# FIVE-YEAR REVIEW REPORT

# CHEM-DYNE SITE TRUST FUND

# HAMILTON, OHIO

**Prepared By:**

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**for**

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**Date**

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## I. Introduction and Statement of Purpose

Section 121(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and Section 300.430(f)(4)(ii) of the National Contingency Plan (NCP) require that periodic (no less often than every five years) reviews be conducted for any site where hazardous substances, pollutants, or contaminants remain at the site above levels that will not allow for unlimited use or unrestricted exposure following the completion of all remedial actions for the site. The main purpose of such a review is to assess whether the remedial actions implemented continue to be protective of human health and the environment. This review focuses on the protectiveness of the remedy implemented at the Chem-Dyne Site Trust Fund (Site).

The United States Environmental Protection Agency (U.S. EPA) has established a three-tier approach to conducting Five-Year Reviews, the most basic of which provides a minimum protectiveness evaluation (Level I review). U.S. EPA contemplates that a Level I review will be appropriate in all but relatively few cases where site-specific circumstances suggest otherwise. The second and third levels of review (Level II and Level III) are intended to provide flexibility to respond to varying site-specific considerations and involve a more detailed analysis of the remedy. Site-specific considerations, including the nature of the response action, the status of on-site response activities, and the proximity to populated areas and sensitive environmental areas determine the level of review for a given site. U.S. EPA has determined that a Level I review will be conducted at this Site.

OSWER Directive 9355.7-02 (Structure and Components of Five-Year Reviews, May 23, 1991) provides that U.S. EPA will conduct five-year reviews as a matter of policy (Policy Review) at sites addressed pre-SARA and at which the remedy, upon attainment of the Record of Decision (ROD) cleanup levels, will not allow unlimited use and unrestricted exposure. The remedy for this Site was selected pre-SARA and established a ground-water clean-up level well above current acceptable levels. Soil contamination remains on-Site under the cap, which must be maintained. These provisions result in a final remedy that will not allow for unlimited use and unrestricted exposure. Thus, the five-year review for this Site is being conducted as a matter of Policy.

The Chem-Dyne Site has been considered fully operational for twelve years. For policy reviews, the Five-Year Review Process is triggered by the completion of physical construction, which is the date a site qualifies for listing on the Construction Completion List (CCL). A site qualifies for listing on the CCL at the time of signature of the preliminary

or final Close Out Report (COR). The Interim Close-out Report for this Site was completed September 11, 1992, thus this is the first five-year review for the Chem-Dyne Site.

## II. Site History and Conditions

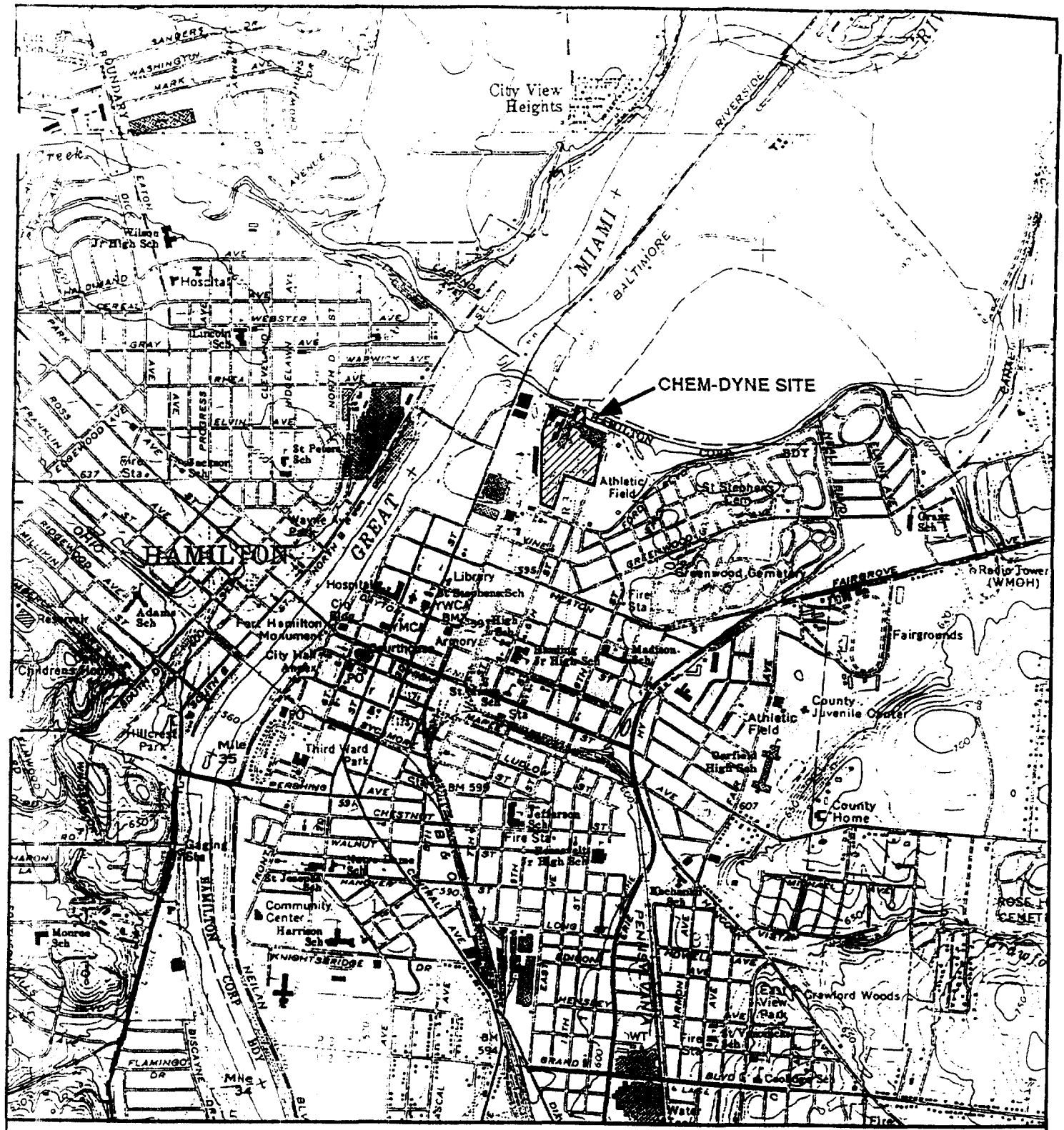
### A. Site Location, Description and Surrounding Land Use

