FEASIBILITY STUDY REPORT
FORMER GE COURT STREET BUILDING 5/5A SITE
TOWN OF DEWITT, ONONDAGA COUNTY, NEW YORK
NYSDEC SITE NO. 734070

Prepared for

Lockheed Martin Corporation
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Feasibility Study Report
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
NYSDEC Site No. 734070

CERTIFICATION STATEMENT

The material and data in this report were prepared under the supervision and direction of the undersigned. All activities described herein were performed in accordance with the New York State Department of Environmental Conservation-approved Remedial Investigation/Feasibility Study Work Plan (August 1996, revised January 1997), and the June 11, 1996 Order on Consent (Index No. D7-0001-96-05) between New York State Department of Environmental Conservation and Lockheed Martin Corporation.

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CONTENTS

CONTENTS (Continued)

TABLES

FIGURES

EXECUTIVE SUMMARY

A Feasibility Study (FS) was performed for the Former GE Court Street Building 5/5A Site (site) located in the Town of Dewitt, Onondaga County, New York. The FS was completed to evaluate remedial alternatives for the site which would be protective of human health and the environment, based on the findings of a Remedial Investigation (RI) and Risk Assessment (RA) which are detailed in a RI Report for the site (EMCON, April 1998). Past site operations have resulted in volatile organic compound (VOC) impacts along the west side of Building 5. Several Interim Remedial Measures (IRMs) have been implemented to eliminate, minimize, and prevent the migration of VOCs in groundwater and surface water pathways. The completed IRMs are as follows:

- Removal of VOC-impacted soils;
- Elimination or minimization of VOC-impacted groundwater infiltration to the storm sewer system through storm sewer system rehabilitation; and
- Prevention of migration of VOC-impacted groundwater through the shallow groundwater system toward creeks to the north and west of the site through the construction and operation of a groundwater collection and treatment system.

The RA presented in the RI Report was comprised of a detailed pathway analysis and risk screening. The RA concluded that, as a result of the IRMs completed, there is no significant risk of site-related contaminants to human health or the environment associated with the following environmental media:

- Soils;
- Surface water quality in Sanders Creek and the South Branch of Ley Creek;
- Storm sewer system discharges; and
- Sediment quality in Sanders Creek and the South Branch of Ley Creek.

The IRM components of soil removal and storm sewer rehabilitation are permanent, final actions. The groundwater collection and treatment system is an ongoing operational component that will operate for a finite period. Without the groundwater collection and treatment system, the potential exists for migration and discharge of VOC-impacted shallow groundwater to the South Branch of Ley Creek and Sanders Creek. Therefore, this FS focused on the impacted medium which remains at the site (shallow VOC-impacted groundwater).

The FS identifies remedial technologies which could be applied at the site to address VOC-impacted shallow groundwater, based on site conditions. These technologies are combined with the natural attenuation properties of the site to form remedial alternatives to address site-specific Remedial Action Objectives (RAOs).

The RAOs for the site are as follows:

- Prevent the migration of VOC-impacted shallow groundwater to the South Branch of Ley Creek and to Sanders Creek, to the extent feasible considering site conditions; and

- Reduce the level of residual VOCs in the shallow groundwater to attain NYSDEC groundwater standards (6 NYCRR Part 703), to the extent feasible considering site conditions, currently available technology, implementability, cost-effectiveness and cost-reasonableness.

This FS evaluates remedial alternatives to address VOC-impacted shallow groundwater at the site, including: No Action; No Further Remedial Action (i.e., continued operation of the groundwater collection and treatment system); and the implementation of a passive in-situ groundwater treatment system (Groundwater Funnel and Reactive Gate). Each of these alternatives involve, at a minimum, site monitoring and are aided by natural attenuation processes.

Based on the detailed and comparative analyses discussed herein, the No Further Remedial Action alternative (Alternative 2) is recommended for the Former GE Court Street Building 5/5A site. This alternative includes the following elements:

- Continued operation and maintenance (O&M) of the existing groundwater collection and treatment system until groundwater concentrations of site-related VOCs have leveled off at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed, and it can be demonstrated that natural attenuation of site-related VOCs will be protective of surface water quality in the South Branch of Ley Creek and Sanders Creek;

- Monitoring of groundwater elevations at the site will be performed in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of shallow groundwater quality at monitoring wells MW-1S, MW-2S, MW-8S, MW-10, MW-11R, MW-12, MW-16A, MW-17A, MW-18A, and MW-19S in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of groundwater collection and treatment system influent and effluent quality in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of the South Branch of Ley Creek storm sewer outfall quality in accordance with the Engineering Certification Report (EMCON, November 1997); and

- Decommissioning of deep (sand unit) monitoring wells (PZ-1, MW-1D, MW-3D, MW-5D, and MW-6D).

Alternative 2 will satisfy the RAO of preventing migration of VOC-impacted shallow groundwater upstream of the existing groundwater collection trench, and control the migration (to the extent feasible) of VOC-impacted shallow groundwater already downstream of the existing groundwater collection trench towards the South Branch of Ley Creek and to Sanders Creek. Groundwater elevation measurements taken between February 1998 and December 1998 (i.e., since startup of the groundwater collection and treatment system) indicate that hydraulic control has been achieved for the site. Implementation of Alternative 2 will facilitate hydraulic control of VOC-impacted shallow groundwater until groundwater concentrations of site-related VOCs have leveled off at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed, and natural attenuation processes can be relied upon to protect surface water quality in the South Branch of Ley Creek and Sanders Creek.

Alternative 2 will also provide removal of measurable contaminant mass from the groundwater, increase the rate of groundwater flow at the site, and increase the advective component of natural attenuation by increasing hydraulic gradients present at the site. Based on a review of available site data and available literature regarding groundwater collection and treatment systems at other sites with heterogeneous geology, it is anticipated that groundwater quality at portions of the site (i.e., near former source areas) will not achieve groundwater standards, criteria, and guidelines (SCGs) (6 NYCRR Part 703) for a number of decades. However, this alternative is considered the best feasible approach to achieve RAOs at the site.

There are currently no unacceptable human health or environmental risks at the site, and Alternative 2 will provide long-term protection.

1 INTRODUCTION

This Feasibility Study (FS) Report has been prepared for the Former General Electric (GE) Court Street Building 5/5A site located at Deere Road and Route 298 in the Town of Dewitt, Onondaga County, New York. The FS was performed in accordance with a New York State Department of Environmental Conservation (NYSDEC) approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan prepared for the site by Blasland, Bouck & Lee, Inc. (August 1996, revised January 1997), on behalf of Lockheed Martin Corporation (LMC). The FS was completed in accordance with Section IV of the June 11, 1996 Order on Consent (Index No. D7-0001-96-05) between NYSDEC and LMC. The site is currently classified as a Class 3 site on the New York State Registry of Inactive Hazardous Waste Disposal Sites (No. 734070). The Class 3 designation is assigned to sites that do not present a significant threat to the public health or environment.

The site consists of approximately 14.1 acres. The Building 5 property (the northern portion of the site) is currently owned by DE & JD Associates, Inc. (DE & JD). The Building 5A property (the southern portion of the site) is currently owned by G&A Properties (G&A). Building 5 occupies approximately 256,000 square feet, and Building 5A occupies approximately 83,200 square feet. The remainder of the site is paved with only small landscaped areas present adjacent to the buildings. The site is bordered on the north by property owned by Ronald G. Gustafson, Sanders Creek and Route 298, on the east by Deere Road, on the south by property owned by Dennis and Pauline Fehr, and on the west by property owned by Onondaga County, and the South Branch of Ley Creek.

An RI Report (EMCON, April 1998) was prepared for the site to characterize existing site conditions and to define the nature and extent of contamination. The RI Report also describes Interim Remedial Measures (IRMs) which have been completed at the site to remove contaminant source materials, and to control migration of residual contaminants from the site. In addition, the RI Report contains a Risk Assessment (RA) which evaluates the risk to human health and the environment based on the nature and extent of contamination, evaluation of receptors, and remedial actions completed to date.

The purpose of this FS is to evaluate alternatives for remediating the site, based on the findings of the RI and RA. The FS report has been prepared based on the National Contingency Plan (NCP) and guidance documents issued by the United States

Environmental Protection Agency (USEPA) and the NYSDEC. Specifically, these guidance documents include the following:

- Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. USEPA, October 1988; and
- Revised Technical and Administrative Guidance Memorandum (TAGM) on the Selection of Remedial Actions at Inactive Hazardous Waste Sites. HWR-90-4030, NYSDEC, May 1990.

1.1 Remedial Investigation Summary

A RI was completed for the site in 1997 to supplement site data obtained during previous investigations (Remedial Action Plan, Wehran-New York, Inc., March 1993 and Remedial Action Plan Addendum, Wehran-New York, Inc., October 1993). Work elements of the RI included the installation of monitoring wells, piezometers, and soil borings as well as sampling and analysis of soil, groundwater, surface water, storm sewer discharges and creek sediment. Significant site features are shown on Figure 1 (Site Plan and Geologic Cross-Section Location). Site data from the RI and previous investigations are compiled and evaluated in the RI Report (EMCON, April 1998).

The findings of the RI can be categorized in the following topical areas: geology, hydrogeology, and nature and extent of contamination. These findings are summarized in this section of the FS Report.

1.1.1 Geology

The site geology has been characterized based on data obtained from a total of 89 test borings. A cross-section of geological units encountered at the site are shown on Figure 2 (Geologic Cross-Section and Piezometric Profile X-X' - June 1997). In descending order, subsurface stratigraphic units have been classified as follows: fill deposits; clay and silt deposits (which includes discontinuous interbedded sand/silt/peat layers); clayey silt deposits; glacial sand unit; and a basal glacial till unit. The following discussion provides an overview of the units encountered.

1.1.1.1 Fill Deposits

Fill materials found at the site consist of predominantly asphalt macadam and a coarse-grained sand and gravel subbase which had a typical combined thickness of 2 feet. Borings completed on the Onondaga County property (to the west of the Building 5 property) encountered approximately 6 feet of reworked clay and silt soils, and a surficial layer of discarded china, approximately 1 to 2 feet thick in some areas. Fill materials (asphalt) and/or soils were encountered in 58 of the 89 test borings.

1.1.1.2 Clay and Silt Deposits

This stratigraphic unit consists mainly of glaciolacustrine deposits of clay and silt with occasional partings of fine sand. The clay and silt deposits range in thickness across the site from approximately 15 to 20 feet. Below a depth of 10 feet, these deposits are almost viscous and lack cohesive strength. Mottling, which is indicative of seasonal water level fluctuations (alternating oxidized and reduced conditions), was observed in the upper few feet of this unit. The clay and silt unit in certain areas of the site contains discontinuous and thinly-bedded seams of silts and fine sands, fine to medium sands, and isolated beds of peat soils.

1.1.1.3 Clayey Silt Deposits

The approximately 5 to 10-foot thick clayey silt unit consists mainly of silt with varying smaller percentages of clay, and is typically found at a depth of between 15 to 25 feet below grade. Fine sands can be typically found as partings, while the basal portion of the unit develops a higher percentage of fine sand at several locations. Geologically, the stratigraphic distinction was based on visual observations and field textural classification according to a system modified after Burmister (Procedures for Testing Soils, D.M. Burmister, ASTM, 1958).

1.1.1.4 Glacial Sand Unit

Underlying the clayey silts is a continuous deposit of fine to coarse glacial sands with smaller percentages of fine gravels and silts. Some stratification was evident as fine sands and silts at the upper portions of the unit graded to coarser sands with fine gravels towards the bottom. The sand unit, encountered at a depth of more than 20 feet below grade, ranged in thickness from 4 to 10 feet.

1.1.1.5 Basal Glacial Till Unit

A dense layer of red-brown till was encountered beneath the sand layer. The till consists of an unsorted, unstratified mixture of silt and clays, sands and gravels, and appears to be continuous across the site. The thickness of the till is unknown since all of the deep borings were terminated within the upper portion of the unit.

1.1.2 Hydrogeology

Characterization of site hydrogeology was based on water elevation data obtained from monitoring wells and piezometers which were screened in the shallow (i.e., fill, clay and silt, and clayey silt deposits), and deeper (i.e., glacial sand) flow regimes. Site hydrogeology relationships are depicted in Figure 2 (Geologic Cross-Section and Piezometric Profile X-X' - June 1997), and Figure 3 (Shallow Groundwater Elevation Contour Map - June 1997).

