	iron, totals	5.1
magnesium, totals	6.05	magnesium, totals	1
manganese, totals	0.093	manganese, totals	.1
nickel, totals	0.143	nickel, totals	<0.05
sodium, totals	24.0	sodium, totals	26
zinc, totals	0.040	zinc, totals	0.07
Cyanide (mg/L) Method 9010			
	0.010		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

AUGUST 27, 1987(1) APPENDIX IX		MAY 13, 1992(2) TCL/TAL	
MW-5		MW-5	
Volatile Organics (ug/L) Method 8240			
acetone	20B	acetone	<20
carbon disulfide	17	carbon disulfide	<10
methylene chloride	8	methylene chloride	<10
xylene (total)	300	xylene (total)	<10
chlorobenzene	<17	chlorobenzene	9
Volatile Organic TICs (ug/L)			
2 unknowns	79J		BDL
Propane, 2-methyl-	19J	Propane, 2-methyl-	BDL
Propane, 1,1-oxybis,(2-methyl-)	58J	Propane, 1,1-oxybis,(2-methyl-)	BDL
		N-butyl ether	48J
Semivolatile Organics (ug/L) Method 8270			
bis(2-ethylhexyl)-phthalate	45	bis(2-ethylhexyl)-phthalate	12
Semivolatile Organic TICs (ug/L)			
butane,1,1'-(methylenebisoxy) bis-	440J	butane,1,1'-(methylenebisoxy) bis-	42J
9 isomers/unknowns	534J	14 isomers/unknowns	450J*
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Herbicides/Pesticides (ug/L) Method 8140, 8151			
	BDL	NA	
Metals (mg/L)			
Method SW-846, 6000 Series		**Method SW-846, 7000 Series**	
barium, totals	0.158	barium, totals	0.2
calcium, totals	32.6	calcium, totals	17
chromium, totals	0.012	chromium, totals	<0.01
iron, totals	31.3	iron, totals	18
lead, totals	0.0032	lead, totals	<0.05
magnesium, totals	3.82	magnesium, totals	3
manganese, totals	12.1	manganese, totals	4.8
silver, totals	0.010	silver, totals	<0.01
sodium, totals	26.2	sodium, totals	61
zinc, totals	0.18	zinc, totals	0.11
Cyanide (mg/L) Method 9010			
	0.010		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

AUGUST 27, 1987(1) APPENDIX IX		MAY 13, 1992(2) TCL/TAL	
MW-25		MW-25	
Volatile Organics (ug/L) Method 8240			
acetone	50J	acetone	<200
benzene	43J	benzene	<100
chlorobenzene	1,300	chlorobenzene	1,400
Volatile Organic TICs (ug/L)			
	BDL		BDL
Semivolatile Organics (ug/L) Method 8270			
bis(2-chloroethyl)-ether	820	bis(2-chloroethyl)-ether	330
2-chlorophenol	<100	2-chlorophenol	16
Semivolatile Organic TICs (ug/L)			
butane,1,1'-(methylenebisoxy) bis-	150J	butane,1,1'-(methylenebisoxy) bis-	BDL
chlorobenzene (isomer)	920J	chlorobenzene (isomer)	680J
benzene (isomer)	BDL	benzene (isomer)	42J
1 isomer/unknown	44J	18 isomers/unknowns	444J*
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Herbicides/Pesticides (ug/L) Method 8140, 8150			
	BDL	NA	
Metals (mg/L)			
Method SW-846, 6000 Series		**Method SW-846, 7000 Series**	
aluminum, totals	BDL	aluminum, totals	0.1
arsenic, totals	0.079	arsenic, totals	0.060
barium, totals	0.585	barium, totals	0.6
calcium, totals	29.6	calcium, totals	42
chromium, totals	0.046	chromium, totals	<0.01
copper, totals	0.013	copper, totals	<0.01
iron, totals	8.1	iron, totals	12
lead, totals	0.0078	lead, totals	<0.05
magnesium, totals	8.91	magnesium, totals	14
manganese, totals	0.145	manganese, totals	0.15
sodium, totals	133	sodium, totals	140
zinc, totals	0.039	zinc, totals	<0.01
Cyanide (mg/L) Method 9010			
	0.010		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

AUGUST 27, 1987(1) APPENDIX IX		MAY 13, 1992(2) TCL/TAL	
MW-41		MW-41	
Volatile Organics (ug/L) Method 8240			
acetone	8J	acetone	<100
chlorobenzene	1,200	chlorobenzene	1,300
Volatile Organic TICs (ug/L)			
	BDL		BDL
Semivolatile Organics (ug/L) Method 8270			
bis(2-chloroethyl)-ether	98	bis(2-chloroethyl)-ether	89
2-chlorophenol	13J	2-chlorophenol	<10
bis(2-ethylhexyl)-phthalate	BDL	bis(2-ethylhexyl)-phthalate	19
Semivolatile Organic TICs (ug/L)			
butane,1,1'-(methylenebisoxy) bis-	15J	butane,1,1'-(methylenebisoxy) bis-	BDL
chlorobenzene (isomer)	1,700J	chlorobenzene (isomer)	BDL
3 isomers/unknowns	61J	15 isomers/unknowns	776J*
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Herbicides/Pesticides (ug/L) Method 8140, 8150			
	BDL	NA	
Metals (mg/L)			
Method SW-846, 6000 Series		**Method SW-846, 7000 Series**	
arsenic, totals	0.0052	arsenic, totals	0.010
barium, totals	0.297	barium, totals	0.3
calcium, totals	170	calcium, totals	28
iron, totals	8.56	iron, totals	28
magnesium, totals	3.64	magnesium, totals	8
manganese, totals	0.33	manganese, totals	1.7
sodium, totals	113	sodium, totals	79
zinc, totals	0.031	zinc, totals	<0.01
Cyanide (mg/L) Method 9010			
	BDL		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

AUGUST 27, 1987(1) APPENDIX IX		MAY 13, 1992(2) TCL/TAL	
MW-43		MW-43	
Volatile Organics (ug/L) Method 8240			
chlorobenzene	640	chlorobenzene	830
Volatile Organic TICs (ug/L)			
	BDL		BDL
Semivolatile Organics (ug/L) Method 8270			
bis(2-chloroethyl)-ether	570	bis(2-chloroethyl)-ether	360
Semivolatile Organic TICs (ug/L)			
1,4-oxathiane	18J	1,4-oxathiane	28J
chlorobenzene (isomer)	210J	chlorobenzene (isomer)	BDL
7 unknowns/isomers	107J	19 unknowns/isomers	844J*
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Herbicides/Pesticides (ug/L) Method 8140, 8150			
	BDL	NA	
Metals (mg/L)			
Method SW-846, 6000 Series		**Method SW-846, 7000 Series**	
arsenic, totals	0.027	arsenic, totals	0.037
barium, totals	0.22	barium, totals	0.4
calcium, totals	49.6	calcium, totals	41
iron, totals	4.84	iron, totals	32
magnesium, totals	7.54	magnesium, totals	9
manganese, totals	5.83	manganese, totals	3.3
silver, totals	17	silver, totals	<0.01
sodium, totals	168	sodium, totals	100
zinc, totals	0.037	zinc, totals	<0.01
Cyanide (mg/L) Method 9010			
	0.010		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List Ground-Water Analytical Results Monsanto Company Indian Orchard Plant

May 12, 1992 TCL/TAL		May 12, 1992 TCL/TAL	
MW-65		MW-65 (Duplicate) MW-76	
Volatile Organics (ug/L) Method 8240			
Chlorobenzene	2600	Chlorobenzene	2200
Ethylbenzene	230	Ethylbenzene	420
Volatile Organic TICs (ug/L)			
	BDL		BDL
Semivolatile Organic (ug/L) Method 8270			
1,4-Dichlorobenzene	18	1,4-Dichlorobenzene	16
		Bis(2-ethylhexyl)phthalate	12
Semivolatile Organic TICs (ug/L)			
5 unknowns	114	8 Unknowns	876 J
Benzene, chloro	640		
Benzene, (isomer)	320	Benzene (isomer)	360 J
Methanol, dibutoxy	38	Methanol, dibutoxy	38 J
Phenol, - (1,1 dimeth(isomer))	30	Phenol, - (1,1 dimeth (isomer))	26 J
Pesticides/PCBs (ug/L) Method 8080			
	BDL		BDL
Metals (mg/L) Method SW-846, 7000 Series			
aluminum, total	6.4	aluminum, total	6.6
arsenic, total	0.006	arsenic, total	0.006
barium, total	0.4	barium, total	0.4
calcium, total	48	calcium, total	47
chromium, total	0.01	chromium, total	0.01
copper, total	0.02	copper, total	0.02
iron, total	20	iron, total	21
manganese, total	1.1	manganese, total	1.1
magnesium, total	6	magnesium, total	6
potassium, total	11	potassium, total	11
sodium, total	220	sodium, total	210
zinc, total	0.06	zinc, total	0.06
Cyanide (mg/L) Method 9010			
	<0.01		<0.01

See Notes on Page 7

TABLE 8

Summary of TCL/TAL and Appendix IX List
Ground-Water Analytical Results
Monsanto Company
Indian Orchard Plant

Notes:

TCL/TAL - Target compound list and target analyte list.
NA - Analysis not performed.
<10 - Not detected above the 10 ug/L detection limit.
TIC - Tentatively identified compound.
J - Estimated concentration below detection limit.
B - Compound was also detected in blank.
BDL - Below detection limit.
(1) - August 27, 1987 Appendix IX analysis performed by Compu Chem Laboratories.
(2) - May 14, 1992 TCL/TAL analysis performed by OBG Laboratories.
(3) - MW-4 and MW-23 are upgradient wells located within 10 feet of each other. MW-4 (missing since March 1989) was 54 feet deep, and MW-23 is 225 feet deep.
* - Represents sum total of semivolatile organic TICs.
Only metals detected above quantitation limits are provided in this table.
ug/L - Micrograms per liter.
mg/L - Milligrams per liter.