The Chem-Dyne Site (Site) is located at 500 Joe Nuxhall Boulevard (formerly Ford Boulevard) and occupies approximately 21 acres in the northern section of Hamilton, Ohio (Figure 1). The Site is bounded immediately to the south by a residential area and athletic fields. To the east are additional athletic fields and, beyond the athletic fields, a residential area. The northern portion of the Site is bounded by the Ford Hydraulic Canal, which flows west to the Great Miami River; immediately north of the canal is a farm field. The Site is bordered on the west by railroad tracks. Adjacent to the railroad tracks is the Ransohoff Company, a sheet metal fabrication plant. Further west are the City of Hamilton Power Plant, warehouses for the Champion Paper Company, a small residential area, and the Great Miami River (GMR).

Ground-water flow at the Site is generally west, toward the GMR. Upon reaching the river, ground-water flow takes a more southerly turn. The City of Hamilton has five production wells in its North well field, located 4500 feet north (upgradient) of the Site. The South Hamilton well field is located approximately 5 miles south of the Site, on the east side of the GMR, and would be in the southerly path of plume migration, were hydraulic capture not maintained. Production wells for Champion Paper Company, Mercy Hospital, Beckett Paper Company and Hamilton Electric Power are all located west and southwest (downgradient) of the Site, within the remediation area (Figure 2). No private wells are located such that they may be impacted by contamination from the Site.

### B. Site History

The Chem-Dyne Site was operated as an industrial waste storage, disposal, and recycling facility from 1974 to 1980. During the years of operation, the Site accepted an estimated 112,000 drums of waste from approximately 200 generators. Materials handled included pesticides and pesticide residues, chlorinated and un-chlorinated solvents, waste oils, plastics and resins, PCBs, acids and caustics, metal and cyanide sludges, and laboratory wastes. Over 30,000 drums and 300,000 gallons of bulk materials were on-Site when operations ended in 1980. Most of the materials left on-Site in 1980 were removed under the supervision of a state court appointed receiver during 1980-1981. The remaining wastes were removed during a surface clean-up under U.S. EPA removal authority during 1983. The Site was proposed for inclusion on the National Priorities List on October 21, 1981, and finalized on September 8, 1983.

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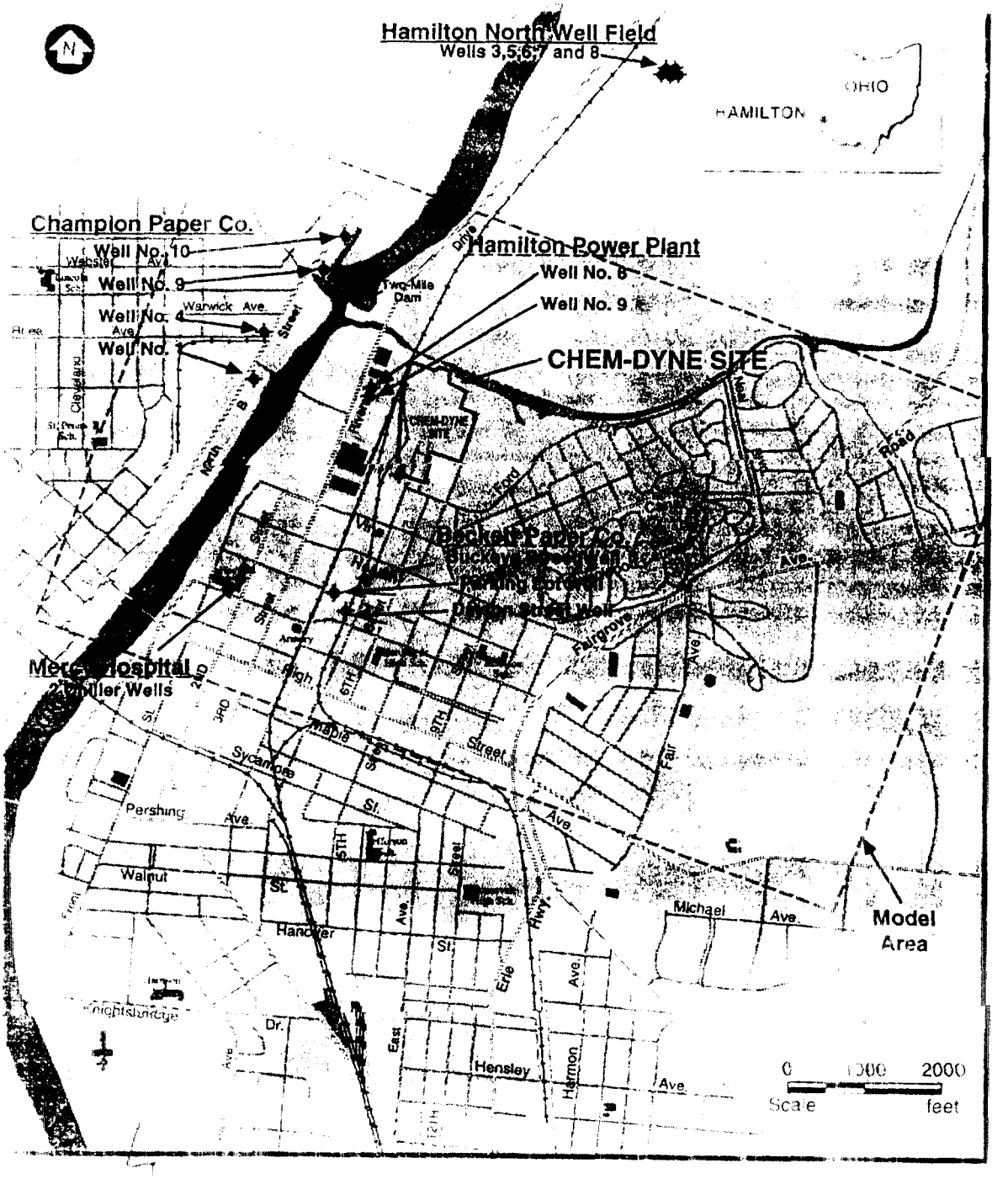
LOCATION OF CHEM-DYNE SITE

FIGURE 1.