1.1.2.1 Shallow Groundwater Flow System

The shallow groundwater flow system (i.e., fill, clay and silt, and clayey silt deposits) was characterized by the use of monitoring wells and piezometers screened at or just below the groundwater surface in addition to staff gauges in Sanders Creek and the South Branch of Ley Creek which provided surface water elevation data.

Depth to water varies with regional precipitation patterns and typically ranges from 1 to 3 feet below the ground surface. As shown in Figure 3 (Shallow Groundwater Elevation Contour Map - June 1997), shallow groundwater elevation data indicates a northwesterly and semi-radial flow pattern with discharge toward the South Branch of Ley Creek (located to the west) and Sanders Creek (located to the north). These two surface water bodies serve as discharge boundaries for the shallow groundwater flow system. Horizontal hydraulic gradients ranged from about 0.01 ft/ft to 0.04 ft/ft across the site. Horizontal permeabilities encountered in the shallow groundwater system range from 10^{-4} cm/sec down to 10^{-6} cm/sec.

As part of the RI, an evaluation was conducted to determine if the 48-inch diameter sanitary sewer line that traverses the Onondaga County property (parallel to the South Branch of Ley Creek), was acting as a preferential pathway for shallow groundwater flow. Based on a review of piezometric heads in three piezometer transects installed across the sewer line during the RI, the sanitary sewer line is not acting as a preferential pathway for groundwater flow.

1.1.2.2 Deep Groundwater Flow System

Deep groundwater elevation data indicates that groundwater in the deep (i.e., glacial sand) unit flows in a north-northwesterly direction. The hydraulic gradient is approximately 0.001 ft/ft. The horizontal permeability encountered in the deep sand system at the site is in the 10^{-2} cm/sec to 10^{-3} cm/sec range.

1.1.2.3 Vertical Head Differences

Vertical head differences were evaluated by installing monitoring wells as couplets or triplets screened in the shallow (i.e., fill, and clay and silt), intermediate (i.e., clayey silt), and deep (i.e., glacial sand) hydrostratigraphic systems, respectively. With minor exceptions, the prevailing vertical gradient between the deeper versus shallower groundwater is upward. In other words, there is a tendency for groundwater to flow from deeper to shallower strata. Some localized reversals (i.e., flow from shallow to deeper strata) have been observed, which are probably due to low recharge periods. These upward gradients occur because the sand unit is confined by the overlying low permeability clayey silt and clay and silt units.

1.1.3 Nature and Extent of Contamination

The RI included collecting and analyzing samples from the following media:

- Soil;
- Groundwater;
- Surface Water;
- Sediment; and
- Storm Sewer Outfalls.

A discussion of each of the media is presented below. As described in the RI Report, the medium of concern is the volatile organic compound (VOC) impacted shallow groundwater. Figure 4 (Isoconcentration Map of VOCs in Shallow Groundwater - March 1997) shows the distribution of total VOCs in the shallow groundwater at the site.

1.1.3.1 Soil

The vertical extent of VOCs in the former underground storage tank (UST) area and solvent storage pad area has been defined. In 1992, VOC-impacted soil removal activities were completed. Post-removal sampling completed at that time confirmed that the majority of VOC-impacted soils were removed from the unsaturated soils and the upper saturated zone, to the extent possible, by excavation. Of 9 unsaturated zone confirmatory samples collected from this excavation, residual concentrations of all VOCs in 7 samples were below NYSDEC recommended soil cleanup objectives (NYSDEC, TAGM, HWR-94-4046). Two unsaturated samples each contained one VOC in excess of NYSDEC recommended soil cleanup objectives. These two samples each contained approximately 2 mg/kg of total VOCs. One of these samples contained 1,1-dichloroethane at a concentration of 1.4 milligrams per kilogram (mg/kg) as compared to a 0.2 mg/kg soil cleanup objective. The other sample contained xylenes at a concentration of 1.8 mg/kg as compared to a 1.2 mg/kg soil cleanup objective.

The RI included deep soil borings in the former UST area and the former solvent storage pad area to evaluate vertical migration of VOCs. RI sampling of saturated zone soils beneath the former UST area and the former solvent storage pad area indicate that there is no evidence of a non-aqueous phase liquid (NAPL), and that the residual VOCs (up to approximately 400 mg/kg total VOCs, including 280 mg/kg of trichloroethene) are limited to a depth interval beneath the former UST excavation that is present well below the water table (18 to 20 feet below grade), but is confined above the underlying sand unit. The presence of residual VOCs at these intervals is related to VOC-impacted groundwater.

PCBs in the soil adjacent to the transformer pad on the north side of Building 5 were not present at levels which require further action. Of the three soil samples collected from worst-case locations adjacent to the transformer pad, only one had a detectable concentration of PCBs (0.23 mg/kg). This transformer pad was removed by the Building 5 property owner (DE & JD Associates, Inc.) during renovation activities completed in October 1997.

1.1.3.2 Groundwater

The RI has defined the vertical and horizontal extent of groundwater impacted by VOCs downgradient of the former source areas. Except for one monitoring location in the deep glacial sand unit, VOC-impacts to groundwater are limited to the shallow flow regime north and northwest of Building 5. Isolated, low level VOCs (approximately 30 micrograms per liter (ug/l) of total VOCs) in the deeper glacial sand unit have been identified at one location (MW-1D) immediately west of Building 5. Downgradient sample locations in the deep system do not detect any significant concentrations of VOCs (all less than 1 ug/l). Vertical migration of VOCs from the shallow system to the deeper sand is not a significant transport mechanism due to upward gradients observed between these units and the low vertical permeability of the geologic units overlying the sands.

1.1.3.3 Surface Water

The migration of VOC-impacted groundwater at the site has not impacted surface water quality in the South Branch of Ley Creek, based on comparison of upstream and downstream samples, and the identified lateral extent of VOC-impacted shallow groundwater. The migration of VOC-impacted groundwater at the site has not impacted surface water quality in Sanders Creek, based on the defined lateral extent of VOC-impacted shallow groundwater.

1.1.3.4 Sediment

VOC analysis of sediment samples collected upstream and downstream of storm sewer outfalls to Sanders Creek and the South Branch of Ley Creek was performed. There was no identifiable impact to sediment quality at the Sanders Creek outfall. In the South Branch of Ley Creek, the downstream sample exhibited slightly higher VOC concentrations relative to the upstream location. However, because of the trace levels present (all detected VOCs were less than 25 ppb) in both South Branch of Ley Creek samples, no impact to the sediments from the outfall was concluded. No adverse impact was found, and no significant human health or ecological risk is associated with the sediment concentrations identified based on evaluation of complete exposure pathways and screening analysis using sediment criteria.

1.1.3.5 Storm Sewer Outfalls

RI activities identified infiltration of VOC-impacted groundwater into site storm sewer systems which discharge to Sanders Creek and to the South Branch of Ley Creek. These discharges did not result in a net impact to surface water quality in the South Branch of Ley Creek, where surface water samples were taken.

1.2 Interim Remedial Measures Summary

This Section of the FS Report provides a summary of IRMs conducted at the site to date. These activities include contaminant source removal and control of residual contaminant migration (storm sewer rehabilitation, and installation of a groundwater collection and treatment system).

1.2.1 Contaminant Source Removal

Previous use of the site by GE included the storage of solvents in 9 USTs (removed in 1986), and a solvent storage pad for dispensing of virgin paint solvents and thinners. Subsurface investigations performed in 1992 indicated that VOC-impacted soil and groundwater were present at the site, primarily along the western site boundary, adjacent to Building 5. Three source areas were identified including the former USTs, the former solvent storage pad, and an area adjacent to a former metal shed at the southwest corner of Building 5. In 1992, IRMs were completed to remove VOC-impacted soils from these areas. Groundwater which accumulated in the excavations was also containerized and transported to an off-site disposal facility.

Confirmatory sampling indicated that the majority of VOC-impacted soils in the former UST area and the former solvent storage pad area were removed, and that complete VOC removal was performed adjacent to the former metal shed.

1.2.2 Storm Sewer Rehabilitation

During the process of evaluating the migration pathways for VOC-impacted groundwater, it was recognized and confirmed that certain site storm sewers were acting as a preferential pathway for migration of VOC-impacted groundwater to surface water. The original storm sewer system at the site consisted of bell and spigot clay tile piping with brick catch basins. This type of construction typically allows infiltration of groundwater into the piping and catch basins. In 1992, 1993 and 1997, IRM activities (detailed in the

1993 Remedial Action Plan, the 1993 Remedial Action Plan Addendum, and the 1997 Engineering Certification Report, respectively) related to the storm sewer system were completed to eliminate or minimize the infiltration of groundwater from VOC-impacted areas into the storm sewers. These activities included: abandonment and relocation of catch basins, grouting of existing sections of clay tile piping, and installation of new storm sewer piping.

Post-construction monitoring of the Sanders Creek outfall (OF-01A) has confirmed that the IRMs were successful in preventing the discharge of VOC-impacted groundwater to Sanders Creek. Post-construction dry weather flow samples collected from the South Branch of Ley Creek outfall (OF-02) indicate trace concentrations of VOCs in the discharge. Trace levels of VOCs persist in dry weather flow from the South Branch of Ley Creek storm sewer system (i.e., less than 50 ug/l total VOCs).

1.2.3 Groundwater Collection and Treatment System

The RI and previous investigations have identified that the main migration pathway for VOCs in the shallow groundwater is through discontinuous sand seams in the otherwise low permeability subsurface of the site. A groundwater collection and treatment system for the site was designed and constructed to intercept and collect groundwater containing residual VOCs from its natural flow path towards the South Branch of Ley Creek and Sanders Creek.

The system includes a collection trench and sump from which groundwater is pumped to a treatment system as shown on Figure 5 (Remedial Alternative 2 - Groundwater Collection and Treatment System). The collected groundwater is then treated prior to discharge to Sanders Creek. The design of the collection trench and treatment system is briefly described below. Details regarding the system are provided in the IRM Work Plan for the Groundwater Collection and Treatment System (EMCON, November 1997), and the Certification Report for the Groundwater Collection and Treatment System Installation (Blasland, Bouck & Lee, Inc., Revised May 1998).

1.2.3.1 Groundwater Collection Trench

Based on evaluation of the test boring logs and groundwater sampling results obtained in support of the design, the depth, alignment and length of the collection trench were designed to intercept the areas where sand seams have been confirmed as the pathways for VOC migration. The trench has a total length of approximately 830 feet, with a collection pipe slope of 0.2 percent and a collection sump at the northeast end. Based on variations in the ground surface elevation, the final depth of the collection trench ranges from 8 to 14 feet below grade. The groundwater sample results from the RI confirm that there were no detectable VOCs present in groundwater at either end of the trench, or below the base elevation of the trench. Accordingly, the groundwater collection trench is intended to intercept VOC-impacted groundwater moving toward Sanders Creek and the South Branch of Ley Creek. The design of the collection trench is intended to provide hydraulic containment of the shallow VOC-impacted groundwater located upgradient of the collection trench, and to collect shallow VOC-impacted groundwater which has already migrated west of the collection trench (i.e., in the vicinity of MW-18A).

Groundwater elevation measurements collected between February and December 1998 (since the startup of the treatment system) indicate that the groundwater withdrawal rates from the collection trench have been effective in establishing and maintaining hydraulic levels in the collection trench, which are lower than the groundwater elevations measured in monitoring wells surrounding the collection trench. Therefore, operation of the groundwater collection and treatment system is an effective means of providing hydraulic containment of shallow groundwater migration.

1.2.3.2 Groundwater Treatment System

Pumps are located within the collection sump to transfer groundwater to a common header pipe located within the treatment building. The header pipe discharges into a diffused aeration tank air stripper designed to remove VOCs. The effluent from the air stripper flows by gravity to a transfer tank. From the transfer tank, the groundwater is pumped through bag filters designed to assure compliance with inorganic discharge requirements (e.g., iron). The treated water flows by gravity to a catch basin (CB-20) and ultimately through storm sewer piping to Sanders Creek (Outfall OF-01A).