TABLE 9

RCRA Facility Investigation Guidance (RFIG) for Work Plan Development
Monsanto Company
Indian Orchard Plant

RFIG Description	Status	Work Plan Location	Additional Reference Documents
2.0 RFI Work Plan			
2.2 Preparation of an RFI Work Plan			
2.2.1 Description of Current Conditions			
2.2.1.1 Facility Background			
Summary of:			
– regional location	Included in Work Plan	Page 4	Work Plan & CSA
– boundary features	Updated in Work Plan	Page 7, 8	RIP Phase I Report
– general physiography	Updated in Work Plan	Page 7	RIP Phase I Report
– hydrogeology	Updated in Work Plan	Page 10–13	CSA
– historical use of facility	Updated in Work Plan	Page 4	CSA & RIP Phase I Report
Maps of:			
– general geographic location	Updated in Work Plan	Page 4	CSA
– property lines	To be included in Work Plan	Page 7	
– *topography and surface water*	*Updated in Work Plan*	*Page 7, 9*	CSA
– tanks, buildings, utilities, paved areas, easements, rights–of–way	To be updated in Report	–	
– hazardous waste storage, treatment, or disposal areas	Updated in Work Plan	Page 1	CSA
– all known past (see above)	Updated in Work Plan	Page 1	CSA
– all known past and present USTs or piping	To be included in Report	–	
– surrounding land use	Completed in Work Plan	Page 8	
– location of all monitoring wells and production wells	Updated in Work Plan	Page 21	CSA
– location of any injection wells	NA	–	RIP Phase I Report
History and Description of Ownership and Operation	Updated in Work Plan	Page 4	CSA, History of On–Site
Approximate Dates of Disposal, Identification, and amount of materials	Updated in Work Plan	Page 4, 28	CSA, History of On–Site
Summary of past permits, enforcement actions, and investigations.	Updated in Work Plan	Page 5	CSA
2.2.1.2 Nature and Extent of Contamination			
Summary of source areas for SWMUs identifying:			
– location of SWMU	Updated in Work Plan	Page 27–36	CSA
– quantities of waste	Supplemented in Work Plan	Page 27–36	CSA
– constituents to the extent known	Supplemented in Work Plan	Page 27–36	CSA
– identification of data gaps	Included in Work Plan	Page 36, 38	RIP Phase II Report
– horizontal extent of wastes	Supplemented in Work Plan	Page 27–36	RIP Phase I Report
Description of degree and extent of contamination on specific media			RIP Phase I Report
–available monitoring data			CSA
*ground water	Included in Work Plan	Page 37–48	CSA &RIP Phase II Addendum
*subsurface soils	Included in Work Plan	Page 28–36	CSA &RIP Phase II
*surface water	Included in Work Plan	Page 51–54	CSA
*sediment	Included in Work Plan	Page 51–54	CSA
*surface soils	Included in Work Plan	Page 54	
*air	Included in Work Plan	Page 54	
–potential migation pathways	Updated in Work Plan	Section 4	CSA
–potential impacts (Receptors)	Updated in Work Plan	Section 4	CSA
2.2.1.2 Present Implementation of Interim Corrective Measures			
Objectives	NA		
Design requirements	NA		
Schedules of construction	NA		
Schedules for reports	NA		
2.2.2 Schedule for Specific RFI Activities	Included in Work Plan	Page 73	

TABLE 9

RCRA Facility Investigation Guidance (RFIG) for Work Plan Development
Monsanto Company
Indian Orchard Plant

RFIG Description	Status	Work Plan Location	Additional Reference Documents
2.2.3 Characterizing Contaminant Source and Environmental Settings			
Characterizing Source	Included in Work Plan	Appendix A	
– evaluation of waste management records	Included in Work Plan	Section 5.0	SSCE & CSA
– sampling and analysis	Included in Work Plan		
– identification of indicator parameters	Included in Work Plan	Page 24	SSCE & CSA
– SWDA construction	Updated in Work Plan	Section 4	RIP Phase I Report
– source control (Cover)			
– 3–D distribution of source	To be completed in Report	Section 5	
– quantity of source	Included in Work Plan	Task Section 4	CSA
– location of source relative to other sources	Included in Work Plan	Task Section 4	CSA
– specific media compatibility with source	Included in Work Plan	Task Section 5	SSCE & CSA
– physical, chemical, and biological process vs. fate and transport	Included in Work Plan	Section 4	
Environmental Setting			
– insert media specific investigations	Included in Work Plan	Section 5	CSA
– Geology and Hydrogeology	Updated in Work Plan	Page 10 & 12	CSA
2.2.4 Monitoring and Data Collection Procedures			
–past	Included in Work Plan	Appendix B	RI Phase I and RI Phase II
–present	Attached in QAPP		
2.2.5 Assembling Existing Data to Characterize the Contaminate Release	Included in Work Plan	Section 3 & 4	
2.2.6 Quality Assurance Quality Control Procedures (see section 4)	Included in QAPP	QAAP	
2.2.7 Data Management and Reporting Procedures	Included in QAPP	QAAP	
2.2.8 Identification of Potential Receptors			
Existing and possible future ground–water uses	Updated in Work Plan	Page 7	CSA & RIP Phase I Report
Location of ground–water users	Updated in Work Plan	Page 9	RIP Phase I Report
Existing and possible future uses of surface water	Updated in Work Plan	Page 9	CSA
Human use and access to facility	Updated in Work Plan	Page 55	CSA
Description of the biota and surface water adjacent to facility	To be completed in Report	NA	
Description of the ecology on and adjacent to facility	To be completed in Report	NA	
Demographic profile of the human population accessing the facility	To be completed in Report	NA	
List of endangered species near the facility	To be addressed in Report	NA	
2.2.9 Health and Safety Procedures	Included in HASP	HASP	

Notes:
Work Plan – RFI/MCP Phase II Work Plan (BB&L, May 1994)
Report – RFI/MCP Phase II Report (BB&L, Scheduled for December 1994)
NA – Not applicable
CSA – Comprehensive Site Assessment (BB&L, March 1987)
RIP – Remedial Investigation Plan (BB&L, February 1984)
SSCE – Site Specific Compound Evaluation (BB&L, October 1984)
QAPP – Quality Assurance Project Plan (BB&L, May 1994)
HASP – Health and Safety Plan (BB&L, May 1994)
RIP Phase I – Remedial Investigation Phase I report (BB&L, August 1984)
RIP Phase II – Remedial Investigation Phase II, Vol. 1 and Vol. 2 (BB&L, December 1984)
RIP Addendum – Addendum Phase II Report Remedial Investigation Plan (BB&L, February 1985)

History of On–Site – History of On–Site Waste Disposal Operations at Monsanto Company (Monsanto, December 1982)

TABLE 10

MCP Phase II Comprehensive Site Assessment Requirements for Work Plan Development
Monsanto Company
Indian Orchard Plant