[illegible] South Well Field

Figure 2 Ground-Water Users in the Vicinity of the Chem-Dyne Site

## 1. Remedial Investigation/Feasibility Study

The Remedial Investigation (RI) was initiated in April 1983 and the Final RI Report was released on May 22, 1984. The RI included sampling and analysis of soils, ground water, nearby surface waters, and Site structures. On-Site soil samples indicated extensive contamination with volatile organic compounds (VOCs) and priority pollutant acid compounds, as well as areas with substantial levels of inorganic compounds, base/neutral organic compounds, and pesticides/PCBs. This contamination was generally concentrated in the upper 3 to 6 feet of the soils but VOC contamination often extended throughout the unsaturated soil zone (approximately 25 feet deep).

Ground-water samples indicated that a contaminant plume, consisting primarily of more mobile VOCs, extended outward from the Site. This plume was later confirmed to be approximately 1000 feet wide, 1800 feet long, and up to 50 feet deep. Some VOCs were present at levels substantially above current drinking water standards. On-Site structures and utilities were also found to be contaminated with a variety of materials. Based on samples of fish, sediments, and water in the Great Miami River and the Ford Hydraulic Canal, it was concluded that surface waters were not significantly impacted by the Site.

Hydrogeologic investigations conducted during the RI provided information about aquifer characteristics including that ground-water velocities in the Site vicinity range from 0.5 to 1.5 feet per day. Ground-water flow is from east to west beneath the Site, with a change in direction to a southerly flow upon reaching the Great Miami River. However, ground-water flow is also being influenced by the Champion Paper Company production wells on the west side of the GMR. If contaminated ground water from the Site were pulled in by production wells, exposure due to volatilization of contaminants could result. Also, it was concluded that the City of Hamilton's South well field was in the path of the southerly component of plume migration.

The Feasibility Study (FS) was released to the public on November 19, 1984. It contained an Endangerment Assessment (EA) for the Site which concluded that soil contaminants presented an unacceptable risk based on direct contact exposure routes. The EA also concluded that ground water presented an unacceptable risk for possible future use at the Site and that continued migration of the plume could present an unacceptable risk to downgradient ground-water supplies.

The FS examined a range of source removal, containment, and aquifer remediation alternatives. The release of the FS was followed by a five week public comment

period, and a public meeting was held in Hamilton on December 3, 1984. A number of comments were received from the general public and the Chem-Dyne defendant steering committee. These comments and U.S. EPA's responses to these comments were presented in a Responsiveness Summary dated June 1985.

## 2. Enforcement Decision Document

Following negotiations with the Potentially Responsible Parties (PRPs), a Remedial Action Plan (RAP) was developed for the Site. The RAP, dated May 1985, served as the basis for Remedial Alternative Selection in the Enforcement Decision Document (EDD), signed on July 5, 1985. The selected remedy for the Site included the demolition of all buildings, soil "hot spot" removal for off-Site disposal, installation and operation of a ground-water pump and treat system, and the installation of a multimedia cap over the remaining contaminated soils. A Consent Decree between U.S. EPA, Ohio EPA, and 173 PRPs to implement the RAP and resolve all pending litigation was entered into U.S. District Court on October 9, 1985. Under the Consent Decree, the PRPs agreed to form the Chem-Dyne Site Trust Fund (Trust) which would oversee the implementation of the requirements of the decree.

## 3. Remedial Design/Remedial Action

Although the remedy was not divided into separate operable units, Remedial Design (RD) and Remedial Action (RA) activities were conducted in two phases to expedite project completion. RD resulted in the following documents, which in turn governed RA activities at the Site: Contract Documents and Specifications, Chem-Dyne Remediation Program, Phase I On-Site Work and Phase I Remedial Construction (July 1985) and Phase II Well Installations and Phase II Forcemains & Earthworks (May 1986).