Operational data collected since groundwater collection and treatment system startup has been reported to NYSDEC monthly in progress reports for the site. This operational information has been excerpted and is included in Appendix A. Effluent monitoring performed for the system has confirmed that all NYSDEC discharge limitations are being achieved by the existing treatment equipment and methods. Influent monitoring data collected between February 1998 through December 1998 indicates the following influent characteristics.

Parameter (units)	Influent High	Influent Low
Vinyl Chloride (ug/l)	130	29
Chloroethane (ug/l)	<10	<10
1,1-Dichloroethane (ug/l)	270	95
1,2-Dichloroethene (ug/l)	99	37
1,1,1-Trichloroethane (ug/l)	<5	<5
Trichloroethene (ug/l)	5	<5
Benzene (ug/l)	<5	<5
Toluene (ug/l)	<5	<5

Parameter (units)	Influent High	Influent Low
Ethylbenzene (ug/l)	<5	<5
Xylenes (ug/l)	<5	<5
pH (s.u.)	7.7	6.8
Iron (ug/l)	650	<100
Average One-Month Flow Rate (gallons/min)	7.2	2.1

Based on the influent VOC concentrations and quantities, VOC discharges to the air from the stripper result in ambient air impacts which are within the short-term guideline concentrations (SGCs) and annual guideline concentrations (AGCs) established by NYSDEC.

1.3 Risk Assessment Summary

The RI process included a RA to evaluate the potential for hazards associated with the following contaminants of concern (COCs) at the site:

- 1,1-dichloroethane;
- 1,1-dichloroethene;
- 1,2-dichlorethene;
- Methylene chloride;
- Trichloroethene;
- cis-1,2-dichloroethene;
- 1,1,1-trichloroethane; and
- Vinyl chloride.

Although methylene chloride was considered a COC for the purpose of the RA, its presence in certain analytical results is most likely laboratory artifact.

The human health component of the RA assessed risks to public health, while the ecological RA (ERA) addressed the potential for site-related contamination to impact biota. Risks were evaluated in the context of site use by humans and wildlife, available habitat, and local/regional conditions.

The human health RA followed the guidelines established by the EPA in performing assessments for RI/FS sites (USEPA, 1989, 1990, 1992). The ERA process was completed in accordance with the NYSDEC's Fish and Wildlife Impact Analysis (FWIA) for Inactive Hazardous Waste Sites (1992), and USEPA's ERA guidance for Superfund sites (1997). The RA included the FWIA Step I, with additional input from USEPA's

ERA guidance Step 1. As part of the RA, standards, criteria and guidelines (SCGs) relevant to the site were identified and a pathway analysis was performed.

The RA concluded that there are no currently complete human health exposure pathways for site-related COCs. Future exposure scenarios that would result from a substantial change in site use, as this term is defined at 6 NYCRR Part 375-1.3(v), are controlled at the site by the NYSDEC under the provisions of its Part 375 regulations that govern new uses of sites Therefore, no future complete human health exposure pathways are anticipated.

Based on the pathway analysis, there are no complete ecological exposure pathways associated with soils or groundwater. The operation of the groundwater collection and treatment system will maintain incomplete ecological exposure pathways. Based on the risk screening evaluation, there are no concentrations of site-related COCs in surface water or sediment that could present an ecological concern.

1.4 Feasibility Study Scope of Work

The scope of this FS includes an evaluation of applicable remedial technologies and alternatives which could be utilized at the Former GE Court Street Building 5/5A Site to meet SCGs and remedial action objectives (RAOs) identified for the site. Section 2 presents the SCGs, RAOs, and general response requirements. The identification and screening of remedial technology types and process options is presented in Section 3. The development of remedial alternatives, and a detailed analysis of applicable alternatives are presented in Section 4.

2 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE REQUIREMENTS

2.1 Introduction

In order to evaluate remedial alternatives for the Former GE Court Street Building 5/5A Site, the RAOs and general response actions were developed for the site. Based on the findings and conclusions of the RI, the environmental medium of concern at the site is VOC-impacted shallow groundwater. IRMs have been completed, to the extent practical, to address source control (former VOC sources and residual contaminants in the unsaturated and shallow saturated soils), and management of contaminant migration related to VOC infiltration into the site storm sewer systems. Therefore, the RAOs addressed in this FS focus on preventing the migration of site-related contaminants through the shallow groundwater.

An RAO is typically based upon environmental or health-based SCGs or, in the absence of these numerical criteria, reductions of unacceptable health risks to an acceptable range. General response actions were developed to identify types of remedial actions that could be utilized to meet the RAOs for the site.

The following sections present the SCGs, RAOs, and general response actions for remediation. The RAOs and general response actions used in this FS are based on the results of the RI and RA, and the SCGs.

2.2 Standards, Criteria and Guidelines (SCGs)

This section provides a discussion of the SCGs that may be relevant to the site RAOs and potential remedial alternatives.

2.2.1 Definition of SCGs

Section 121(d) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial actions comply with applicable or relevant and appropriate requirements (ARARs) under Federal, State, and local environmental laws.

SARA defines a potential ARAR for a given site as follows:

- Any standard, requirement, criterion, or limitation under any Federal environmental law; and

- Any promulgated standard, requirement, criterion, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criterion, or limitation.

Under some circumstances, remedial actions which do not meet ARARs are allowed under the NCP. Such circumstances include: technical impracticability, technological infeasibility, and lack of state enforcement of certain ARARs in remedial actions. See 40 CFR 300.430(f)(1)(ii)(C)(3), and (5).

The USEPA draft guidance document entitled "CERCLA Compliance with Other Laws Manual" (USEPA, August 8, 1988), and the USEPA memorandum entitled "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements" (USEPA, July 9, 1987) provide the basic framework for the identification and use of ARARs. According to these documents, there are two general categories of ARARs (i.e., “applicable" and "relevant and appropriate") to a remedial action.

Although the remedial actions for this site are not being performed for USEPA, but under a Consent Order between LMC and NYSDEC, the same concept is applicable to the New York State program for this project. Therefore, as described in 6 NYCRR Part 375, the site’s program must be designed in conformance with standards and criteria, unless good cause exists for not doing so. NYSDEC guidance documents must be considered. Under the New York State program, ARARs are referred to as Standards, Criteria and Guidelines (SCGs).

The two general categories of SCGs may be further divided into three types of classifications: chemical-specific, location-specific, and action-specific. These classifications are defined in the 1988 draft CERCLA Compliance with Other Laws Manual as follows:

- Chemical-specific requirements are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Chemical-specific SCGs could include: New York State Groundwater Quality Standards (6 NYCRR Part 703); and New York State

Department of Health (NYSDOH) Drinking Water Standards (10 NYCRR Part 5);

- Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur within special, regulated locations. Examples of location-specific SCGs are the regulatory programs of the Army Corps of Engineers (40 CFR Part 230 and 33 CFR Parts 320 through 330), and New York State Standards for Construction in Flood Hazard Areas (6 NYCRR Part 500); and

- Action-specific requirements are usually technology performance, design, or activity-based limitations taken with respect to the remedial activities. An example of an action-specific SCG is the Draft New York State Air Guide-1, Guidelines for the Control of Toxic Ambient Air Contaminants (NYSDEC, Draft 1991).

Potential chemical-specific SCGs were utilized to develop the RAOs for the site. Potential action-specific and location-specific SCGs were identified for each remedial alternative to facilitate screening and detailed evaluation of each alternative. The potential chemical-, location-, and action-specific SCGs for each remedial alternative are also presented in conjunction with the description of these alternatives in Section 4.

Finally, it should be noted that under New York State Regulations, on-site actions are exempt from having to obtain NYSDEC-issued permits. On-site actions must demonstrate full compliance with all substantive permit requirements. These actions, however, need not comply with the administrative permitting aspects, provided they are performed pursuant to a Consent Order. Off-site actions, such as off-site removal, treatment, storage, or disposal actions must meet all applicable permit requirements.

2.2.2 Potential Chemical-Specific Groundwater SCGs

Potential chemical-specific SCGs for the Former GE Court Street Building 5/5A Site have been identified from New York State environmental regulations and guidance documents, as well as applicable Federal regulations. These SCGs are shown in Table 1 (Summary of Chemical-Specific Groundwater SCGs). The following subsections describe each SCG.

New York State Groundwater Quality Standards (6 NYCRR Part 703)

The New York State Groundwater Quality Standards establish acceptable water quality levels for designated uses of groundwaters throughout the State. The class standard that has been applied to the Former GE Court Street Building 5/5A Site is Class GA Fresh Groundwaters.

Best usage of Class GA Fresh Groundwaters is defined as a source of potable water supply. However, Class GA is applied to all freshwater groundwaters of the State by the NYSDEC, regardless of the usability as a water supply. VOC concentrations in groundwater (Table 5 of the RI Report) exceeded Class GA standards for vinyl chloride, chloroethane, methylene chloride, 1,1-dichloroethane, cis-1,2-dichloroethene, 1,1,1-trichloroethane, and trichloroethene. These standards are to be used in the FS process to assist in remedy selection, but are not necessarily specific goals and objectives of the remedial action for the site. Specific goals and objectives of the remedial action are established in the Record of Decision following selection of the preferred remedial action.

New York State Department of Health (NYSDOH) Drinking Water Standards (10 NYCRR Part 5-1.52)

The NYSDOH Drinking Water Standards provide drinking water standards for public water systems. These regulations have been promulgated for public community water supplies, after treatment. In practice, NYSDOH may apply these standards to existing untreated supplies, including groundwater. NYSDEC incorporates NYSDOH standards in GA standards of 6 NYCRR Part 703 discussed above.

2.2.3 Location-Specific SCGs

Location-Specific SCGs were identified which would be applicable to remedial actions considered for the site. Actions which would involve these SCGs include:

- Remedial Construction Activities On Site (Local review and permitting requirements, including building permit and plumbing permit).

2.2.4 Action-Specific SCGs

Action-Specific SCGs were identified which would be applicable to remedial actions considered for the site. These SCGs are summarized in Table 2 (Summary of Potential Location-Specific and Action-Specific SCGs). Actions which would involve these SCGs include:

- Treated Groundwater Discharges to Surface Water (6 NYCRR Parts 750-758; State Pollutant Discharge Elimination System (SPDES) Requirements);

- Potential Air Emissions from Selected Treatment Systems (6 NYCRR Parts 211-254. and Draft New York State Air-Guide - 1 (NYSDEC, 1991) Guidelines for the Control of Toxic Ambient Air Contaminants);

- Remedial Construction Activities On Site, Technical Administrative Guidance Memorandum (TAGM) No. 4031; Fugitive Dust Suppression and Particulate Monitoring, NYSDEC; and 29 CFR Parts 1910 and 1926 (Safety and health standards for worker safety and construction activities); and

- Potential Transport of Materials or Wastes to and from the site (6 NYCRR Parts 364, 370-372, 374; 40 CFR Parts 262 and 263; and 49 CFR Part 107).

2.3 Remedial Action Objectives

As detailed in the RI Report for the site, and discussed in Section 1 of this FS, residual VOCs are present in the shallow groundwater. These residual VOCs resulted from historical release of virgin solvents from solvent storage and dispensing areas located west of Building 5. Several IRMs have been completed since 1992 to remove source materials (e.g., contaminated soil and groundwater removal) resulting in permanent and significant reduction in the mass of VOCs at the site. The RAOs for this site address the presence of residual VOCs (above potential chemical-specific SCGs) in the shallow groundwater at the site.

The RAOs for the site are as follows:

- Prevent the migration of VOC-impacted shallow groundwater to the South Branch of Ley Creek and to Sanders Creek, to the extent feasible considering site conditions; and

- Reduce the level of residual VOCs in the shallow groundwater to attain NYSDEC groundwater standards (6 NYCRR Part 703), to the extent feasible considering site conditions, currently available technology, implementability, cost-effectiveness and cost-reasonableness.