310 CMR MCP Phases I and II Conditions	Status	Work Plan Location	Additional Reference Documents
40.543 Phase I – Limited Site Investigation			
Location History			
Past and present owners	Updated in Work Plan	Page 4	CSA
Past and present uses	Updated in Work Plan	Page 4	CSA
Types of materials used at the site	Updated in Work Plan	Page 4	CSA
History of disposal methods	Updated in Work Plan	Page 4	CSA
Location of wells, piping, storage tanks, septic systems	Updated in Work Plan	Page 37	CSA
Summary of releases	Included in Work Plan	Page 5 & 15	CSA
Location description			
Geographical location on USGS Quad	Included in Work Plan	Figure 1	CSA
Representation of location – plot plan, topo maps, aerial photos	Included in Work Plan	Figure 2	RIP Phase I
Characterization of geology, hydrogeology, and hydrogeologic conditions	Included in Work Plan		CSA
Description of the present conditions			
– evidence of a release	Included in Work Plan	Section 3	CSA & RIP Phase I
– any damage to the environment	Included in Work Plan	Section 4	CSA
– any evidence of filling or excavations	Included in Work Plan		RIP Phase I
Utility placement in the vicinity of the area	Included in Work Plan	Page 37	CSA & RIP Phase I
Initial characterization of migration pathways, receptors, and exposure points			
– location of water supply wells		Section 4	RIP Phase I
– characterization for potential for human contact	Updated in Work Plan	Section 4	
– surrounding land use	Included in Work Plan	Page 7	
– identification of surface water recreational or recharges public water supply wells	Included in Work Plan	Section 4	
– food chain exposure pathways	To be included in Report		
– identification of nearby environmentally sensitive areas	To be included in Report		
Initial location sampling and screening			
– to: determine the priority of disposal area	Updated in Work Plan	Page 2	CSA
– to: identify types of and quantities of wastes	Updated in Work Plan	Section 2	CSA
– to: characterize pathways and extent of migration	Updated in Work Plan	Section 4	CSA
Techniques used	Included in QAPP	QAAP	RIP Phase I
QAQC must be documented	Included in QAPP	QAAP	Previous Investigations Documented in RIP
Site Health and Safety Plan Must be prepared	Attached as HASP	HASP	
Evaluation of short term measures	NA		
40.544 Interim Disposal Site Classification System			
3.c Indian Orchard Plant disposal areas were classified as non–priority	Completed	November 1986	
40.545 Phase II – Comprehensive Site Assessment			
Phase II Scope of Work			
A plan to fill in the data gaps indentified in the Phase I and 40.545	Included in Work Plan	Section 5	
A schedule	Included in Work Plan	Section 6	
A sampling plan for all media and protocols (if media are not included in the sampling plan, justification will be provided)	Included in Work Plan	Section 5 & QAPP	
A Quality Assurance Project Plan	Included in QAPP	QAPP	
A Health and Safety Plan	Included in HASP	HASP	

TABLE 10

MCP Phase II Comprehensive Site Assessment Requirements for Work Plan Development
Monsanto Company
Indian Orchard Plant

310 CMR MCP Phases I and II Conditions	Status	Work Plan Location	Additional Reference Documents
Phase II Activities			
Investigation of Physical Characteristics			
– site map with Universal Transverse Mercator and Lat. and Long.	Included in Work Plan		
– characterize topo., surface drainage, and vegetation	Included in Work Plan	Figure 2	
– identification and characterization of surface water	Included in Work Plan	Page 9	
– characterization of flooding potential	Included in Work Plan	Page 9	
– identification and characterization of wetland and critical habitat	To be included in Report		
– types of overburden materials, thicknesses, soil classification, and permeabilities	Included in Work Plan	Page 24	CSA
– characterization of bedrock and depth to bedrock	Included in Work Plan	Page 10	CSA
– water–table elevations, horizontal and vertical gradients, and ground–water flow rate and direction	Included in Work Plan	Page 12	CSA
– existing and future land uses	Included in Work Plan	Page 37	RIP Phase I
– meteorological and ambient air, utilities, if pertinent	To be included in Report		
Identification of Source and Extent of Release			
– sources of release	Included in Work Plan	Page 4	CSA & RIP Phase I
– horizontal and vertical extent	Included in Work Plan	Section 4 & 5	
– estimated volume of materials, contaminated soils, and water	Updated in Work Plan	Section 4	CSA
– potential migration pathways including soil, ground water, surface water, air, and food chain	Included in Work Plan	Section 4	
– existence of plume of material in the ground water and potential migration of the plume	Included in Work Plan	Section 4	
– potential of air emissions from disposal site	Included in Work Plan	Section 4 & 5	
Identification of Exposure Points and Determination of Exposure Point Concentrations			
– identify human and environmental receptors, current and future	Included in Work Plan	Section 4	CSA
– identify exposure points for above receptors	Included in Work Plan	Section 4	CSA
– identify routes for exposures for above exposure points	Included in Work Plan	Section 4	CSA
– determine exposure point concentrations	Included in Work Plan	Section 4	CSA
Results of the Phase II provided on maps			
– site characteristics	Included in Work Plan	Section 3 & 4	CSA
– source of releases	Included in Work Plan	Section 3	CSA
– extent of concentrations of releases in all media		Figure	CSA
– future migration of release			CSA
Characterization of Risk of Harm to Human Health	To be included in Report		
Characterization of Risk of Harm to Safety, Public Welfare, and the Enviroment	To be included in Report		
Phase II Report			
Summary of findings and conclusions	To be included in Report		
Phase II scope of work	To be included in Report		
Physical characteristics	To be included in Report		
Source and extent of release	To be included in Report		
Characterization of materials	To be included in Report		
Identification of exposure points and exposure point concentrations	To be included in Report		
Identification of background levels	To be included in Report		
Characterization of risk to harm to human health	To be included in Report		
Characterization of risk to harm to safety, public welfare, and to environment	To be included in Report		
Conclusions	To be included in Report		
Recommendations for future actions	To be included in Report		
Appendices of:	To be included in Report		
– raw data and summary of data	To be included in Report		
– documentation of revisions to the approved scope of work	To be included in Report		

Notes:
Work Plan – RFI/MCP Phase II Work Plan (BB&L, May 1994)
Report – RFI/MCP Phase II Report (BB&L, Scheduled for December 1994)
NA – Not applicable
CSA – Comprehensive Site Assessment (BB&L, March 1987)
RIP – Remedial Investigation Plan (BB&L, February 1984)
SSCE – Site Specific Compound Evaluation (BB&L, October 1984)
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HASP – Health and Safety Plan (BB&L, May 1994)
RIP Phase I – Remedial Investigation Phase I report (BB&L, August 1984)
RIP Phase II – Remedial Investigation Phase II, Vol. 1 and Vol. 2 (BB&L, December 1984)
RIP Addendum – Addendum Phase II Report Remedial Investigation Plan (BB&L, February 1985)

History of On–Site – History of On–Site Waste Disposal Operations at Monsanto Company (Monsanto, December 1982)

Table 11
SWMU/Disposal Areas
Summary of Operation History and Physical Characteristics

Monsanto Company
Indian Orchard Plant

SWMU/ Disposal Area	Location and Plant Coordinates	Source of Waste	Dates of Operation	Types of Waste Received	Size (acres)	Maximum Depth (ft.)	Volume (cubic yards)	Average Depth to Ground Water (ft.)
SWMU 35/Solid Waste Disposal Area No. 1	Southwest Corner of East Plant N3350-N3800, E4900-E5700	Springfield Plant (East Plant)	1952 - 1970s	Trash Construction Debris Scrap Plastics and Resins Colorants & Stabilizers Electric Transformers	5.8	45	220,000	~~40~~ to 52 37
SWMU 36/Solid Waste Disposal Area No. 2	Southeast Corner of West Plant N3300-N3500, E3400-E4400	Springfield Plant	1966 - 1970s	Same as Above	3.0	10-14	46,000	10
SWMU 34/Liquid Waste Disposal Area No. 1	Southwest Corner of East Plant N3800-N4100, E4700-E5150	Springfield Plant Bircham Bend (West Plant)	1954 - 1972	Waste Solvents Oils Sludges	2.7	35	58,000	10-30
SWMU 37/Liquid Waste Disposal Area No. 2	West of SWDA 1 E4700, N3500	Unknown	1960s	Unknown	.2±	15-20	7,400±	40
SWMU 33/Fiberloid Landfill	North-Central East Plant N5150-N5600, E4650-E550	Springfield Plant	1935 - 1940	Construction Debris Coal Plant Ash	7.0	20	225,000	14
SWMU 47/Building 99 Leach Fields	West of Building 99 (Saflex Building) N4000-E3600	Saflex Building	1969 - 1970s	Solvents - Toluene, DMF inks	Unknown	N/A	N/A	12
SWMU 38/Burning Pit A	Southeast Corner of West Plant N3500-E4340	Springfield Plant	1952 - 1954	Same as SWDA 2 (SWMU 36)	Description is included with SWDA 2 (SWMU 36).			
SWMU 39/Burning Pit B	Beneath Bldg. 99	Bircham Bend Plant	1966 - 1968					
SWMU 40/Burning Pit C	Western Edge of West Plant N4260-N4400, E2930-E3020	Springfield Plant	1960 - 1968	Plant Trash Plastic Scrap	1.0	20	4,300±	18
SWMU 41/Burning Pits D	Northwest Corner of West Plant N5000-E3000	Bircham Bend Plant	1939 - 1961	Plant Trash - Fiber Barrels, Construction Debris, Scrap Plastic	0.2	25	4,000 to 7,000	18