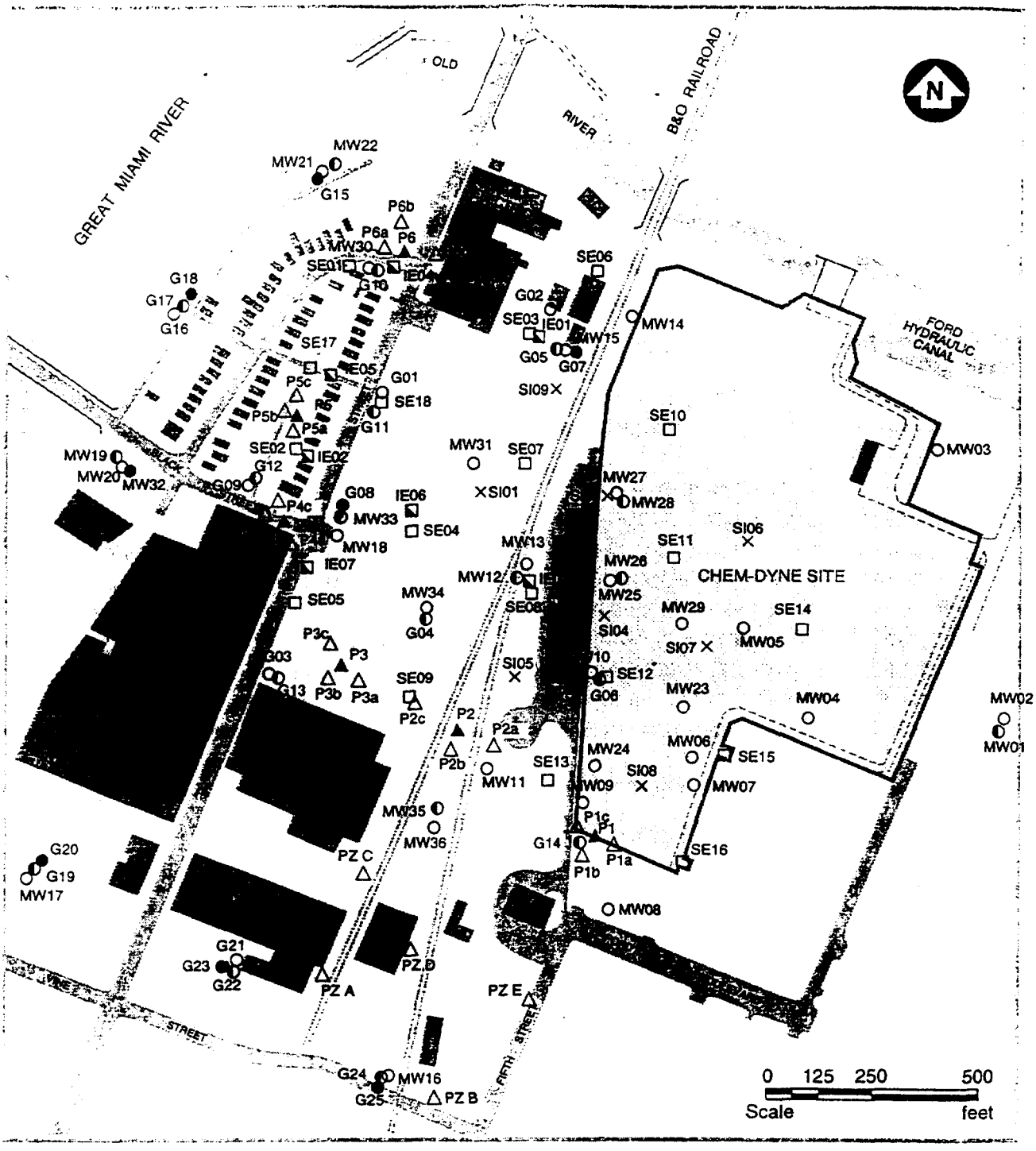
Soil hot spots were removed and disposed at an approved off-Site facility in an expedited action during April and May 1985. Phase I RA activities were initiated on October 14, 1985 and concluded on February 7, 1986. A total of 8 buildings were demolished and uncontaminated salvageable materials were taken off-site. The remaining debris was stored on-Site for placement under the Site cap. A perimeter utility cutoff trench approximately 4000 feet in length and 15 feet deep was excavated around the Site and all intercepted utilities were sealed. Finally, a storm sewer system for draining the capped Site was installed, and portions of the ground-water extraction and injection forcemain system were installed.

Concurrent with Phase I construction activities, monitoring wells were sampled to further define the boundaries of the ground-water plume prior to remediation. A Technical Enforcement Support (TES) contractor for U.S. EPA provided oversight for the sampling and collected split samples to confirm the results. The results of this sampling were presented in the report "Definition of Contaminant Plume Boundary" in April 1986. Based on these results, the scope of the ground-water extraction system was expanded in Phase II RD.

Phase II RA activities began on May 9, 1986 and ended in February 1987. During this time the ground-water extraction/injection system was completed, the multimedia Site cap was installed, and the ground-water treatment system was installed. A total of 25 extraction wells (18 shallow and 7 intermediate in depth) and 8 injection wells were installed (Figure 3). Approximately 10,000 feet of piping was installed to connect these wells to the treatment system. The Site cap was installed over 15 acres and required 640,000 square feet of high density polyethylene liner, followed by the placement of 118,000 cubic yards of material for layers of clay, sand, loam, and topsoil. The main components of the ground-water treatment system include an air stripping tower, 3 activated carbon beds for the treatment of off-gases from the air stripper, a steam regeneration system for the carbon beds, and a pressure leaf filter system for the water prior to injection. The ground-water extraction and treatment system was designed to provide for the injection of some of the treated water into the aquifer in order to provide a flushing effect through the most contaminated areas. The remainder of the treated water was discharged directly to the Ford Hydraulic Canal, in accordance with an NPDES permit issued by the Ohio EPA.

All Phase I and Phase II activities were overseen by the U.S. Army Corps of Engineers, which issued its final report on February 17, 1987. Also during Phase II activities, compliance wells established near the Site were sampled to determine background/ baseline conditions. A TES contractor for U.S. EPA provided oversight for the sampling and collected split samples to confirm the results.

Once on-Site construction was completed in February 1987, limited operations of the ground-water pump and treat system were initiated. System shakedown continued through 1987 as a variety of design and operational problems were encountered. Several meetings between U.S. EPA, Ohio EPA, and the Chem-Dyne Site Trust Fund were held during this period to review the status of the Trust's efforts. This included a joint U.S. EPA and Ohio EPA inspection of the Site on June 30, 1987. Agreement was reached at that time that although the ground-water treatment components were not fully achieving design criteria, the Trust would




Explanation

- ○ Shallow Monitoring Well
- × Shallow Injection Well
- □ Shallow Extraction Well
- △ Shallow Piezometer
- ◐ Intermediate Monitoring Well
- ◪ Intermediate Extraction Well
- ▲ Piezometer Cluster
- ● Deep Monitoring Well
- ◓ Surface-Water Gage

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|---|---|---|
| S.S. PAPADOPULOS & ASSOCIATES, INC.<br>ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS | CHEM-DYNE SITE WELL LOCATIONS | FIGURE<br>3 |

continue to operate the system since it was removing substantial quantities of contaminants from the plume and providing some control over plume migration. During the continuing dialogue regarding operations, the Trust subsequently proposed that the system be considered fully operational as of January 1988. Modifications necessary to bring the treatment system up to design criteria were completed in June 1988.

**4. QA/QC Measures**

The Phase I and Phase II design documents submitted by the Chem-Dyne Site Trust Fund were reviewed and approved by U.S. EPA and Ohio EPA (the Agencies) prior to implementation. As described above, Phase I and Phase II RA construction activities were overseen by the U.S. Army Corps of Engineers. The Consent Decree did not address the need for a Quality Assurance Project Plan (QAPP) for sampling and analytical activities but it did specify standard U.S. EPA analytical methodologies for all ground-water monitoring. The Trust did submit QAPPs for the plume definition and background sampling for compliance wells and these were approved. In addition, the use of TES contractors to oversee and split samples during critical monitoring activities provided additional quality assurance. Documentation from the TES contractors is on file. The Trust also submitted Monthly Progress Reports throughout Phase I and II activities and prepared reports entitled "Well Construction and Testing Data" (July 1987) and "Chem-Dyne Remediation Program - Final Report" (August 1987).