The NYSDEC draft strategy document for groundwater remediation decision-making (NYSDEC, April 1996) provides guidance on issues to be considered when evaluating the need and feasibility of groundwater remediation at inactive hazardous waste disposal sites. This document presents an overview of the evaluation process, addressing goals, alternatives, and effectiveness of groundwater remedial programs, in addition to evaluations for the RI/FS process, practicability, institutional controls, and monitoring. A decision tree and summaries of prior studies regarding the effectiveness of groundwater remedial actions are included in the guidance. The general conclusion is that although the goal of a groundwater remedial program is to either restore the site to pre-disposal conditions or the achievement of groundwater quality standards, in certain situations, restoration to these ends is not feasible. The evaluation as to whether or not to require groundwater remediation must address site-specific factors and recognize that a feasible remedy is one that is suitable to site conditions, capable of being successfully carried out with available technology, and that considers, at a minimum, implementability and cost-effectiveness.

2.4 General Response Actions

General response actions describe those actions that could be utilized to meet the site RAOs. General response actions may include: treatment, containment, excavation, collection, disposal, institutional controls, or a combination of these actions.

The general response actions that could potentially aid in meeting the RAOs for shallow VOC-impacted groundwater include:

- Natural attenuation;
- Containment;
- Collection;
- Treatment; and
- Disposal.

3 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

3.1 Identification and Screening of Technologies

The purpose of this step in the FS process is to identify and assess technically feasible options for each general response action identified in Section 2.4 and select representative technologies that will be used to form remedial alternatives for the site. Technologies and process options for each of the general response actions (excluding institutional controls and natural attenuation) presented in Section 2.4 are shown in Table 3 (Identification and Screening of Remedial Technologies). Descriptions of these technology types and process options are discussed in the remainder of this section. The technologies were screened with respect to effectiveness, technical implementability, and relative cost differences. Where applicable, the evaluation for effectiveness and implementability focuses on the following:

- Potential effectiveness in remediating the adversely impacted environmental media;
- Potential for meeting the site-specific RAOs;
- Potential for impacts to human health and the environment during construction and implementation;
- Estimated level of success of the technology and its reliability when applied to the conditions at the site; and
- Cost-effectiveness of the remedial technology.

Consistent with the RI Report, and the RAOs for the site, the medium of concern at the site is VOC-impacted shallow groundwater. General response actions (i.e., containment, collection, treatment, and disposal technologies) along with ancillary processes, are discussed as they apply to the site.

Soils, surface waters and sediment were not identified as media of concern in the RI Report. Since there are no RAOs related to soils, surface waters or sediment, no technologies are presented which apply directly to these media. However, mitigation of contaminant migration from or to these media would be provided through the groundwater technologies evaluated in this FS Report.

3.2 Containment of Groundwater

The containment of shallow groundwater is an appropriate general response action for management of groundwater migration at the site. The following containment technologies are considered for this site:

- Capping;
- Subsurface Barriers; and
- Groundwater Collection by Hydraulic Containment.

3.2.1 Capping

Capping involves the placement of a horizontal low-permeability barrier over the area of concern to greatly reduce or eliminate the infiltration of precipitation upgradient of impacted zones thereby reducing the generation of impacted groundwater and the potential for contaminant migration. At this site, shallow groundwater recharge tributary (drainage basin) to the affected area is very large and mostly developed. Therefore, capping would be extensive and impractical due to the adverse impact on other existing facilities and wildlife in remaining undeveloped lands. This technology will not be considered further.

3.2.2 Subsurface Barriers

Subsurface barriers may be used to reduce or prevent the migration of impacted groundwater from areas of concern at the site. Likewise, they may be used to prevent or limit the flow of clean groundwater into contaminated areas thereby reducing the generation of impacted groundwater. When combined with collection systems, subsurface barriers can reduce the volume of groundwater that would be collected and treated. Vertical barriers are applicable containment technologies where horizontal gradients exist or would be imposed. Horizontal barriers are applicable where vertical gradients are predominant. Subsurface barrier technologies for containment of groundwater include:

- Vertical Barriers (e.g., slurry wall, sheet pile wall, and clay wall); and
- Horizontal Barriers (e.g., bottom sealing).

Slurry Wall

Slurry walls are constructed by excavating a trench through unconsolidated or rock formations and into a geologic confining layer. The trench is kept open during excavation with a slurry of bentonite and water and as excavation proceeds, the trench is backfilled with a soil/bentonite, cement bentonite, or plastic concrete mixture. When utilizing plastic concrete, the wall is typically constructed in panels. A composite slurry wall can be constructed by adding a geomembrane to the sides or the center of the backfilled wall to further reduce the wall permeability. Slurry walls are generally considered a reliable containment technology which can be used to provide long-term waste and contaminated soil/groundwater containment, and groundwater diversion.

Application of this technology would require a slurry wall location which would fully encompass all areas of impacted groundwater. Additional investigations would be required to identify the appropriate location for the wall. However, based on groundwater analysis performed for the RI, VOC-impacted groundwater has already migrated downgradient of a sanitary sewer on the west side of the site along the east side of the South Branch of Ley Creek. Therefore, no slurry wall alignment through this portion of the site would provide complete containment of impacted groundwater. In addition, slurry walls (without groundwater collection) have the tendency to increase hydraulic heads within the containment area. At this site, where an upward gradient exists between the deeper sands and the more shallow silts and clays, construction of a slurry wall may have the effect of reversing the vertical gradient and contaminating groundwater in the deeper sand. This technology will not be considered further.

Sheet Pile Wall

Sheet pile walls are formed by driving interlocking sheets (e.g., steel) from the surface through unconsolidated materials, to an underlying low permeability layer to impede groundwater flow. Sheet piles are a proven technology for short-term waste containment and water diversion, but are ineffective for long-term use. Also, sheet piles do not form a completely impermeable barrier to groundwater flow and are not as resistant to long-term deterioration as the soil/bentonite mixtures used in slurry walls. In addition, sheet piles are subject to the same site-specific limitations as slurry walls discussed above (i.e., not able to provide complete containment of the affected area, and may increase hydraulic heads in the shallow saturated system). This technology will not be considered further.

Clay Wall

Clay walls can be constructed by excavating a trench through a water-bearing, unconsolidated stratum and beyond, into a shallow geologic unit of low permeability or bedrock, and then backfilling with clay in compacted lifts. With this method, a vertical barrier against horizontal movement of groundwater is often practical and economical for shallow applications in unconsolidated materials. Clay walls are generally considered reliable containment technology which can be used to provide long-term waste containment or groundwater diversion. Limitations to this application are that clay placement requires dry conditions (no standing water) and a trench large enough to provide access for suitable compaction equipment.

Clay walls would be applicable for shallow overburden groundwater containment if there were an economic advantage over other technologies. The use of clay walls is not expected to be more cost-effective relative to other technologies. In addition, clay walls are subject to the same site-specific limitations as slurry walls discussed above (i.e., not able to provide complete containment of the affected area, and may increase hydraulic heads in the shallow saturated system). This technology will not be considered further.

Bottom Sealing

Bottom sealing is a horizontal barrier technology which involves placing a horizontal barrier beneath an area to prevent vertical migration of contaminants by the injection of grout. This technique is generally utilized to protect deeper saturated zones from shallow groundwater contamination.

At this site, naturally low vertical permeabilities and the presence of an upward hydraulic gradient eliminate the benefit of this technology. This technology will not be considered further.

3.2.3 Groundwater Collection by Hydraulic Containment

Groundwater collection can be used to develop hydraulic gradients within saturated hydrogeologic units resulting in hydraulic containment that prevents or limits further migration of impacted groundwater. By maintaining groundwater piezometric level drawdowns toward the perimeter of the contamination or at the center of contamination, inward (reverse) gradients can be established and maintained to minimize or reduce further migration of contaminants.

Since this technology involves the collection of contaminated groundwater, this approach also removes contamination and requires ancillary technologies (i.e., groundwater treatment or disposal). If combined with groundwater treatment, hydraulic containment is applicable at this site.

Specific groundwater collection technologies are discussed in Section 3.3 of this FS Report and may be applicable in combination with groundwater containment at the site.

3.3 Groundwater Collection

A groundwater collection system can be utilized to serve the following purposes:

- Provide contaminant recovery by pumping impacted groundwater from the target geologic formation;

- Create a zone of hydraulic influence across the downgradient side of the affected area to serve as an effective barrier to contaminant migration; and

- Intercept or divert clean groundwater at the upgradient side of a contaminated area to reduce contaminant migration or reduce the generation of contaminated groundwater.

The sections below present descriptions of available technologies for groundwater collection:

- Collection Wells (i.e., pumping wells and well point dewatering);
- Collection Drains (i.e., trench drains and horizontal drains); and
- Ancillary Aquifer Development Technologies.

3.3.1 Collection Wells

This subsection describes collection well performance considerations along with a description and screening of pumping well and well point dewatering technologies.

Well Performance Considerations

With regard to collection well performance in remedial systems, the USEPA, National Research Council, and Oak Ridge National Laboratory have evaluated pump and treat (P&T) systems implemented and operated at sites with groundwater contamination. The evaluation results are summarized in a draft NYSDEC guidance entitled "Strategy for Groundwater Remediation Decision Making at Inactive Hazardous Waste Sites and Petroleum-Contaminated Sites in New York State" (April 22, 1996) and an article entitled "Limitations of Pump and Treat Technology," Pollution Engineering, November 1991. The general relevant conclusions of these evaluations include:

- Groundwater extraction and treatment systems can be very effective for the purpose of hydraulically containing or retracting contaminant plumes and for removing a portion of the contaminant mass in the saturated zone;

- Following extraction system start-up, contaminant concentrations generally dropped rapidly. This initial trend was generally followed by contaminant concentrations that decreased at a much slower rate or by concentrations leveling off;

- The technical feasibility and effectiveness of groundwater P&T systems is very site-specific and depends to a great degree on hydrogeologic conditions and contaminant characteristics;

- Contaminant sorption rates, the presence of non-aqueous phase contaminants, and the presence of low permeability zones are probably the major contributors to the limited effectiveness of groundwater P&T systems;

- Restoration of groundwater quality to health-based levels may be extremely difficult, if not technically infeasible, and the time required is usually longer than originally estimated; and

- In addition to the general conclusions of the available literature on P&T systems, the draft NYSDEC guidance also points out that one of the studies on P&T technology reported that data collection during the remedial investigation and during operation of the system was frequently not sufficient to fully assess contaminant movement and the response of the groundwater system to extraction.

- Another study referenced in the draft NYSDEC guidance stated that inadequate design may have contributed to the poor performance of groundwater extraction and treatment systems.

- The need to view groundwater remediation as an iterative process through the re-evaluation of remedial design, remedial timeframes, and data needs was evident at all sites where systems were continuing to operate.

Observed groundwater remediation system performance factors have led to the development of a pump system operational approach which has been shown to be more cost-effective for P&T remediation. This approach entails intermittent pumping to increase the cleanup rate and reduce the operational costs associated with the collection of excessive amounts of clean water. Intermittent pumping accounts for the realities of slow desorptive and diffusion processes as the major influences on the remedial timeframe for aquifer remediation. Groundwater pumping systems will quickly flush contamination from highly conductive geologic zones but will not have a similar effect on lower conductivity zones where capillary effects control advective processes. The rate of removal of contamination residing in the lower conductivity zones is controlled primarily by the solubility and the rates of desorption and diffusion for the specific contaminants. Intermittent pumping first provides flushing of the highly conductive zones with adjacent clean water, removing easily collectable contaminants when the pumps are on. This flushing induces a concentration gradient thereby accelerating desorption and diffusion processes to draw contaminants from adjacent low conductivity zones for the interval when pumps are off. This on/off cycling serves as a cost-effective operational procedure.

Pumping Wells

Pumping wells are typically installed as single wells for hot spot pumping, or in multiple installations placed linearly within, or along a downgradient edge of an area of interest. Pumping wells are typically utilized in homogenous saturated materials where hydraulic connection with all conductive zones can be achieved. Low horizontal permeabilities can limit the zone of influent of pumping wells, requiring more frequent well spacing as permeability decreases.

Horizontal permeabilities encountered in the shallow groundwater system at the site range from 10^{-4} cm/sec to 10^{-6} cm/sec. These permeabilities would require a very close spacing of pumping wells to assure hydraulic containment. Due to the heterogeneous nature of the shallow saturated materials at this site, this technology does not provide assurance that all conductive zones would be contained. The use of pumping wells for active aquifer remediation alternatives would likely not be completely effective at removing contaminants in a reasonable timeframe This technology will not be considered further.