Table 11 (cont.)
SWMU/Disposal Areas
Summary of Operation History and Physical Characteristics

Monsanto Company
Indian Orchard Plant

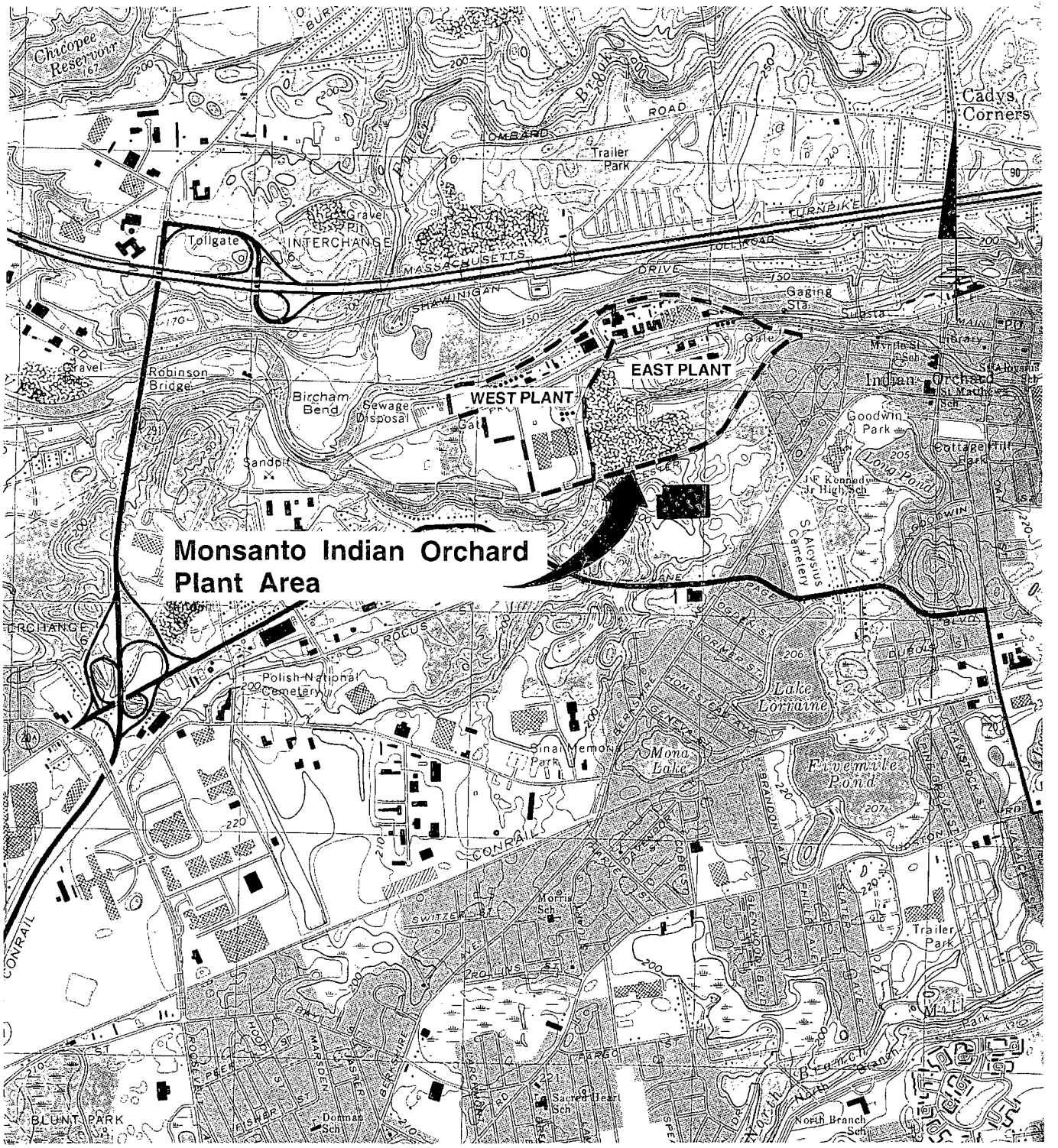
SWMU/ Disposal Area	Location and Plant Coordinates	Source of Waste	Dates of Operation	Types of Waste Received	Size (acres)	Maximum Depth (ft.)	Volume (cubic yards)	Average Depth to Ground Water (ft.)
AOC 7/Former Building 44 & Tank Farm E	North-Central East Plant N5100-E5000	Phenolic and Melamine Resins Process	Unknown - 1989	Possible MEK and Styrene	3.0	NA	NA	12
SWMU 16/ Accumulation Area/ Gelva East Storage Tank	North-Central West Plant N5100-E4000	Gelva Process	Unknown - Present	Possible Ethyl Alcohol, Polyvinyl, Formal Acetic Acid Solution, and Toluene	Unknown	NA	NA	NA
SWMU 30/336 Drum Storage Area	Northwest Corner West Plant N5100-E3000	Storage of 55-gallon drums of wastes from Gelva Process, Butvar Process, and Pilot Plant	Later 1920s - Present	Possible Waste Oil, Spent Plasticizers, Lab Wastes	0.2	NA	NA	18
West Resins Area	North-Central West Plant N5100-E4400	Unknown	Unknown - Present	NA	Unknown	NA	NA	NA

Note:

NA - Not Applicable.

FIGURES

FIGURES



REFERENCE: *Base Map Source: USGS 7.5 Min. Topo. Quad., Springfield North, Mass. 1972 (Photoirevised 1979)*

2000' 0 2000'

Approximate Scale: 1" = 2000'

MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASSACHUSETTS
RFI/MCP PHASE II WORK PLAN

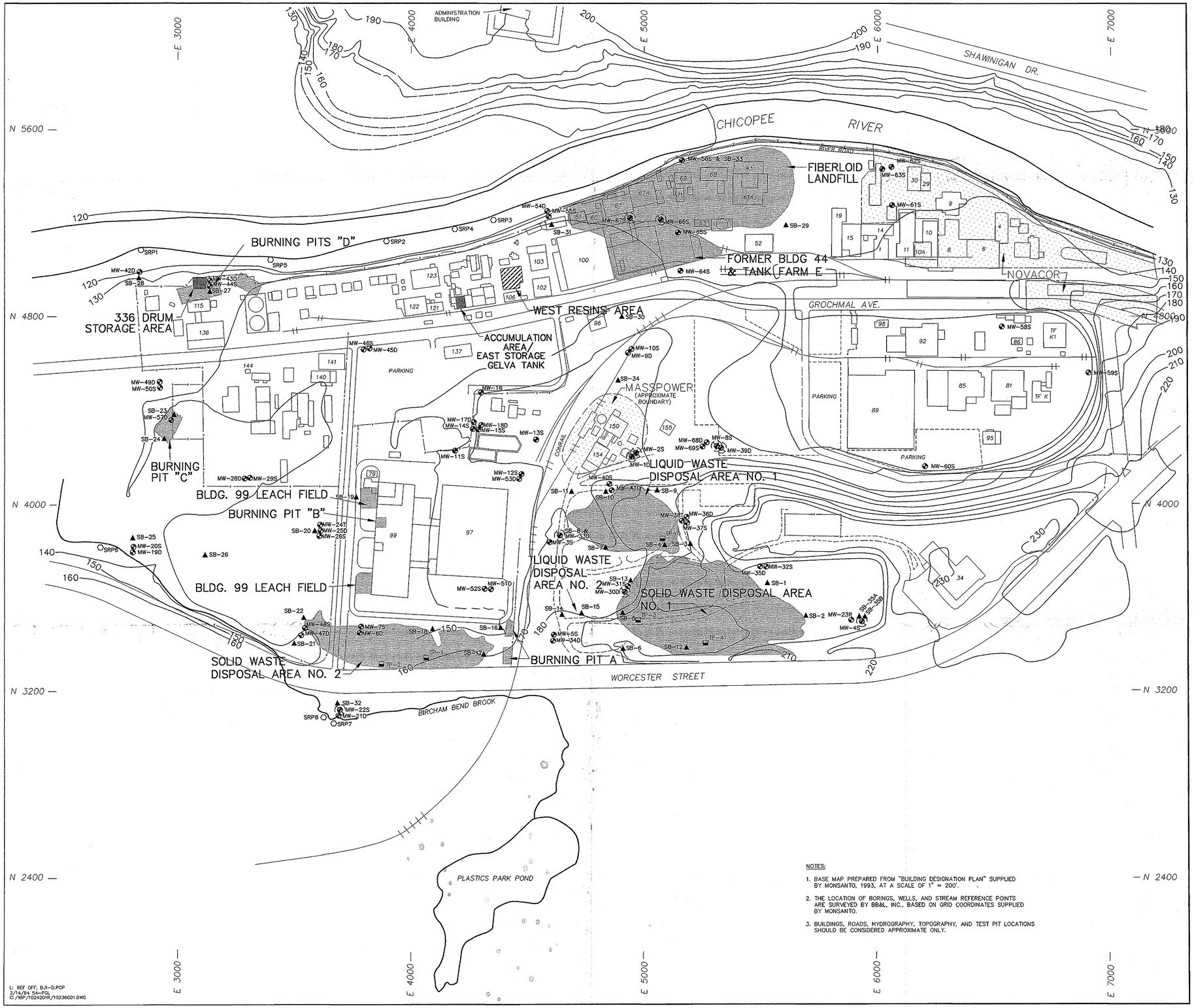
SITE LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE 1

05/96 SYR-D54-jvm
10247002/10247n01.cdr

FIGURE 2



NOTES:

1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BB&L, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO.
3. BUILDINGS, ROADS, HYDROGRAPHY, TOPOGRAPHY, AND TEST PIT LOCATIONS SHOULD BE CONSIDERED APPROXIMATE ONLY.