Routine monitoring of the ground-water pump and treat system and the Site cap continued to be done in accordance with a QAPP submitted in March 1988. In August 1993, the Agencies formally requested that the Trust initiate a process to update and obtain approval of a QAPP. This process continued through 1995 and resulted in an updated QAPP. U.S. EPA no longer uses a TES contractor to oversee activities at the Site. The Trust submits monthly and annual reports summarizing all activities and meetings are held between the Agencies and the Trust when necessary.

The QA/QC program utilized throughout this remedial action has been sufficiently rigorous and adequately complied with to enable the determination by the Agencies that all activities have been correctly carried out and all results accurately reported. The Agencies are thereby assured of the satisfactory execution of the remedial action consistent with the Enforcement Decision Document.

## III. Summary of Response Actions

Remedial activities required by the RAP include the following:

- Demolition of all on-Site structures with on-Site disposal of debris unsuitable for salvage. Removal and disposal at U.S. EPA-approved sites or hazardous wastes of potentially significantly contaminated materials from within the on-Site structures.

- Excavation and disposal at sites approved by U.S. EPA of selected "hot spot" surficial Site soils containing excessive contamination.

- Disposal of miscellaneous non-hazardous materials from in and adjacent to the existing Site structures.

- A protective soil cover over the Site to isolate remaining soil contamination and to eliminate both direct contact with Site contaminants by humans and animals, and off-Site migration of contaminants by surface runoff, volatilization, and wind transport.

- An engineered cap over the Site constructed of low permeability natural and synthetic materials to effectively prevent the migration of remaining soil contaminants from the unsaturated zone to the ground-water system.

- A ground-water extraction/injection system designed to contain hydraulically and remove the ground-water contaminant plume to the stated level of 100 parts per billion (ppb) total Priority Pollutant Volatile Organic Compounds (VOCs).[1]

- A system to treat extracted ground water to meet permit requirements for discharge or re-injection.

- Elimination of other potential pathways of migration of contaminants from the Site, including existing sewers and subsurface utilities.

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[1]In October 1992 the re-injection system was shut down and adjustments were made to the extraction system to maintain hydraulic capture. As a result, all extracted and treated ground water is now discharged to the Ford Hydraulic Canal. At the same time intermediate extraction well IE6, which had been producing clean water for several years, was also shutdown. Intermediate extraction well IE4 was shutdown in June 1995. Adjustments were made to the system to accommodate for these changes.

- Provision of health, safety and personnel hygiene programs designed to minimize adverse impacts to on-Site workers, the general public and the environment at large during the implementation of the RAP.

- Contingencies for various remedial components as outlined in the RAP.

- A program for operation and maintenance of the various remedial components of the RAP.

## IV. Remedial Objectives

The Remedial Action Plan discusses three major environmental objectives: 1) the protection and enhancement of ground-water quality and recovery of the natural resource in the Site vicinity; 2) protection of surface waters near the Site; and, 3) protection of the public from direct contact with contaminated material on the Site and from migration of surficial contaminants by surface water runoff, wind erosion and volatilization.

The RAP addresses these objectives through the implementation of the components summarized in Section III. A more detailed assessment of the on-going components is given below.

### A. Containment (Site Cover)

The containment portion of the remedy consists of a multi-layer cap installed over the contaminated soils remaining on-Site. The remedial objectives of the containment portion of the remedy are to provide exposure protection, and to reduce contaminant loading of the ground water from soil "hot spots" on-Site. The cap has been effective in restricting exposure to contaminated soils. Moisture content measurements of the various soil layers beneath the cap indicate that the cap continues to provide a barrier to infiltration. In addition, the cap prevents contaminated surface water runoff from reaching near-by surface water bodies.

Although completion of the containment portion of the remedy has minimized contaminant loading, it appears that areas of residual contamination may still be influencing ground water. This is likely the result of the water table rising into the contaminated soil during wet seasons and leaching contaminants into the ground water. This effect can be observed in the increasing VOC concentrations in the influent during the summer months of 1996, after heavy precipitation throughout the winter and spring months, and again in the summer months of 1998, following torrential rains in the spring of 1998. The opposite effect is noted during times of drought, such as during the Summer and Fall of 1999. Most

recently, there has been a general trend of increasing VOC concentrations in the influent to the treatment system during 2000.

### 1. Monitoring Requirements

Section V, Paragraph 8.4(c) of the Consent Decree describes the programs for monitoring cap performance. These programs include the use of neutron probes and coupon samples of the synthetic liner material installed proximate to and under the same conditions as the synthetic liner itself. These coupon samples are to be evaluated every third year. Visual inspection of the cap for slumping and erosion is to be performed quarterly, or more frequently if necessitated by Site conditions.

Although the Consent Decree requires 15 neutron probes (at least one per acre), only 6 neutron probes were installed in the cap. No documentation regarding this change was located in the file. The Consent Decree specifies that the neutron probes be monitored "once in the spring and once in the fall each year for three-day periods immediately following a significant precipitation event."

### 2. System Performance

Destructive testing of liner coupons was performed in January 1990, January 1993, March 1996, and March 1999. The results of this testing indicates that the properties of the liner exceed original design criteria, with the possible exception of tensile stress at break for the January 1993 and March 1996 coupons, and the peel test for the March 1999 coupons. The March 1996 coupons showed an increase in tensile strength at break over the January 1993 coupon, and the March 1999 coupons performed even better and exceeded design criteria. Thus, the data do not indicate a trend for decreasing tensile strength at break. With respect to the peel test failure of the March 1999 coupons, the failure refers to the weld failing before failure of the liner. However, since the March 1999 coupons exhibit higher peel strengths than previous coupons, the test indicate that the integrity of the seams is maintained. Continued long-term monitoring will aid in determining trends in changes to the material properties of the liner.