Well Point Dewatering

Well point collection systems consist of a series of closely spaced wells. The well points can be driven into unconsolidated soils or suction tubes can be placed in drilled wells. Water removal is provided by suction lift pumps. This technology is subject to greater limitations as described for pumping wells. This technology will not be considered further.

3.3.2 Collection Drains

Collection drain technologies include trench drains and horizontal drains as discussed separately below.

Trench Drains

Trench drains are typically constructed by excavation of a trench into the stratum of concern, placement of a perforated drainage pipe in the base of the trench, and backfilling the trench with highly permeable material such as sand or aggregate. These types of drains are installed where necessary, depending on site conditions and the intended hydraulic performance of the drain system. When placed upgradient of the area of interest, they can be used to divert clean groundwater from entering contaminated zones.

When located downgradient or around the perimeter of the area of interest, the drain can be used as a hydraulic barrier or collection system. Trench drains have the ability to collect groundwater from areas which are naturally downgradient of the drain location by reversing the hydraulic gradient. Collection sumps and pumping systems are typically required for these systems.

Trench drains are potentially applicable to the site, and are retained for further consideration. As discussed in Section 1.2.3, a trench drain has been constructed at the site as part of an IRM completed in January 1998 to collect shallow VOC-impacted groundwater.

Horizontal Drains

Horizontal drains can be used for dewatering or groundwater collection. This system is constructed by boring horizontally through or beneath the strata of concern and then installing perforated drainage pipes. Horizontal drains would be installed radially from a central boring pit or in a parallel arrangement from numerous boring pits. Collection sumps and pumping systems are typically required for these systems. The overlapping cones of depression created by pumping from low points in the system would dewater the area of interest.

This technology could be applied at the site. However, this technology would be more expensive and potentially less effective than the trench drain method discussed above. Also, as discussed for pumping wells, assuring hydraulic connection to contaminated zones is difficult with point or line withdrawal systems at sites with heterogeneous geology. This technology will not be considered further.

3.3.3 Ancillary Aquifer Development Technologies

In bedrock groundwater flow systems where the rock formations are massive and, where the formations have low, if any, sustainable yield, aquifer development techniques can be employed cost-effectively to dramatically increase well yield and enhance groundwater collection. Aquifer development, also referred to as aquifer stimulation, is considered a secondary level of development usually initiated only after standard bedrock well development procedures have been completed. Aquifer stimulation methods are used to increase overall hydraulic conductivity, and in turn, aquifer yield by increasing the number, size, extent, and interconnectedness of open fractures within a bedrock formation. These methods include the use of acid, explosives, or hydrofracturing.

Site contaminants exist within unconsolidated materials at the site, eliminating the benefit of this technology. This technology will not be considered further.

3.4 Groundwater Treatment

Treatment technologies can be applied in three formats:

- In-situ;
- On-site (ex-situ); and
- Off-site (ex-situ).

In-situ refers to treatment of groundwater in place typically without collection. On-site and off-site ex-situ technologies require groundwater collection, as described in Section 3.3 of this FS Report. On-site refers to the process of treating collected groundwater, typically in a transportable or constructable system, while off-site means transporting or conveying the collected groundwater to an off-site treatment facility.

Off-site treatment is considered disposal and is discussed later in Section 3.5 of this FS Report. General treatment technologies for on-site treatment of collected groundwater are discussed below and include in-situ and ex-situ treatment technologies.

In-Situ Treatment

- Air Sparging;
- Reactive Wall/Gate; and
- Catalysts (enhanced chemical or biological)

Ex-Situ Treatment

- Carbon Adsorption;
- Air Stripping;
- Steam Stripping;
- Membrane Separation;
- Filtration;
- Biological (Aerobic/Anaerobic);
- Biophysical;
- Chemical Oxidation;
- Wet Air Oxidation;
- Plasma Arc Technology;
- Chemical Precipitation; and
- Ion Exchange.

3.4.1 In-Situ Treatment

This section discusses groundwater treatment technologies which are applied in place without groundwater collection.

Air Sparging

Air sparging of groundwater is achieved by injecting compressed air below the groundwater table via injection wells. The rising air bubbles allow for volatilization of the contaminants in the groundwater and help mobilize them to the unsaturated zone. From the unsaturated zone, the volatilized contaminants are typically removed from the soil matrix by a soil vapor extraction system. Air sparging is generally used as an enhancement to soil vapor extraction. Both techniques are most effective for VOC removal when applied to soils with high permeabilities (i.e., permeabilities of 1×10^{-4} cm/sec or greater).

Due to the characteristic low permeability of the soils at the site, air sparging is not practical and will not be considered further.

Reactive Wall/Gate

Reactive walls or funnel and gate systems typically utilize permeable vertical zero-valent iron walls to provide flow-through treatment of chlorinated organics in groundwater. Funnel and gate systems typically utilize hydraulic barriers to divert groundwater flow to smaller reactive zones reducing both capital and O&M costs related to this technology. Multiple gates in parallel can be used to address wide plumes and multiple gates in series can address a mixture of chemicals.

Since this technology is a flow through system, the potential for increased hydraulic heads upgradient of the wall or gate is less than with hydraulic barrier systems alone. The potential exists for producing persistent degradation products such as vinyl chloride. In addition, precipitates (e.g. siderite and ferrous hydroxide) may form, fill pore spaces, block reaction sites and reduce the reactivity of the iron. Subject to further technical evaluation through pilot study, this technology is potentially applicable to the site. This technology will be retained for further consideration for this site.

Various Catalysts (Enhanced Chemical or Biological)

In-situ technologies exist which involve the introduction of various chemical or biological agents to augment natural attenuation processes in groundwater remediation. These technologies are not practical for shallow groundwater at the site. Shallow saturated soils within the area of concern exhibit such a low permeability (10^{-4} cm/sec to 10^{-6} cm/sec) that the application of treatment fluids would not be effective. In non-homogeneous or anisotropic media, adequate, uniform delivery and recovery of remediation fluids, and monitoring of treatment progress, cannot be reliably accomplished. For this reason, these techniques are typically limited to homogeneous, conductive overburden aquifers. This technology will not be considered further.

3.4.2 Ex-Situ Treatment

This section discusses groundwater treatment technologies which are applied ex-situ. Application of these technologies involve groundwater collection.

Carbon Adsorption

Carbon adsorption is a viable process for the removal of dissolved contaminants in groundwater. Granular activated carbon (GAC) can be used for pretreatment, complete treatment or effluent polishing, provided that pretreatment for the removal of suspended solids and oil and grease is included in the system. It is most effective for non-polar, high molecular weight, slightly soluble organic compounds. This is due to the relatively low sorptive capacity of the carbon for the low molecular weight organics in contaminated groundwater. The primary site groundwater contaminant (1,1-DCA) is poorly adsorbed in liquid phase GAC.

This on-site process is potentially applicable for use in combination with other processes, at the site. However, this technology will not be considered further since there is no economical or technological advantage of this treatment technology over other available technologies (e.g., 1,1-DCA is easily stripped using an air stripper, and is poorly adsorbed in liquid phase GAC).

Air Stripping

Air stripping of volatile organics from aqueous streams has proven to be a viable treatment for dilute as well as concentrated wastewater. In order to be effectively removed from wastewater by air stripping, a volatile organic compound must, in general, have a dimensionless Henry's Law Constant greater than 0.10. This constant is the ratio of the vapor to liquid phase concentrations of a substance at equilibrium.

Several different process options exist, including: packed tower, shallow tray, and diffused air strippers. The selection of a particular process option is typically a function of the initial VOC concentration, the effluent requirements, and presence of other substances that can cause plugging or fouling upon oxidation (suspended solids, ferrous iron, hardness). Packed towers generally provide the greatest VOC removal but are the most sensitive to plugging and fouling. Diffused air strippers are the least sensitive to fouling and plugging, as they can be easily disassembled and cleaned. Another consideration is appearance, with low profile shallow tray and diffused air strippers preferred over packed towers that can be 20 to 30 feet high. Typically, air-to-water ratios of 100 to 200 are necessary for achieving greater than 90 percent removals of volatile organics at normal groundwater temperatures. Depending on the mass of VOCs stripped, vapor phase treatment may be required.

This option is potentially applicable to the VOC-impacted groundwater at the site. The technology could be applied on-site to collected groundwater. Diffused air stripper technology is currently being applied successfully at the site.

Steam Stripping

Steam stripping of VOCs is a proven technology which is used extensively in industry for the recovery of solvents from concentrated wastewater. Steam stripping is a fractional distillation process designed according to vapor/liquid equilibrium data and by calculation of the required number of distillation trays. The principal index used to estimate stream-stripping capacity, is a boiling point less than 150°C, and the ability to form an azeotrope with water at an organic weight fraction of 0.8 or greater. The estimated steam requirements are on the order of 1.5 to 2.5 pounds of steam per gallon of water treated.

Steam stripping could be potentially applicable for VOC removal from the groundwater at the site. However, because the VOCs identified are readily air strippable at a lower cost, the additional capital and O&M costs associated with steam stripping is not justified. This method will not be considered further.

Membrane Separation

Membrane separation processes include: reverse osmosis, ultrafiltration, hyperfiltration, and electrodialysis, each of which physically separates a contaminant from a liquid phase (typically water) by filtration at a molecular level. Membrane processes can function in several ways: volume reduction, recovery and/or purification of the liquid phase, and concentration and/or recovery of the contaminant.

Normally, membrane separation is used as a final, polishing process, removing contaminants (e.g., dissolved metals, dissolved salts, and organics) to very low ppb concentrations after primary treatment method(s). It is not anticipated that this type of treatment will be required to meet effluent requirements for this site. This technology will not be considered further.

Filtration

Filtration is a unit process which physically removes particulate matter from water. Membrane filters are used for removal of solids at a molecular level and are discussed above. Other types of filters, used for removal of suspended solids, include: granular media filters, bag filters, and cartridge filters.

Granular media filters consist of a bed composed of sand or, for additional solids removal, sand and other layers of granular medium such as garnet, magnetite or diatomaceous earth. When multiple layers of granular medium are used, the filters are known as dual media filters. Flow in sand filters is typically by gravity and pressure is added to enhance the operation of dual media filters. The removal of suspended material occurs within and on the surface of the filter bed. The particles are removed by impaction or adhesion onto the granular media. As material builds up within the filter, there is an increase in head loss in the system and the filter must be cleaned to restore efficient particle removal. This can be quickly accomplished by hydraulic backwashing (i.e., by reversing the flow of water through the filter bed). This expands the granular media and dislodges the adsorbed particles by shear force.

Bag and cartridge filters utilize pressurized flow through fibrous media with specified pore size openings to remove suspended solids. These filtration systems are utilized where available space or other design constraints do not allow for granular media filtration. Various types of filters are available to meet design and O&M requirements. As solids build up on the filter media, the filter is either cleaned or replaced.

This technology is not applicable for treatment of VOCs in groundwater. However, filtration is potentially applicable as a secondary method for the treatment of groundwater at the site to provide solids control in the effluent in order to meet discharge requirements. Filtration is discussed in Section 3.6 of this FS Report as an ancillary process.

Biological (Aerobic/Anaerobic)

Conventional aerated wastewater treatment systems such as activated sludge, trickling filters, and rotating biological contactors utilize mixed populations of heterotrophic microorganisms to remove soluble organic matter (as 5-day Biochemical Oxygen Demand, or BOD_5). This process would not be applicable to the site because the groundwater contains almost no organics besides the residual levels of VOCs and would therefore provide insufficient substrate to maintain the microorganisms.

A sequencing batch reactor (SBR) system utilizes two different aerobic reactors operated in a batch mode with each reactor operated (fill, aeration, settle, discharge) in sequence so that semi-continuous operation is achieved. The same considerations that apply to the conventional aerated systems described above also apply to SBR systems. Therefore, SBRs are not applicable to the groundwater at the site.

Several different process variations exist for treating wastewater anaerobically, such as fluidized bed, fixed film, and suspended growth systems. Anaerobic systems utilize facultative and anaerobic microorganisms that hydrolyze and ferment complex organics to simple organic acids; strict anaerobes then convert the organic acids to methane and carbon dioxide. These processes are generally utilized for high-strength wastewaters, typically preceding aerobic treatment. Anaerobic treatment is attractive because significantly less sludge production and energy consumption compared to aerobic treatment. However, the same limitations discussed above for the aerobic treatment systems apply to the anaerobic systems as well (i.e. insufficient substrate is present in groundwater). Therefore, neither aerobic nor anaerobic biological treatment systems will be considered further.