L: REF OFF. DJI-D.PCP
3/14/94 54=PGL
C:/MIP/102420IR/10236C01.DWG

LEGEND

- MONITORING WELL – (55)
- SOIL BORING – (35)
- STREAM REFERENCE POINTS – (8)
- TEST PIT LOCATION – (5)
- MONITORING WELLS DAMAGED OR ABANDONED – (10)
- 220 GROUND SURFACE ELEVATION CONTOUR

SWMU/DISPOSAL AREAS

- RCRA/MCP SITE – (11)
- MCP ONLY SITE – (1)
- RCRA ONLY SITE – (2)

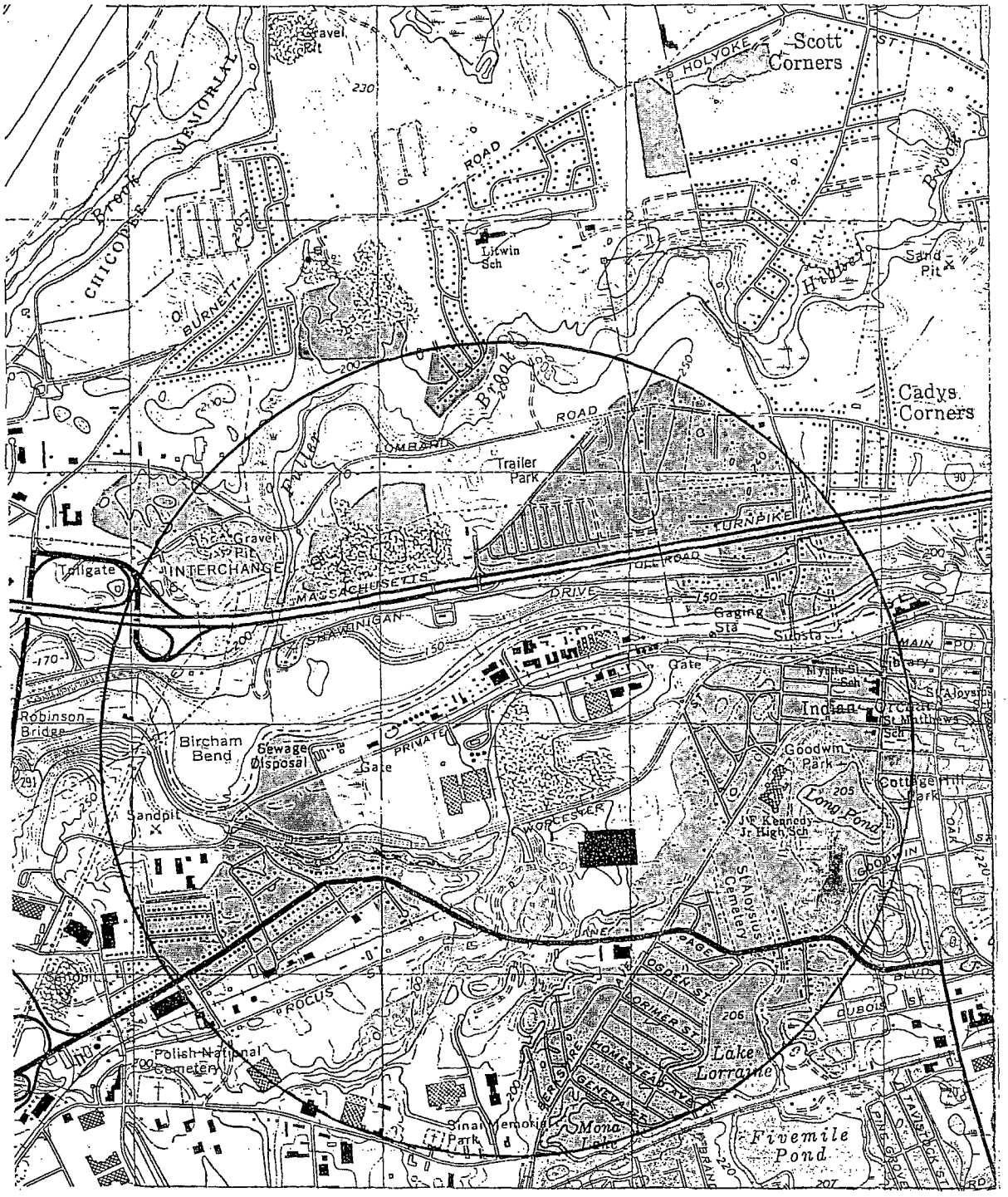
MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

SWMU/DISPOSAL AREAS WITH GENERALIZED TOPOGRAPHY MAP

APPROXIMATE SCALE IN FEET
200 0 200 400

ALL LOCATIONS ARE APPROXIMATE

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS



LEGEND

- RESIDENTIAL
- COMMERCIAL
- RECREATIONAL/OPEN SPACE
- DEP PERMITTED LANDFILL (POST 1971)
- WETLANDS
- LANDUSE INFORMATION UNAVAILABLE

SCALE

2000' 0' 2000'

BASE MAP PREPARED FROM SPRINGFIELD NORTH, MASS., USGS 7.5' QUADRANGLE, PHOTOREVISED 1979, @ 1"=2,000'

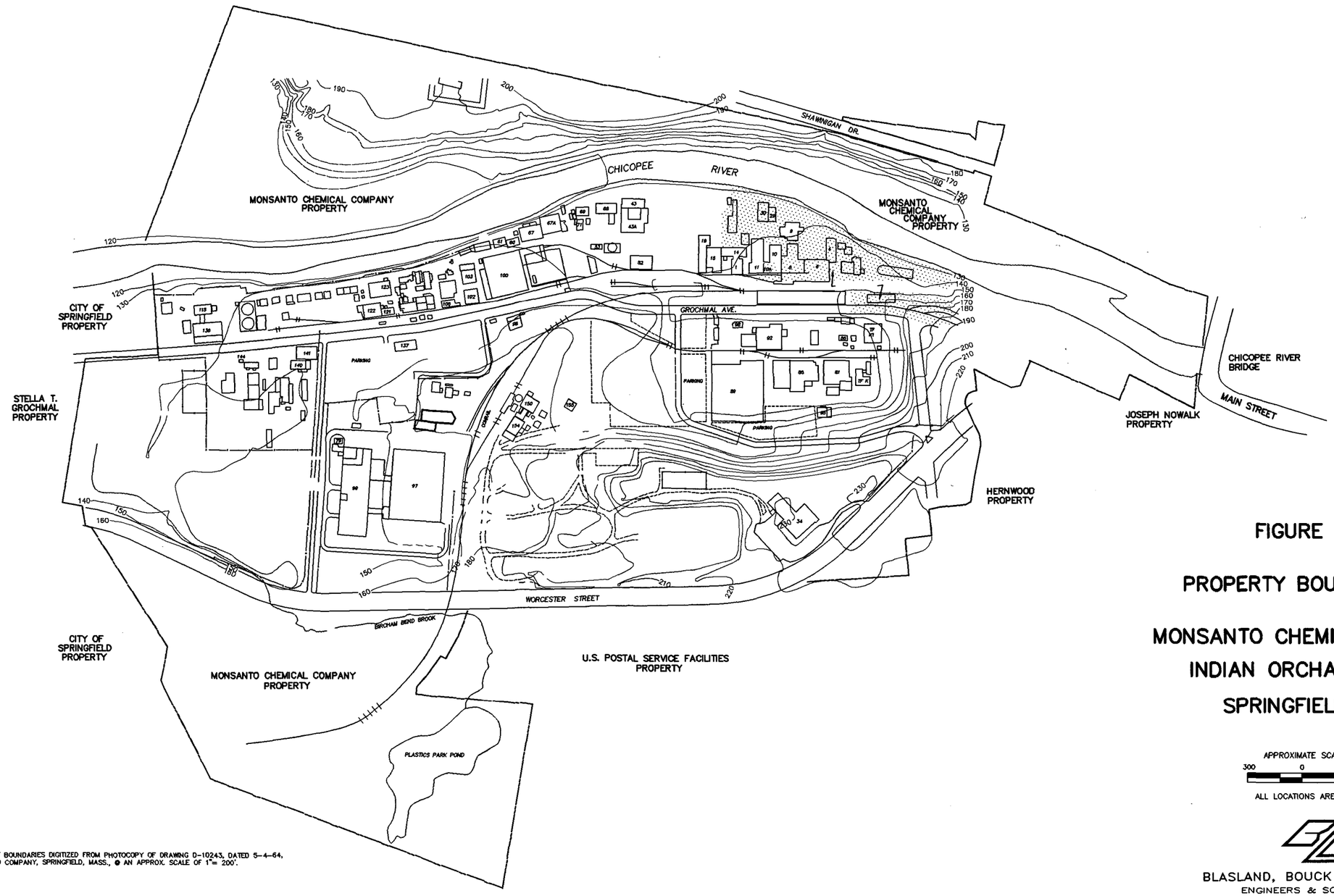
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASSACHUSSETTS
RFI/MCP PHASE II WORK PLAN