Based on available soil moisture test data, it appears that the liner continues to provide a barrier to infiltration. However, although the Consent Decree specifies that the tests be conducted twice per year, once in the spring and once in the fall, there has been little consistency in the testing schedule at the Chem-Dyne Site. In addition, between 1994 and 1998, one or more of the six tubes were not been sampled due to outdated equipment and damage to the original tubes. A

recommendation was made to the Trust that all original neutron tubes be replaced. This was completed in 1997 and soil moisture tests were performed in June 1998, despite on-going equipment problems. In 1999, the Trust requested to discontinue neutron tube sampling and the Agencies have agreed with this request.

## B. Ground-water Extraction and Treatment System

The remedial objective of the ground-water extraction system is to intercept and contain VOC-contaminated ground water and to achieve the clean-up level of 100 ppb total Priority Pollutant VOCs within the compliance boundary. Based on analysis of water-level measurements during system operation and the additional investigations in the area of the southern compliance wells, it appears that vertical and horizontal hydraulic capture is maintained throughout the contaminant plume. The remedial action goal of 100 ppb total Priority Pollutant VOCs throughout the plume as specified in the Consent Decree and RAP, has not yet been achieved.

The Site is currently in Long-Term Response Action (LTRA). Under the terms of the Consent Decree, the earliest time at which the Site can enter the Operation and Maintenance (O&M) phase is after 10 years of operation. Once the LTRA (groundwater cleanup) is completed, O&M plans will be prepared to maintain the protectiveness of the remedy, and provisions will be made to ensure that O&M activities are performed and that necessary institutional controls are in place.

The EDD specifies the following primary requirements for the Chem-Dyne Site ground-water LTRA:

- Establish the plume boundary at the 100 ppb total VOC isopleth, via additional ground-water sampling.
- The ground-water extraction system must establish and maintain an inward hydraulic gradient, both horizontally and vertically, to ensure that the contaminated ground water within the plume is contained and removed for treatment.
- The pump and treat system is intended to reduce contamination in the plume to 100 ppb total Priority Pollutant VOCs, and may be terminated after operating for a minimum of ten years, provided that the concentration of total Priority Pollutant VOCs within each monitoring well throughout the plume is below this level and is effectively constant.
- If the 100 ppb performance goal is not achieved after ten years of operations, then the system must be operated for up to an additional ten years in an attempt to meet the goals. If not achieved after twenty years of

operations, then the parties to the Consent Decree must decide whether further operations would be "cost-effective."

## 1. System Performance

The quantity of ground-water pumped to the treatment system averaged 660 gallons per minute during 1999. Based on influent concentrations of VOCs to the pump and treat system, approximately 32,000 pounds of VOCs have been removed from the plume during the period of February 1987 through June 2000. Although the average influent total VOC concentration for the system has decreased from approximately 2000 ppb in 1988 to 135 ppb in 1999, compliance with the Consent Decree cleanup goal of 100 ppb throughout the plume is not anticipated at any time in the next several years.

The consent decree specified that the treatment system have a design goal of 95% removal of the peak influent concentration of total Priority Pollutant VOCs. During the early operations of the treatment system, when VOC concentrations in the influent were extremely elevated, this design goal was achievable. As the VOC concentrations in the influent have declined, it has become more difficult for the treatment system to maintain a 95% removal efficiency. The Trust maintained that the design goal was intended to mean 95% removal of the peak influent concentration of total Priority Pollutant VOCs, *at the time of system start up*, and that this level of removal would not be possible once VOC levels dropped substantially. The treatment system continues to achieve a removal efficiency of approximately 90%, and all permit requirements are consistently met through 1999. Thus, the Agencies are satisfied with the performance of the treatment system.

During 1999, the Trust requested permission to remove the vapor phase carbon treatment component from the treatment system. This component treated air releases that resulted from stripping VOCs from the groundwater. Since the air releases at the Site had reached a deminimis level prior to treatment, and hence did not require a permit, the Agencies agreed with this request.

Downtime for the pump and treat system generally averages between 5 and 10% of the year, most of which is associated with maintenance of the treatment components. Downtime of a portion of the extraction system resulted in November 1997 due to leakage along the forcemain piping alignment between SE12 and the main 4-inch diameter extraction main. Excavation of the 3-inch diameter forcemain identified the forcemain to be in a deteriorated condition due to sulphur reducing bacteria. In January 1998 a portion of the extraction system was again shutdown

due to a leaking pipe. As the system ages, additional downtime for repairs of this type can be expected.

Hydraulic control at the Site is monitored via water level measurements at the monitoring wells and at piezometers installed for this purpose. There are also a number of compliance wells located beyond the extent of the plume which are regularly monitored for any indication of loss of plume control. Compliance criteria are specified in the Consent Decree. Compliance criteria for the western compliance wells are (a) concentrations of total Priority Pollutant VOCs shall not exceed 100 ppb during operation of the system and for five years after termination; and (b) the concentration of the other Priority Pollutants shall not exceed the maximum concentration of these compounds that are found prior to commencement of the remedial system operation. The following compliance criteria apply to the southern compliance points: (a) any water quality criteria for protection of human health (based on $10^{-6}$ health risk criteria), (b) background conditions as determined in accordance with 40 C.F.R. § 264.97, or (c) detection limits attainable using the analytical methods prescribed in the Consent Decree (subparagraph 2.17), whichever is highest.

Two areas of concern emerged after startup of the ground-water remediation system: the northwest and southwest edges of the plume. The northwest edge is problematic due to several large industrial production wells west of the Great Miami River which appear to be pulling some ground water from the vicinity of the Site. These wells are monitored for VOCs and are slightly contaminated, raising the possibility that there is some loss from the Chem-Dyne plume. The southwest edge of the plume represents a potentially more serious problem. Beginning in 1989, data from several southern compliance wells indicated that compliance criteria for VOCs had been exceeded. This ultimately resulted in additional investigations as described in Section 2 below.