Biophysical

Biophysical processes utilize a physical process to enhance biological treatment in the same reactor (e.g., use of carbon in the activated sludge process aeration tank), and provide additional flexibility and enhanced treatment compared to biological processes. These processes are applicable to treatment of highly contaminated groundwaters and may be performed on-site.

Powdered activated carbon treatment (PACT) is a method of combining powdered activated carbon and biological treatment in one stage. As a result, bio-oxidation and physical adsorption occur simultaneously. Biodegradable pollutants are biologically assimilated, while other contaminants that are non-degradable are adsorbed on the activated carbon. Most of these applications involve adding powdered activated carbon to the aeration basin in the activated sludge system. After aeration, solids are separated in a clarifier and a portion of the underflow solids are recycled to the inlet of the aeration tank. Waste solids are a mixture of activated sludge, carbon, organics, and inert material which typically provides a better settling and dewaterable sludge than a conventional activated sludge process. PACT is typically applicable to higher-strength waste streams, such as manufacturing wastewaters and landfill leachate. O&M costs may be reduced using PACT versus granular activated carbon.

Fluidized carbon beds for high-rate treatment of high-strength leachates and wastewaters can be operated aerobically or anaerobically. The adsorption onto carbon enhances the availability of substrate for the microorganisms. This process is a relatively new technology.

Because collected groundwater at the site would be a relatively low-strength wastewater, biophysical processes will not be considered further for removal of VOCs from the groundwater.

Chemical Oxidation

Chlorinated hydrocarbons in the low ppb range can be treated by chemical oxidation on-site. Hydrogen peroxide works well on organic compounds with double and triple bonds. Addition of ultraviolet light has been used with smaller amounts of hydrogen peroxide or ozone to form hydroxyl radicals to catalyze the ozone reaction. While a relatively new process, it has been shown to be highly effective for treating chlorinated solvents in evaluations done under the USEPA SITE Program.

Chemical oxidation cannot address all site-specific COCs and will not be considered further for ex-situ groundwater treatment because it requires a higher level of suspended solids pretreatment.

Wet Air Oxidation

Wet air oxidation, also known as super-critical water oxidation, is an on-site process which oxidizes organics utilizing either air or oxygen. The process operates under high temperatures (>705°F), and pressures (>218 atm) in order to maintain the water above its critical point. The solvent properties of water in the super-critical state change from those of liquid water so that non-polar, oily compounds become soluble, and salts become insoluble. With the addition of an oxidant, hazardous organic chemicals (e.g., VOCs) have been reported to be destroyed rapidly and completely in super-critical water. Although this oxidation is similar to combustion, it takes place at a much lower temperature than incineration and in a completely contained system.

Due to the high temperatures and pressures required for this process the O&M costs are excessively high. This technology will not be considered further.

Plasma Arc Technology

Plasma arc technology utilizes the extremely high temperatures (approximately 18,000°F) generated by an electrical discharge through a gas to pyrolize contaminants in a waste stream. The end products of this process are hydrogen, carbon monoxide, some acid gases, and an ash component. The major components of this on-site system include: a liquid-waste feed system, plasma torch, reactor, caustic scrubber, on-line analytical equipment, and flare.

Plasma-arc treatment is very energy intensive and expensive compared to the technologies available for treatment of the VOCs in groundwater. This technology will not be considered further.

Chemical Precipitation

Chemical precipitation in wastewater treatment involves the addition of chemicals to coagulate dissolved substances and facilitate their removal by sedimentation. The process typically consists of chemical addition, coagulation, flocculation, and sedimentation. In the coagulation phase, coagulant agents and/or aids are dissolved in the wastewater through rapid mixing. The subsequent flocculation phase promotes the contact, coalescence and size increase of coagulated particles through gentle mixing. The heavier particles found in the flocculation step are removed from the water by gravity in the sedimentation phase, wherein the wastewater undergoes quiescent settling conditions.

The use of various coagulant agents and/or aids has been proven inefficient in the removal of soluble VOCs from groundwater. Such techniques are quite effective as pretreatment and polishing steps in the overall treatment scheme for removing suspended solids, metals, and high concentrations of certain soluble organic compounds (e.g., BOD and COD). However, iron and suspended solids concentrations do not warrant the use of chemical precipitation. Therefore, chemical precipitation is not applicable for removal of low concentrations of VOCs from groundwater, and will not be considered further for this site.

Ion Exchange

Ion exchange is a process for substituting other ions for the contaminant ions to be removed in the waste stream. Innocuous ions such as hydrogen (H^+) or hydroxide (OH^-) can be exchanged with the contaminant ions and put into solution. The contaminants are recovered from the exchange resin by chemical regeneration with acids or alkalis. The concentrated contaminants must then be treated in additional processes or disposed.

Typically, ion exchange is utilized most effectively in the removal of metals and other inorganics from liquid waste streams. It can efficiently remove low concentrations of contaminants, and is therefore commonly used as a polishing process after a primary treatment phase. However, discharge requirements do not warrant the use of ion exchange (i.e., filtration will be sufficient).

Ion exchange is not applicable for removal of VOCs from groundwater and will not be considered further for this site.

3.5 Groundwater Disposal

Groundwater disposal technologies are discussed below as methods for disposal of untreated collected groundwater or for treated groundwater effluent. These include:

- Discharge to Surface Water;
- Discharge to Groundwater;
- Local Publicly-Owned Treatment Works (POTW); and
- Off-Site Treatment and Disposal Facilities.

Discharge to Surface Water

On-site treatment of collected groundwater could be utilized to allow for discharge of treated groundwater to nearby surface water bodies (i.e., Sanders Creek or the South Branch of Ley Creek) within discharge requirements established by the NYSDEC. NYSDEC has established effluent limitations and monitoring requirements as part of an existing IRM discussed in Section 1.2.3 of this FS Report. A review of discharge information collected to date indicates that the existing groundwater treatment system is meeting NYSDEC discharge requirements. Therefore, discharge of treated groundwater to surface waters is applicable and will be considered further for this site.

Discharge of untreated groundwater would be subject to pollutant effluent limitations and monitoring requirements established by the NYSDEC. Review of influent VOC concentrations from the groundwater collection and treatment system indicate that untreated discharge of groundwater would not meet NYSDEC discharge requirements at this time. However, inorganics analysis of influent samples from the groundwater collection and treatment system indicate the possibility that the inorganic quality of the influent may meet NYSDEC discharge requirements. In the future, if the quality of collected groundwater were to meet NYSDEC discharge requirements, discharge of collected groundwater without treatment would be applicable with appropriate monitoring. In addition, if inorganic influent quality continues to meet discharge requirements, discharge of treated groundwater without filtration may be appropriate.

Discharge to Groundwater

On-site treatment of collected groundwater could be utilized to allow for recharge of treated groundwater back into the site groundwater. However, due to the shallow water table and the low permeability of the shallow saturated materials at the site, recharge of treated groundwater is not considered practical. In addition, discharge to groundwater has no particular advantages over surface water discharge in terms of discharge limits, and will not be considered further.

Local Publicly-Owned Treatment Works (POTW)

Discharge of untreated groundwater to the Onondaga County sanitary sewer system would substantially reduce the capital and O&M costs of a groundwater collection system. However, the Onondaga County Department of Drainage and Sanitation specifically precludes discharge of groundwater from NYSDEC listed hazardous waste sites. This technology will not be considered further.

Off-Site Treatment and Disposal Facilities

Untreated groundwater could be transported and disposed at an off-site treatment and disposal facility, such as an industrial wastewater treatment facility. Typically, this is an economical disposal method for small amounts of groundwater over a short timeframe as opposed to implementation of on-site ex-situ treatment. However, collection of groundwater at this site will likely involve much greater quantities. This technology will not be considered further.

3.6 Ancillary Processes

All of the ancillary processes identified below may be used as part of the main remedial alternatives, except as otherwise noted. These include:

- General;
- Air Pollution Treatment;
- Water Filtration;
- Miscellaneous Materials Handling; and
- Monitoring.

3.6.1 General

The following activities would be applicable in conjunction with any earthwork activities (e.g., excavation and trenching):

- Regrading;
- Backfilling;
- Surface water controls (e.g., siltration controls, dikes, berms, channels, ditches, trenches, terraces, and benches); and
- Dust suppression.

3.6.2 Air Pollution Treatment

Air pollution treatment may be required as part of certain groundwater treatment processes (e.g., thermal desorption or air stripping) to maintain acceptable ambient air quality conditions. The applicability of the following air pollution control processes are described below:

- VOC Treatment (i.e., carbon adsorption, co-combustion, catalytic incineration, and catalytic oxidation); and

- Combustion Off-gas Treatment (i.e., wet precipitator, ionized wet scrubber, Venturi/packed tower, spray dryer/baghouse, and Thermal DeNOX).

3.6.2.1 VOC Treatment

Carbon Adsorption

Activated carbon can be used to remove organics from the gas generated from the volatile organic stripping processes. The contaminated air is directed through a carbon filter and the organic compounds are adsorbed onto the carbon. When the carbon has reached its adsorbent capacity it is replaced, and the used filter is regenerated off-site by the supplier, or in the case of very large carbon usage, on-site. This technology could be applicable if necessary for air stripping processes. For treatment of low concentration air streams, this would be the most cost-effective treatment method.

If carbon adsorption cannot be implemented, VOC oxidation (thermal or catalytic) methods may be utilized to destroy the VOCs.

Co-Combustion

VOC destruction can be effected by combustion with a reliable supplemental fuel source such as methane or propane.

Catalytic Incineration

Catalytic incineration is used to eliminate volatile organics in the emission stream of a VOC stripping process through combustion assisted by a catalyst. Catalysts used for VOC incineration are usually platinum and palladium. The emission stream passes through the catalyst bed which is usually a metal mesh or ceramic structure designed to maximize the surface area of the catalyst in the combustion chamber. After combustion, the exhaust gases are passed through a heat exchanger and then into the atmosphere. This process can destroy up to 98 percent of the overall volatile compounds present in an emission stream.

Catalytic Oxidation

A catalytic oxidizer oxidizes VOCs at lower temperatures than the catalytic incinerator and without combustion. When used to oxidize chlorinated VOCs, catalysts can become ineffective.

3.6.2.2 Combustion Off-gas Treatment

Based on available site data, air pollution control for combustion processes will not be required. If appropriate, combustion off-gases could be treated using a wet precipitator, ionized wet scrubber, a Venturi/packed tower system, a spray dryer/baghouse system, or Thermal DeNOX (ammonia injection). These processes will be reconsidered if combustion processes are implemented.

3.6.3 Water Filtration

Filtration is a unit process which physically removes particulate matter from water. As discussed above for ex-situ treatment technologies in Section 3.4 of this FS Report, filtration may be required to control solids in a treated groundwater effluent stream prior to discharge or as a pretreatment for certain VOC treatment processes. As discussed in Section 3.4, this technology may be applicable for suspended solids control and will be retained for further consideration of this site.

3.6.4 Miscellaneous Materials Handling

Various types of material handling equipment may be used depending on the remedial actions selected for the site. For groundwater collection systems, materials handling equipment includes piping systems, tanks and pumps.

3.6.5 Monitoring

Monitoring of site conditions is expected to be part of any remedial alternative selected. Typically, monitoring as part of a groundwater remedial alternative may include: hydraulic monitoring to demonstrate groundwater containment, groundwater quality monitoring to monitor remedial progress and downgradient water quality, monitoring of treatment system influent quality to evaluate treatment efficiency, and treated groundwater effluent quality monitoring. The specific monitoring components for each remedial alternative will be developed in the following section of this FS Report.

3.7 Retained Technologies

Based on the information presented in this Section, as summarized in Table 3 (Identification and Screening of Remedial Technologies), the remedial technologies retained for further consideration include the following:

- Groundwater Collection: Trench Drains;
- Groundwater Treatment: In-Situ, Reactive Wall/Gate;
- Groundwater Treatment: Ex-Situ, Air Stripping;
- Treated Groundwater Disposal to Surface Water;
- Untreated Groundwater Disposal to Surface Water; and
- Ancillary Processes.