LAND USE WITHIN ONE MILE RADIUS OF SITE

FIGURE 3

2/17/94-DIV 60 -RCB
ALL LAYERS ON
C:\WIP\DGN /10236L01.DGN



NOTES:

1. PROPERTY BOUNDARIES DIGITIZED FROM PHOTOCOPY OF DRAWING D-10243, DATED 5-4-64, MONSANTO COMPANY, SPRINGFIELD, MASS., @ AN APPROX. SCALE OF 1"= 200'.

3/16/94 54-PGL
F:/USERS/PGL/10236/DRAFT.DWG

FIGURE 4

PROPERTY BOUNDARY MAP

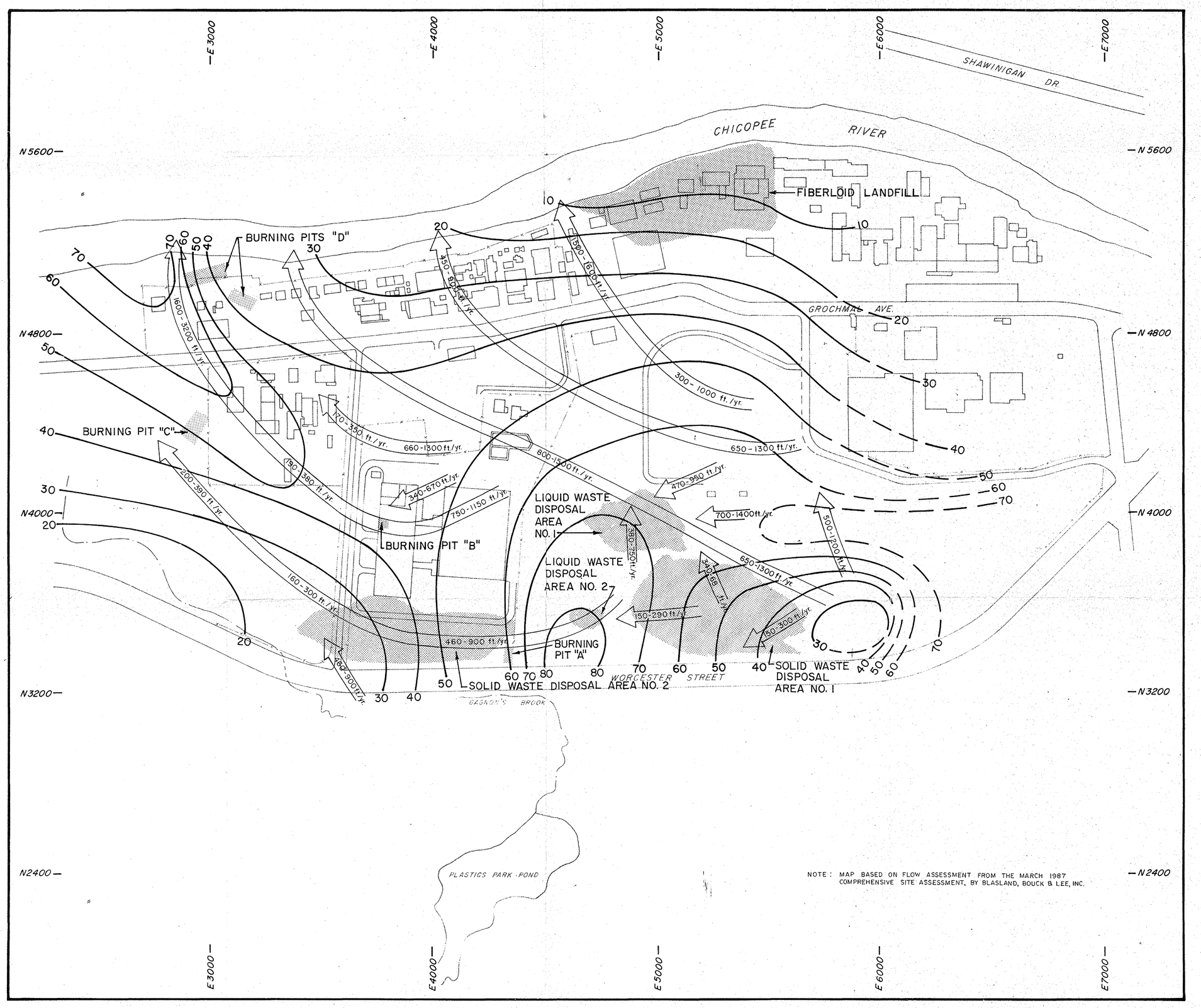
MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

APPROXIMATE SCALE IN FEET
300 0 300 600

ALL LOCATIONS ARE APPROXIMATE

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

FIGURE 5



NOTE: MAP BASED ON FLOW ASSESSMENT FROM THE MARCH 1987 COMPREHENSIVE SITE ASSESSMENT, BY BLASLAND, BOUCK & LEE, INC.

LEGEND

WASTE DISPOSAL AREA

70 — SATURATED THICKNESS CONTOUR LINE

MONSANTO POLYMER PRODUCTS CO.
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