On several occasions the Agencies encouraged the Trust to update the ground-water model associated with the Site, in order to increase understanding of the hydraulic control and enable sound decision-making about the ground-water extraction system. At the May 8, 1997, meeting, the Trust presented a new ground-water model and submitted a report describing this model to the Agencies. This submittal has been reviewed as part of this five-year review process. A summary of the report is presented in Section 3 below.

## 2. Additional Investigations - Southern Compliance Wells

The RI determined that ground water to the south and southwest of the Site had not been impacted by the Site. Three compliance points, subject to the compliance criteria described above, were established to ensure that the ground water would remain unaffected by the Site, i.e., detect loss of plume control. Data from compliance monitoring began showing VOCs present in the southern compliance wells in 1989. In 1990, the Agencies required the Trust to investigate the source of the VOCs and, if necessary, implement a Corrective Action Plan (CAP) as specified in the Consent Decree.

The additional investigation near the southern compliance wells was carried out in two phases, with a soil gas survey being conducted as the first phase. Based on the results of the soil gas survey, more investigation activities were planned. This second phase of the investigation included conducting soil borings and installing additional piezometers and monitoring wells for monitoring water levels and water quality in the area of the southern compliance wells. A detailed discussion of the investigations, conclusions and recommendations may be found in "Additional Investigations in the Vicinity of the Southern Compliance Wells, Chem-Dyne Site, Hamilton, Ohio," dated December 1993.

Based on the results of the investigations, the Trust reached a number of conclusions in their report, including the following:

- Several areas of contamination in the unsaturated zone were identified off-Site within the study area. However, there is no correlation between contaminants in these areas and those found in ground water;
- The compliance wells are within the area under hydraulic control from the extraction system. Thus ground water flowing through the compliance wells is originating off-Site;
- The source of the contamination in the southern compliance wells is likely a limited plume of unknown origin.

The Trust also made the following recommendations in the report:

- The southern compliance wells should continue to be monitored with the understanding that samples from these wells are not indicative of ground water migrating from the Site;
- Compliance criteria specified in the Consent Decree for the southern compliance wells should not be applied to data from these wells until after the termination of the extraction system;

- Continue quarterly monitoring of G21 and MW16 through 1994 and include piezometers PZA through PZE in the monthly water-level monitoring program;
- Reassess conditions in the vicinity of the southern compliance wells after at least a year of water-level and water-quality data collection and conduct no further investigations until the reassessment is complete.

The Agencies concurred with the Trust's recommendations to continue monitoring and to re-evaluate the situation periodically. From 1994 through 1999, there were no significant changes in the status of the southern compliance wells. Water-level measurements indicate the compliance wells are within the capture zone of the extraction system and water-quality data indicates that contaminant levels in the southern compliance wells are decreasing.

### 3. Ground-Water Model Report

In response to requests from the Agencies to update the Site ground-water model, the Trust presented an updated model at the May 8, 1997, meeting between the Agencies and the Trust. In addition, the Trust included in the 1996 Annual Report a report entitled "Modeling Analysis of Ground-Water Flow Patterns at the Chem-Dyne Site" (Model Report). A review of the Model Report was conducted as part of this five-year review process and specific comments have been sent to U.S. EPA under separate cover. In general, there are several elements of the model that need further clarification to support the model's creation and ability to predict capture. Once these issues are addressed and the purpose of the model is made clear, the Agencies can proceed with a more thorough model review.

## C. Institutional Controls

Institutional controls in the form of ground-water use restrictions are in place. The restrictions stem from Section VII, Paragraph E of the Consent Decree which states that "(t)he State agrees to use its statutory and regulatory authority to prohibit the installation of wells into contaminated ground water at or near the Chem-Dyne Site within the area marked on Appendix 5, or as it may be enlarged or reduced by Ohio EPA following consultation with USEPA. This prohibition shall not apply to wells installed as part of the Work." This is in keeping with Ohio Administrative Code (OAC) 3745-9-04, which regulates the location of new wells and does not allow installation of wells in areas where contamination may be drawn into the well.

## V. Applicable or Relevant and Appropriate Requirements (ARARs) Review

Five-year review guidance establishes policy for U.S. EPA to review and analyze the remedial action as it is effected by newly promulgated or modified Federal and State environmental laws, or ARARs. The Enforcement Decision Document contains a discussion of environmental laws associated with the construction and long-term maintenance and monitoring of the systems for this Site. Environmental laws that were determined to apply to this Site include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act (SDWA), and the Toxic Substances Control Act (TSCA). Section IV, paragraph C(1) of the Consent Decree states that "all activities undertaken...pursuant to this Consent Decree shall be undertaken in accordance with the requirements of all applicable local, state and federal laws, regulations and permits."

Contaminated ground water is extracted by pumping and treated by air strippers on-Site, prior to discharge to the Ford Hydraulic Canal. This activity is regulated by Section 307(b) of the Clean Water Act, and regulations promulgated thereunder (40 CFR 403). The State of Ohio issued a National Pollution Discharge Elimination System (NPDES) permit to the Site for discharge of treated ground water to the Ford Hydraulic Canal. From 1989 to 1992 the NPDES permit limits for the VOCs 1,1,2,2-tetrachloroethane and 1,2-trans-dichloroethylene were occasionally exceeded. The Site's NPDES permit was renewed on October 1, 1992, with modified discharge limits achievable by the treatment system, and an expiration date of September 1997. Permit limits for VOCs have not been exceeded since the permit renewal. A second renewal application was submitted to Ohio EPA in March 1997. This application is currently undergoing review and will be issued during State Fiscal Year 2001, which ends on June 30, 2001.

The Ohio EPA also issued underground injection control (UIC) permits for the re-injection system. Coincident with the cessation of the re-injection system in October 1992, the Trust voluntarily relinquished its eight Class V Injection Well Permits. The Trust agreed to maintain the re-injection system through 1997 and Ohio EPA has authorized that the injection wells may be operated under Permit by Rule.