4 DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

Alternative development involves utilizing the technologies and process options identified in Section 3 to form alternatives which address the RAOs. The general types of remedial alternatives considered for the site include:

- No action; and
- Management of contaminant migration in shallow groundwater (containment, collection, treatment, disposal).

The alternatives presented in this section were developed from these general types of remedial alternatives, based on the RAOs and general response actions presented in Section 2, and using potentially applicable remedial technologies resulting from the technology screening presented in Section 3. Each alternative consists of multiple components which include one or more of the following: groundwater remedial methods, monitoring, and natural attenuation.

The remedial technologies that remain following the technology screening in Section 3 have been assembled as appropriate into the following three remedial alternatives:

- No Action;
- No Further Remedial Action - continued O&M of the existing groundwater collection and treatment system; and
- Groundwater Funnel and Reactive Gate Treatment - implementation of a funnel and gate system for in-situ groundwater treatment, and closure of the existing groundwater collection and treatment system.

Typically, the FS process includes an alternative screening step after alternative development and prior to detailed analysis based on the following criteria:

- Effectiveness (general ability to meet SCGs and/or RAOs as well as being protective of human health and the environment);

- Implementability (ability to construct and meet substantive permitting requirements); and

- Order of magnitude cost.

However, for this FS, the number of viable remedial alternatives for groundwater are limited based on the results of the technology screening and therefore all three alternatives will be carried through to detailed analysis.

In this section, each remedial alternative is described in detail and evaluated in terms of a variety of criteria, as described in Section 4.1 below. These alternatives are also evaluated in this section with respect to their compliance with action-specific, location-specific, and chemical-specific SCGs. Based upon the results of this evaluation and comparative analysis, a recommended alternative for the site is presented in Section 4.4.

Detailed remedial alternative cost estimate summary tables are presented in Appendix B. The O&M portion of the present value cost was estimated based on a 30-year maintenance period and a discount rate of 2 percent, considering interest and inflation.

4.1 Evaluation Criteria

In this section, each complete alternative is defined in detail and evaluated in terms of the following criteria:

Threshold Criteria (Minimum Requirements)

- ***Overall protectiveness of human health and the environment*** — The assessment for this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

- ***Compliance with SCGs*** — The assessment for this criterion describes how the alternative complies with SCGs, or if a waiver is permissible, how it is justified. SCGs include chemical-specific, action-specific and location-specific SCGs, as described in Section 2 and summarized in Table 1 (Summary of Chemical-Specific Groundwater SCGs) and Table 2 (Summary of Potential Location-Specific and Action-Specific SCGs). A discussion of attainment of RAOs is also included under this criterion.

Balancing Criteria

- ***Long-term effectiveness and permanence*** — The assessment for this criterion evaluates the long-term effectiveness of the alternative in maintaining protection of human health and the environment after RAOs have been met. The magnitude of residual risk and the adequacy and reliability of controls are also taken into consideration.

- ***Reduction of source toxicity, mobility, or volume through treatment*** — The assessment for this criterion evaluates how the alternative reduces the toxicity, mobility, or volume of contaminants through treatment of the source of contamination. Consideration is given to the anticipated performance of the specific treatment technologies employed regarding volume of materials destroyed, degree of expected reductions, degree to which the treatment is irreversible, and the type and quantity of remaining residuals.

- ***Short-term effectiveness*** — The assessment for this criterion examines the effectiveness of the alternative in protecting human health and the environment during the construction and implementation until RAOs have been met. The time to meet RAOs is also considered.

- ***Implementability*** — This assessment evaluates the technical and administrative feasibility of the alternative and the availability of required goods and services. Also considered is the reliability of the technology, the ability to monitor the effectiveness of the remedy, and the ease of undertaking additional remedial actions, if necessary.

- ***Cost*** — This assessment evaluates the capital, and O&M and present value costs of each alternative. The present value cost was based on a discount rate of 2 percent, considering interest and inflation.

4.2 Individual Analysis of Alternatives

It is appropriate to note that the following IRMs (discussed in Section 1.2) to reduce the potential for human health and environmental exposure to site contaminants have already been implemented:

- Contaminant Source Removal;
- Storm Sewer Rehabilitation; and
- Groundwater Collection and Treatment System.

The costs for these actions, well in excess of $500,000, are not reflected in the remedial alternative costs presented in this FS Report.

The time perspective for the alternative descriptions provided below recognizes the conditions that exist on-site at this time. Each alternative is described relative to the IRMs taken to date and the fact that there is a groundwater collection and treatment system already in-place and operating. For example, the no action alternative would include discontinuing the operation of the existing groundwater collection and treatment system, whereas the no further remedial action alternative would include continued operation of the existing groundwater collection and treatment system, and the third alternative (an in-situ reactive wall/gate) would include modifications to the existing system to provide in-situ treatment.

4.2.1 Alternative 1 - No Action

4.2.1.1 Description

This alternative includes discontinuing the existing groundwater collection and treatment system and conducting no additional remedial activity at the site. Site remediation would occur by natural attenuation processes, and there would be no active measures taken to prevent further migration of contaminants. The existing groundwater collection and treatment system would not be operated, and hydraulic conditions would be allowed to return to natural conditions.

Site monitoring would include monitoring sentinel wells at the downgradient edge of the migration pathway (i.e., along the South Branch of Ley Creek to the west and the site property boundary to the north), and wells in the former source area along the west side of Building 5. Monitoring wells MW-1S, MW-2S, MW-8S, MW-17A, and MW-18A (i.e., 5 wells) would be sampled and analyzed for VOCs on a semi-annual basis. The dry-weather discharge into the South Branch of Ley Creek (OF-02) would be sampled and analyzed on an annual basis during April (i.e., relatively high water table).

4.2.1.2 Evaluation

Overall Protectiveness of Human Health and the Environment

Based on the risk assessment, there are no complete human health exposure pathways under current site conditions, site-related contaminant concentrations are below levels that would that result in unacceptable risks to ecological receptors. Monitoring would identify any unexpected significant increases in downgradient groundwater concentrations. While it is unlikely that off-site concentrations under this alternative would result in significant human health risks, the potential for ecological risks would increase. Neither on-site nor downgradient future risks would be reduced or controlled by the No Action Alternative.

Compliance with SCGs

Under Alternative 1, it is anticipated that groundwater quality at portions of the site will not achieve groundwater standards (SCGs) for a number of decades. However, contaminant concentrations at the downgradient limit of characterization are at or near the groundwater standard values for VOCs. As indicated in the RI, there is evidence that natural degradation is occurring. Therefore, natural attenuation processes (including natural degradation, advection, etc.) may continue to protect surface water quality.

This alternative does not achieve the RAO of preventing migration of VOC-impacted groundwater towards the South Branch of Ley Creek and Sanders Creek. Natural processes such as dilution, dispersion, diffusion, adsorption/detention, and natural biodegradation are relied upon solely to reduce VOC concentrations over the long term.

This alternative would have no location-specific SCGs with which to comply. Action-specific SGCs would include the maintenance of a site-specific health and safety plan for worker protection during environmental sampling activities.

Long-Term Effectiveness and Permanence

Given the absence of currently unacceptable risks associated with current conditions, this alternative may be effective long-term in protecting human health and the environment. Although the potential for future migration of VOCs towards the South Branch of Ley Creek and Sanders Creek would continue, it is possible that natural attenuation may continue to provide effective control of VOCs relative to surface water impacts. Site monitoring would be performed to assure that acceptable conditions persist. Improvements in groundwater quality through natural attenuation would be permanent.

Reduction of Source Toxicity, Mobility, and Volume

This alternative does not meet this criterion since the criterion applies only to reduction of toxicity, mobility, and volume of contaminant sources through treatment.

Short-Term Effectiveness

Implementation of this alternative would not have any associated short-term impacts. Current health and environmental risks, which are not unacceptable, would not be created or increased by the remedial action. Relying on natural attenuation processes alone, however, this alternative does not achieve the RAO of preventing migration of VOC-impacted groundwater towards the South Branch of Ley Creek and Sanders Creek. It is anticipated that groundwater standard SCGs would not be achieved at portions of the site for a number of decades. Therefore, short-term effectiveness across the entire site would not be achieved.

Implementability

No technical or administrative restrictions exist that would prohibit implementation of this alternative. No component will prevent the implementation of additional remedial actions as necessary. Periodic groundwater quality sampling and analysis can be performed as described and would be reliable in monitoring effectiveness.

Cost

A summary of the estimated present value costs for capital and O&M is provided in Table 4 (Remedial Alternative Cost Estimates). The estimated present worth cost for this alternative ($101,600) includes 30 years of monitoring.

4.2.2 Alternative 2 - No Further Remedial Action

4.2.2.1 Description

This alternative includes continued O&M of the existing groundwater collection and treatment system until groundwater concentrations have leveled off at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed, and it can be demonstrated that natural attenuation of VOCs will be protective of surface water quality in the South Branch of Ley Creek and Sanders Creek. The major components of the groundwater collection and treatment system are shown on Figure 5 (Remedial Alternative 2 - Groundwater Collection and Treatment System).This alternative will meet the RAOs by:

- Collecting mobile VOC contamination that resides in the zone of influence of the groundwater collection system and would otherwise migrate due to continued infiltration of precipitation;

- Preventing the migration of VOC contaminants in shallow groundwater, within the zone of influence of the groundwater collection trench, toward the South Branch of Ley Creek and Sanders Creek; and

- Treating the collected groundwater.

Containment of VOC-impacted groundwater would be maintained through the hydraulic control provided by establishing lower hydraulic heads along the existing groundwater collection trench. Site remediation will occur by active removal of VOCs from the groundwater through groundwater collection, and by natural degradation. Natural attenuation processes would be assisted by increasing the hydraulic gradients across the impacted area. Collected groundwater would continue to be treated in the existing groundwater treatment system (air stripping and filtration) prior to discharge to Sanders Creek via the site storm sewer system.

Site monitoring would be implemented to evaluate the following:

- Hydraulic control of the collection system would be monitored on a monthly basis by checking the water level in both collection system cleanouts to assure free drainage of the collection system to the sump;

- Dry-weather discharge from the storm sewer system into the South Branch of Ley Creek (OF-02) would be determined annually (during April) to identify any significant change in VOC concentration;

- Compliance with treated groundwater effluent requirements and compliance with ambient air quality guidance would be determined by collecting monthly influent and effluent samples; and

- Monitoring of shallow groundwater quality at monitoring wells MW-1S, MW-2S, MW-8S, MW-10, MW-11R, MW-12, MW-16A, MW-17A, MW-18A, and MW-19S in accordance with the O&M Plan (EMCON, revised February 1998). During collection of groundwater samples, groundwater elevation data will also be collected.

4.2.2.2 Collection and Treatment System Operational Considerations

As discussed in the NYSDEC's draft Strategy for Groundwater Remediation Decision Making at Inactive Hazardous Waste Sites and Petroleum Contaminated Sites in New York State (NYSDEC, April 1996), recent studies of operating P&T remedial systems by the USEPA indicate that P&T systems have been effective at providing containment and partial contaminant removal. However, in most cases, P&T systems have not been effective in meeting cleanup goals (see Section 3.3.1). Restoration of groundwater quality to health-based levels may be extremely difficult, if not technically infeasible, and the time required is usually longer than originally estimated. Typically, contaminant concentrations drop rapidly following start-up, but, in time, the contaminant concentration reduction rates diminish significantly and concentrations level off.

In an attempt to increase the cleanup rate and reduce the operational costs associated with the collection of excessive amounts of clean water, the groundwater collection system may be operated using the intermittent pumping technique described in Section 3.3.1. An evaluation of this on/off cycling of the collection/treatment system operation would be required to verify the performance enhancement and to estimate the shutdown/startup timeframes. The evaluation would entail studying the system performance through the following operational/monitoring steps:

- Baseline water level and groundwater quality monitoring;

- Turn the system off and monitor the rise of the water table within the collection system;

- Just before hydraulic containment is lost, turn the system back on and monitor drawdown;

- Resume monitoring quality of collected groundwater during system operation; and

- When the rate of change in water quality begins to level-off, begin the shutdown procedures again.