SATURATED THICKNESS AND FLOW LINES

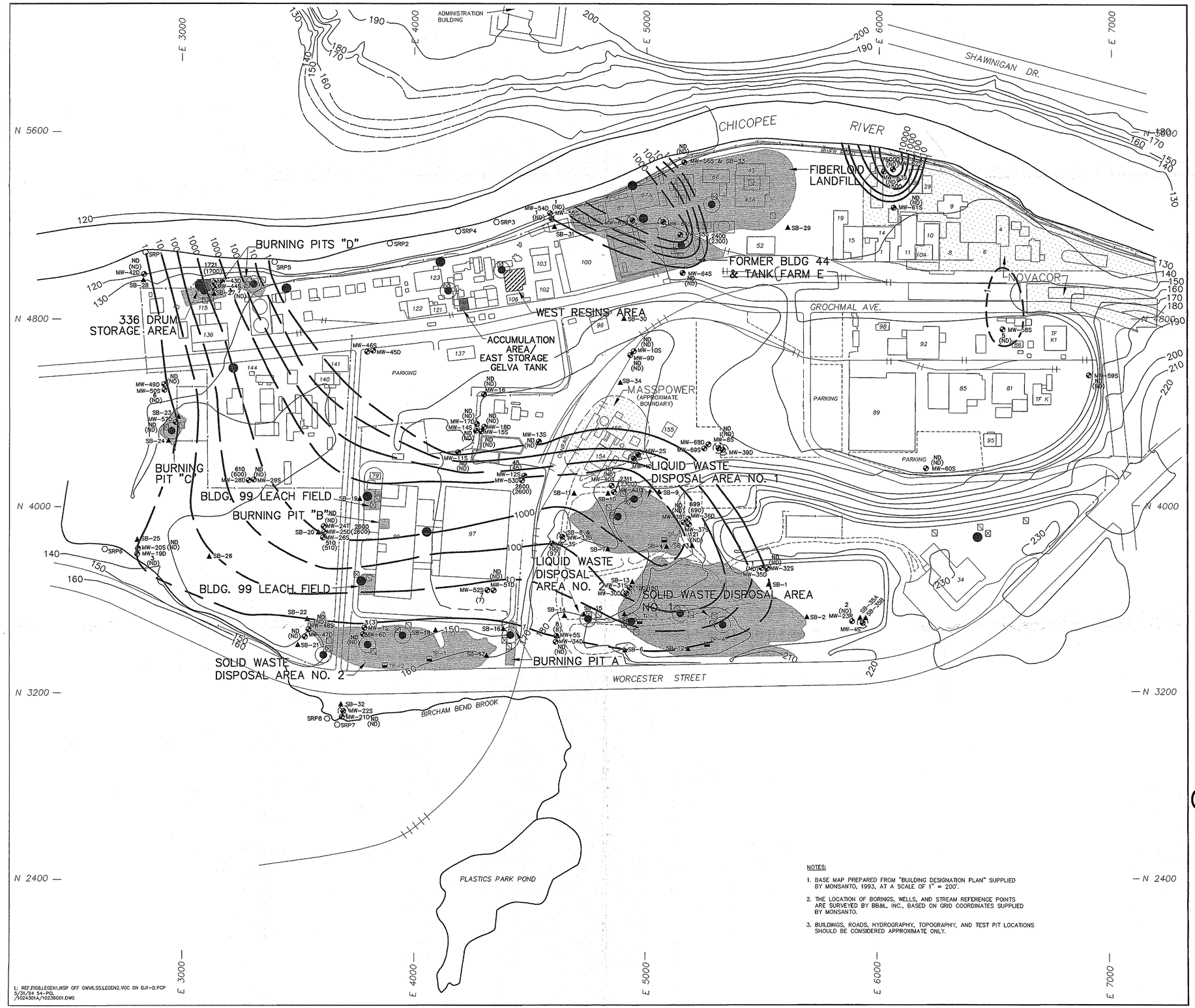
FOR JUNE 27, 1985

SCALE IN FEET
200 0 200 400

BLASLAND & BOUCK ENGINEERS, P.C.

G102-03-2.3/4

FIGURE 6



NOTES:

1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BB&L, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO.
3. BUILDINGS, ROADS, HYDROGRAPHY, TOPOGRAPHY, AND TEST PIT LOCATIONS SHOULD BE CONSIDERED APPROXIMATE ONLY.

L: REF,FIGB,LEGEN1,HSP OFF GWV6,SS,LEGEN2,VOC ON DJI-D.PCP
5/31/94 54-PGL
/1024301A/10236001.DWG

LEGEND

- PROPOSED SOIL BORING FOR WELL INSTALLATION – (10)
- PROPOSED SOIL BORING – (17)
- PROPOSED SURFACE SOIL SAMPLE LOCATION (20)
- PROPOSED SUBSURFACE SOIL SAMPLE LOCATION (20)
- MONITORING WELL – (55)
- SOIL BORING – (35)
- STREAM REFERENCE POINTS – (8)
- TEST PIT LOCATION – (5)
- MONITORING WELLS DAMAGED OR ABANDONED – (10)
- 220 —— GROUND SURFACE ELEVATION CONTOUR
- 100 —— TVOC GROUND-WATER CONCENTRATION CONTOUR (DASHED WHERE INFERRED)
- 180 = TVO CONCENTRATION IN ug/L
- (180) = CHLOROBENZENE CONCENTRATION IN ug/L
- ND = NOT DETECTED

SWMU/DISPOSAL AREAS

- RCRA/MCP SITE – (11)
- MCP ONLY SITE – (1)
- RCRA ONLY SITE – (2)

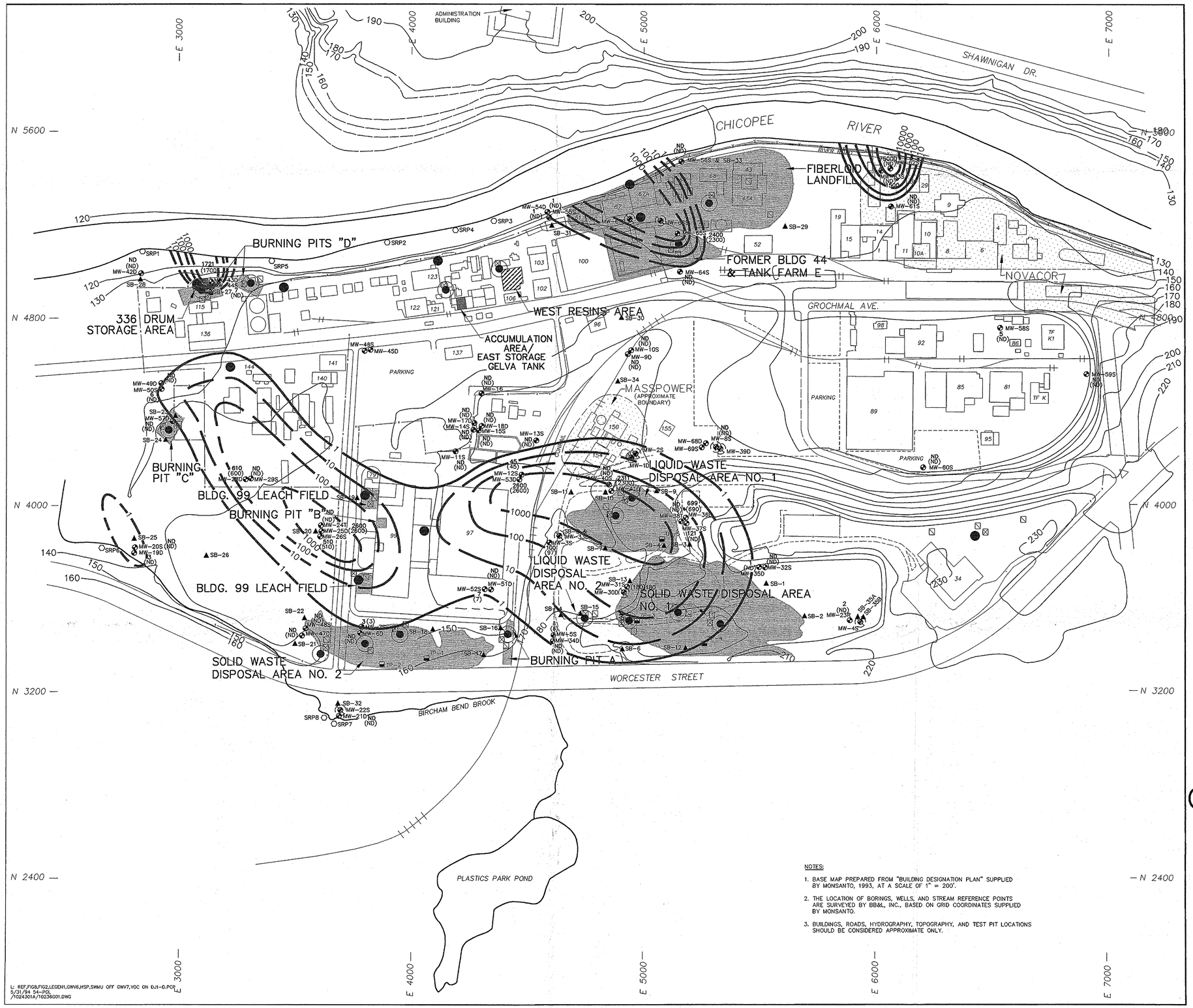
MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

TOTAL VOC GROUND-WATER CONCENTRATION CONTOUR OCTOBER 1991 SINGLE PLUME CONCEPT

APPROXIMATE SCALE IN FEET
200 0 200 400

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

FIGURE 7



NOTES:

1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BB&L, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO.
3. BUILDINGS, ROADS, HYDROGRAPHY, TOPOGRAPHY, AND TEST PIT LOCATIONS SHOULD BE CONSIDERED APPROXIMATE ONLY.