At system start-up an air permit was issued by Ohio EPA in compliance with the Clean Air Act to regulate emissions from the air strippers used to treat contaminated ground water. Compliance sampling required by the permit indicates that the mass emission rates have been in compliance throughout operations at the Site. In November 1998, Ohio EPA issued a letter to the Site indicating that emission concentrations were of the amount and type to be considered minimal and would no longer require a permit. As these levels can be achieved without the treatment provided by the vapor phase carbon system, the Trust

requested permission to remove that part of the treatment system, and the Agencies agreed to this request. In addition, air monitoring required by the permit has been discontinued. Should there be a significant increase in groundwater influent contaminant concentrations, the treatment system may be reinstated.

The Site also has a RCRA permit to operate as a generator of RCRA regulated materials. This includes off-Site shipments of waste materials generated from air stripper cleaning and condensate recovery from the regeneration of carbon vessels. Provisions of RCRA applicable to the Site also include the technical standards for the placement of the final cap.

The Endangerment Assessment (EA) for the Site concluded that soil contaminants presented an unacceptable risk based on direct contact exposure routes. Contaminated soils were removed from the Site and disposed of appropriately. The provisions of TSCA applied to cleanup and disposal of soils contaminated with PCBs.

The EA also concluded that ground water presented an unacceptable risk for possible future use at the Site and that continued migration of the plume could present an unacceptable risk to downgradient ground-water supplies. The area of the plume to be remediated was determined to be that area within the 100 ppb total VOC isopleth. The cleanup goal for individual wells within the contaminant plume was set at 100 ppb total Priority Pollutant VOCs. Compliance wells were installed to the south and west of the plume boundary. Compliance wells to the west of the Site have compliance criteria of 100 ppb total Priority Pollutant VOCs. Those to the south, which had not been impacted by the Site at the time of the RI, have compliance criteria of $10^{-6}$ health based criteria.

Maximum Contaminant Levels (MCLs) are enforceable standards dictating the maximum permissible level of a contaminant in public water supplies. MCLs were not promulgated at the time the remediation goals for this Site were determined and the Consent Decree was lodged. The Enforcement Decision Document (EDD), which pre-dates the Consent Decree, briefly discusses the use of RCRA's Groundwater Protection standards, the $10^{-6}$ additional cancer risk criteria for carcinogens, and the best available analytical detection limits for the individual compounds, as influencing factors in determining the ground-water cleanup goal. The Priority Pollutant List would not be applicable to ground-water cleanup if this site were being addressed under CERCLA today. Instead, MCLs or risk-based numbers would be used to determine a clean-up goal which would be protective of human health and the environment.

## VI. Summary of Site Visit

No Site visit was conducted specifically for the five-year review. This is due to on-going presence at the Site and a Site visit conducted by the reviewer within six months of initiation of the five-year review. Occasional phone calls and written correspondence, as well as monthly and annual reports also facilitate recent knowledge of Site activities. Meetings between the Agencies and the Trust occur when necessary.

## VII. Areas of Non-compliance

The only consistent compliance difficulty at the Site had been occasional violations of the NPDES permit for several VOCs which tended to resist "stripping" in the air stripping tower (namely 1,1,2,2-tetrachloroethane and 1,2-dichloroethene). The Site's NPDES permit was renewed on October 1, 1992 with modified discharge limits which the treatment system is capable of meeting. The NPDES permit limits have not been exceeded since that time. There are currently no areas of non-compliance associated with this Site.

## VIII. Conclusions and Recommendations

Based on this Five-Year Review, the following recommendations are made.

A recommendation is made to obtain the necessary information to complete a review of the updated Site ground-water model. Upon completing such a review, a determination should be made as to whether this ground-water model accurately reflects Site conditions and is usable as a sound decision-making tool.

Five-year review guidance indicates that a review of the remedy in light of newer and more effective technologies is appropriate. In the U.S. EPA document "Evaluation of Ground-Water Extraction Remedies: Volumes 1 and 2" (1989), a number of case studies are evaluated regarding the efficacy of ground-water extraction and treatment as a cleanup option. In general, this evaluation concludes that extraction and treatment of ground water alone will rarely achieve cleanup goals. In keeping with this conclusion, it is recommended that newer treatment technologies for source remediation be reviewed for possible implementation at this Site. These technologies, such as soil vapor extraction and air sparging, would address contamination remaining in the on-Site soils, which acts as a continuing source of ground-water contamination. Implementing one of these new treatment technologies may provide a faster, more cost-effective means of achieving cleanup goals.

Finally, the cleanup goal dictated in the Consent Decree of 100 ppb Priority Pollutant VOC remains protective while the extraction system continues to operate. However, no studies have been conducted to date to determine whether contamination remaining on-Site after system shutdown could reach the City of Hamilton's South Wellfield. In addition a number of MCLs have been promulgated and newer technologies for source remediation allow for the achievement of lower cleanup levels. For these reasons, a review of how protective of the cleanup goals will be once the extraction system is shutdown is recommended.

## IX. Statement of Protectiveness

All non-LTRA components of the remedial action have been fully implemented. Therefore, the interim Site completion requirements for this LTRA Site, as specified in OSWER Directives 9320.2-3A, -3B, and -3C have been met. The remedy has eliminated all unacceptable threats to human health and the environment associated with exposure to contaminated soil, air, and surface water at the Site. The LTRA is addressing the ground-water contamination. Human exposure to ground-water contaminants is currently limited through the use of institutional controls and hydraulic control of the ground-water contaminant plume by the extraction system.

The selected remedy is operating as intended, but a more detailed review of the ground-water model will ensure that this continues. Because the system has not achieved clean-up levels in the first 10 years, the Trust is committed to operating the system for up to another 10 years. Per the Consent Decree, if clean-up goals have not been achieved after 20 years of system operation, a determination shall be made as to whether further operation and modification of the system would be cost effective.

The remedy, as currently operating, remains protective of human health and the environment. However, because clean-up levels are only 100 ppb total Priority Pollutant VOCs, the remedy may not remain protective after extraction system shutdown and the remaining contaminants resume migrating. The institutional control consisting of the State's agreement to prohibit wells from being installed in a designated area will not protect the City of Hamilton's South well field.

## X. Next Review

The next Five-Year Review for the Chem-Dyne Site will be completed by September 11, 2002.