L: REF,FIG8,FIG2,LEGEN1,GWV6,HSP,SWMU OFF GWV7,VOC ON DJ1-D.PCP
5/31/94 54-PCL
/1024301A/10236G01.DWG

LEGEND

- PROPOSED SOIL BORING FOR WELL INSTALLATION – (10)
- PROPOSED SOIL BORING – (17)
- PROPOSED SURFACE SOIL SAMPLE LOCATION (20)
- PROPOSED SUBSURFACE SOIL SAMPLE LOCATION (20)
- MONITORING WELL – (55)
- SOIL BORING – (35)
- STREAM REFERENCE POINTS – (8)
- TEST PIT LOCATION – (5)
- MONITORING WELLS DAMAGED OR ABANDONED – (10)
- 220 GROUND SURFACE ELEVATION CONTOUR
- 100 TVOC GROUND-WATER CONCENTRATION CONTOUR (DASHED WHERE INFERRED)
- 180 = TVO CONCENTRATION IN ug/L
- (180) = CHLOROBENZENE CONCENTRATION IN ug/L
- ND = NOT DETECTED

SWMU/DISPOSAL AREAS

- RCRA/MCP SITE – (11)
- MCP ONLY SITE – (1)
- RCRA ONLY SITE – (2)

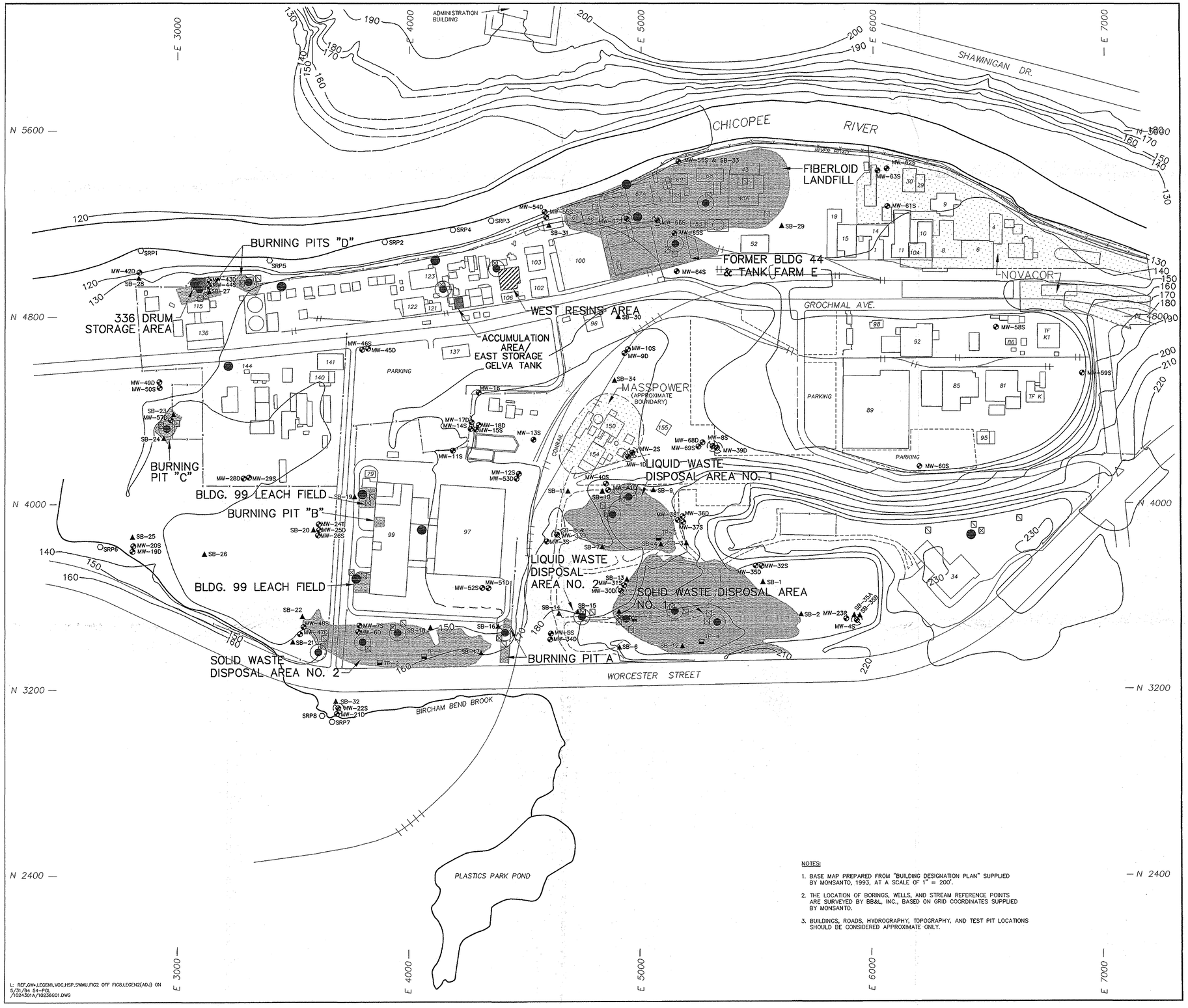
MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

TOTAL VOC GROUND-WATER CONCENTRATION CONTOUR OCTOBER 1991 MULTIPLE PLUME CONCEPT

APPROXIMATE SCALE IN FEET
200 0 200 400

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

FIGURE 8



LEGEND

- PROPOSED SOIL BORING FOR WELL INSTALLATION – (10)
- PROPOSED SOIL BORING – (17)
- PROPOSED SURFACE SOIL SAMPLE LOCATION (20)
- PROPOSED SUBSURFACE SOIL SAMPLE LOCATION (20)
- MONITORING WELL – (55)
- SOIL BORING – (35)
- STREAM REFERENCE POINTS – (8)
- TEST PIT LOCATION – (5)
- MONITORING WELLS DAMAGED OR ABANDONED – (10)
- 220 —— GROUND SURFACE ELEVATION CONTOUR

SWMU/DISPOSAL AREAS

- RCRA/MCP SITE – (11)
- MCP ONLY SITE – (1)
- RCRA ONLY SITE – (2)

MONSANTO CHEMICAL COMPANY
INDIAN ORCHARD PLANT
SPRINGFIELD, MASS.

PROPOSED SOIL BORING, MONITORING WELL AND SAMPLING LOCATION MAP

NOTES:

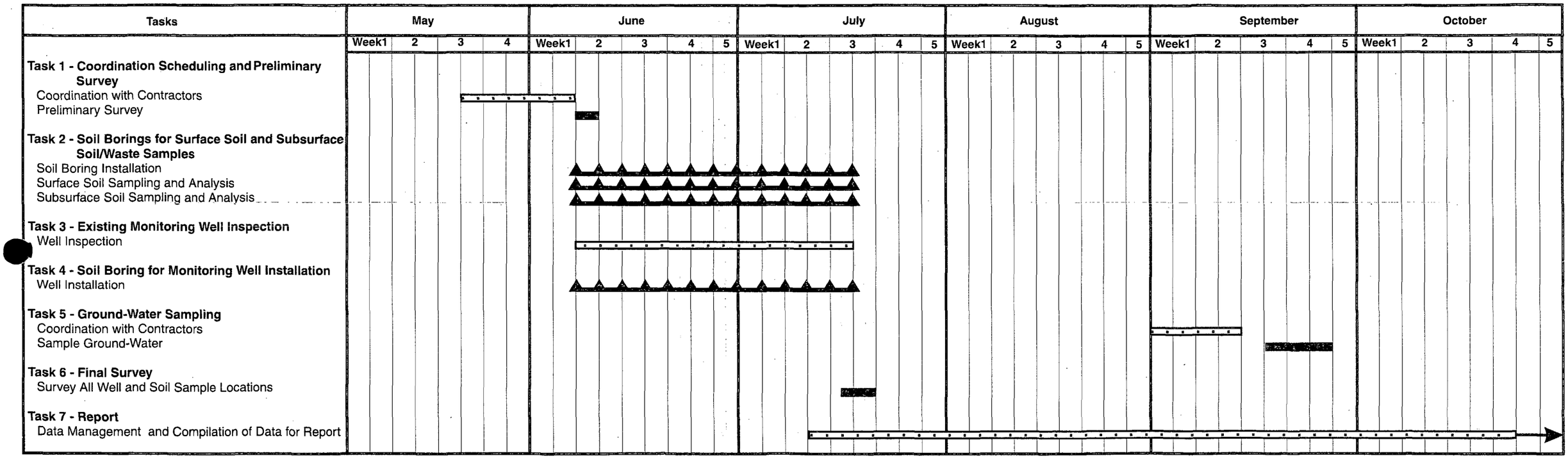
1. BASE MAP PREPARED FROM "BUILDING DESIGNATION PLAN" SUPPLIED BY MONSANTO, 1993, AT A SCALE OF 1" = 200'.
2. THE LOCATION OF BORINGS, WELLS, AND STREAM REFERENCE POINTS ARE SURVEYED BY BB&L, INC., BASED ON GRID COORDINATES SUPPLIED BY MONSANTO.
3. BUILDINGS, ROADS, HYDROGRAPHY, TOPOGRAPHY, AND TEST PIT LOCATIONS SHOULD BE CONSIDERED APPROXIMATE ONLY.

APPROXIMATE SCALE IN FEET
200 0 200 400

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

L: REF,GW=LEGEN1,VOC,HSP,SWMU,FIG2 OFF FIGB,LEGEN2(ADJ) ON
5/31/94 54-PGL
/1024301A/10236G01.DWG

Figure 9
1994 RFI/MCP Phase II Comprehensive Site Assessment Implementation Schedule
Monsanto Company
Indian Orchard Plant



8949871.CDR

Key:

Fully Engaged Work Activity

Multiple Work Activities Performed Simultaneously

Intermittent Work Activity