Hydraulic containment (as described above) would be considered lost when groundwater gradients depict flow across or away from the groundwater collection system. Therefore, while pumps are off, groundwater levels in the collection trench cleanouts and wells adjacent to the collection trench (and in the same hydrogeologic unit) would be monitored and the pumping resumed when the levels in the cleanouts approach the elevation of adjacent monitoring wells.

4.2.2.3 Collection and Treatment System Termination

It is anticipated that shutdown of the groundwater collection and treatment system may be appropriate prior to achieving groundwater quality SCGs across the site. Continued O&M of the existing groundwater collection and treatment system is anticipated to continue until groundwater concentrations of site-related VOCs have leveled of at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed, and it can be demonstrated that natural attenuation of VOCs will be protective of water quality in the South Branch of Ley Creek and Sanders Creek.

An annual evaluation will be made in the Annual O&M Reports comparing collected groundwater quality trends and the trends in ambient groundwater monitoring. This comparison would provide the basis for determining when groundwater concentrations of site-related VOCs have leveled of at a relatively low concentration over the majority of the site, when significant amounts of site-related VOCs are no longer being removed, and when natural attenuation of residual VOCs will be protective of downgradient surface water quality. At that time, groundwater collection will be terminated. For cost estimating, it has been assumed that these conditions can be established within 20 years. Site monitoring has been included for a period of 30 years.

4.2.2.4 Evaluation

Overall Protectiveness of Human Health and the Environment

This alternative provides an active method to prevent migration of VOC-impacted shallow groundwater towards the South Branch of Ley Creek and Sanders Creek, instead of relying on natural attenuation to continue to protect surface water quality. Therefore, this alternative would offer increased protectiveness of human health and the environment as compared with Alternative 1. In addition, by preventing migration of VOCs beyond the collection trench and collecting VOC-impacted groundwater which has already migrated beyond the collection trench location, groundwater concentrations west and north of the collection trench will decrease in a shorter timeframe with groundwater collection than in its absence.

Since no unacceptable risks are associated with current conditions, and concentrations will continue to decrease, this alternative is protective of human health and the environment.

Compliance with SCGs

Alternative 2 will provide removal of measurable contaminant mass from the groundwater, increase the rate of groundwater flow at the site, and increase the advective component of natural attenuation by increasing hydraulic gradients present at the site. Also this Alternative would prevent further contaminant migration toward downgradient surface water receptors by providing hydraulic containment of VOC-impacted shallow groundwater within the zone of influence of the existing groundwater collection trench. Based on a review of available site data and available literature regarding groundwater collection and treatment systems at other sites with heterogeneous geology, it is anticipated that groundwater quality at portions of the site will not achieve groundwater SCGs (6 NYCRR Part 703) for a number of decades. It is anticipated that the operation of the groundwater collection and treatment system would result in an incremental improvement in the timeframe required to achieve SCGs (compared to that for Alternative 1) since the system's operation would increase the hydraulic gradient near the collection trench (i.e., increasing advection) and result in the removal of additional contaminant mass.

SCGs associated with the selected treated groundwater disposal method (i.e., discharge of treated groundwater to Sanders Creek) would not be exceeded. The treated groundwater concentrations would conform with the applicable limitations of the water discharge and air emission NYSDEC approvals. If this alternative is selected, the necessary discharge approvals have already been obtained for the existing groundwater collection and treatment system. Operational data collected to date (Appendix A) indicate conformance with these action-specific SCGs.

Worker safety and construction activity requirements will also be met through the utilization of the existing site-specific Health and Safety Plan.

Location-specific SCGs (e.g., local review, and building and plumbing permits) have been obtained and satisfied for construction of the existing groundwater collection and treatment system.

Long-Term Effectiveness and Permanence

This alternative would be effective at preventing migration of VOC-impacted shallow groundwater that is upgradient of the existing groundwater collection trench towards the South Branch of Ley Creek and Sanders Creek, since it maintains hydraulic containment over the VOC-impacted area until it can be demonstrated that natural attenuation will be protective of downgradient surface water quality. In addition, this alternative controls VOC-impacted groundwater which has already migrated beyond the groundwater collection trench by establishing a gradient toward the trench over a portion of the site between the trench and the creeks. O&M of the collection and treatment system would be required in order to maintain effective hydraulic control.

An incremental decrease in the long-term remedial timeframe (i.e., time to meet groundwater standards) would be expected with Alternative 2 as compared to Alternative 1. Also, some additional level of permanence is provided by additional contaminant removal from the groundwater.

Reduction of Source Toxicity, Mobility, and Volume

This alternative does not meet this criterion since the criterion applies only to overall reduction of toxicity, mobility, and volume of contaminants through treatment. The treatment technology involved (air stripping) transfers the VOCs from the groundwater to the air.

Short-Term Effectiveness

Implementation of this alternative would not be anticipated to result in impacts to the surrounding community. Worker impacts would be mitigated by standard engineering and health and safety practices.

This alternative would be effective in the short term at providing hydraulic containment of the VOC-impacted shallow groundwater. However, it is not anticipated that a reduction in groundwater concentrations across the entire site would be achieved in the short term.

This alternative is already operating as an IRM at the site, therefore, no time is required to implement this alternative after issuance of the ROD. The time required for groundwater collection has not been determined, however, a period of operation of 20 years has been used for cost estimating purposes (Appendix B).

Implementability

No technical or administrative restrictions exist that would prohibit implementation of this alternative. The groundwater collection and treatment system is already in-place and additional materials and equipment that may be required for continued O&M are commercially available. Groundwater collection, air stripping, and filtering are reliable technologies that are appropriate for the described applications. Disposal methods currently meet water quality and air quality requirements. No component will prevent the implementation of additional remedial actions as necessary. Periodic groundwater discharge and groundwater quality sampling and analysis can be performed as described and would be reliable in monitoring effectiveness.

Cost

A summary of the estimated present value costs for capital and O&M is provided in Table 4 (Remedial Alternative Cost Estimates). The estimated present worth cost for this alternative ($522,600) includes 20 years of groundwater collection and treatment, and 30 years of monitoring.

4.2.3 Alternative 3 - Groundwater Funnel and Reactive Gate Treatment

4.2.3.1 Description

This alternative includes the design, installation, and O&M of a groundwater funnel and reactive gate treatment system to provide in-situ groundwater treatment of groundwater as it migrates across the site. The major components of the groundwater funnel and reactive gate are shown on Figure 6 (Remedial Alternative 3 - Groundwater Funnel and Reactive Gate). The difference between this alternative and Alternative 2 is that this alternative provides treatment via contaminant oxidation which ultimately reduces the mass of contaminants, as opposed to transfer of the contaminant mass from the groundwater to the air.

A groundwater barrier (funnel) would be installed downstream of the existing collection trench and across the natural groundwater flow pathway such that it would divert groundwater through a reactive zone (gate). The reactive gate would be installed at a central location along the barrier. Flow is therefore directed through the gate to degrade VOCs prior to reaching the South Branch of Ley Creek or Sanders Creek. Operation of the existing groundwater collection and treatment system would be discontinued. The existing collection trench would continue to help overcome hydrogeologic heterogeneity and provide for hydraulic connection between the contaminated groundwater zones and the reactive gate. Sizing of the gate and the limits of the funnel barrier components would be determined during remedial design such that hydraulic containment is maintained over the site area exhibiting contaminant concentrations in excess of the groundwater standards. Containment of VOC-impacted groundwater would be provided by the hydraulic barrier funnel, and groundwater treatment would be affected by directing flow through the reactive gate. For the purposes of this FS, the conceptual design includes one gate, approximately 100 feet in length. This gate coincides with the most permeable hydrogeologic section (i.e., the segment with the highest presence of sand seams) identified along the existing collection trench alignment. Remedial design studies may identify the need for additional gates or low flow pumping to maintain hydraulic control of the VOC-impacted shallow groundwater. Site remediation would occur by natural attenuation processes and oxidation of VOCs in groundwater which passes through the reactive gate. Groundwater released from this system would be treated.

Site monitoring would be implemented to evaluate:

- The hydraulic control of the funnel system would be monitored by measuring piezometric levels in the two cleanouts of the existing collection trench, and two additional piezometers (one installed in the reactive gate and one installed in the collection trench backfill, near the existing collection sump);

- Dry-weather discharge from the storm sewer system into the South Branch of Ley Creek (OF-02) would be determined annually (during April) to identify any significant change in VOC concentration;

- One additional monitoring well (RG-1) would be installed at the downgradient side of the reactive gate for monitoring treatment of VOCs through the gate; and

- Groundwater quality along the groundwater funnel and gate system and near former source area would be determined on a semi-annual basis to monitor progress of VOC contaminant reduction. Monitoring wells to be sampled and analyzed include: MW-1S, MW-2S, MW-8S, MW-10, MW-11R, MW-12, MW-16A, MW-17A, MW-18A, MW-19S and RG-1 (i.e., 11 wells).

4.2.3.2 Evaluation

Overall Protectiveness of Human Health and the Environment

This alternative would satisfy the RAO of preventing migration of VOC-impacted groundwater towards the South Branch of Ley Creek and Sanders Creek since containment of the majority of VOC-impacted groundwater would be maintained. However, VOC-impacted groundwater that is already downgradient (i.e., west and north) of the funnel and gate system would not be controlled. Therefore, this alternative would offer increased protectiveness of human health and the environment as compared with Alternative 1, but less than Alternative 2.

Compliance with SCGs

This alternative would not provide any benefit relative to Alternative 1 with respect to meeting SCGs in areas of the site upgradient of the funnel and gate. With respect to Alternative 2, meeting SCGs in areas upgradient of the funnel and gate, this alternative would be less effective in achieving SCGs because Alternative 2 has the additional benefit of increasing hydraulic gradients and flow across the site. Between the funnel and gate and the creeks, this Alternative would be more effective than Alternative 1, but less effective than Alternative 2, at meeting SCGs. The anticipated remedial timeframe to achieve groundwater standards across the entire site by funnel and gate treatment and natural degradation is similar to that of natural degradation alone.

Although this alternative would be effective in controlling most of the potential contaminant migration relative to Alternative 2 (with the exception of VOC-impacted groundwater which has already migrated beyond the groundwater funnel and gate), this alternative does not provide an additional level of protection.

SCGs associated with the selected treated groundwater disposal method (i.e., discharge to groundwater downgradient of the reactive gate) are anticipated to be 6 NYCRR Part 703 groundwater standards. Reactive gate treatment would not result in air contaminant discharges. Worker safety and construction activity requirements will also be achieved through the implementation of a site-specific Health and Safety Plan.

Long-Term Effectiveness and Permanence

This alternative would be effective at preventing further VOC-impacted groundwater migration between the funnel and gate and the South Branch of Ley Creek and Sanders Creek. However, it would not offer additional long-term effectiveness at attaining SCGs or RAOs upstream of the existing groundwater collection trench relative to Alternatives 1 and 2. Between the funnel and gate and the creeks, this Alternative would be more effective than Alternative 1, but less effective than Alternative 2. Some additional level of permanence is provided relative to Alternative 1 by contaminant oxidation. Relative to Alternative 2, this alternative requires a lower frequency of O&M to maintain effectiveness (i.e., periodic replacement of gate medium)."**Reduction of Source Toxicity, Mobility, and Volume**

This alternative provides a reduction in the volume of contaminants via treatment of the VOCs as the groundwater passes through the reactive gate.

Short-Term Effectiveness

Implementation of this alternative would not be anticipated to result in impacts to the surrounding community. Worker impacts would be mitigated by standard engineering and health and safety practices.

This alternative would be effective shortly after completion at reducing contaminant migration. However, it is not anticipated that a reduction in groundwater concentrations would be achieved in the short term.

The estimated time to implement this alternative, after issuance of the ROD, is estimated at 2 to 3 years. The time to implement is based on negotiating a Remedial Design/Remedial Action Consent Order, scoping and performing a pre-design study, completing a remedial design, contracting, construction, and implementation.

Implementability

No technical or administrative restrictions exist that would prohibit implementation of this alternative. The required materials and equipment are commercially available for the constructed components. Applicable groundwater barriers and reactive gates are reliable available technologies that are appropriate for the described applications. Assuming that the barrier is removable, no component is expected to prevent the implementation of additional remedial actions as necessary. Periodic groundwater quality sampling and analysis can be performed as described and would be reliable in monitoring effectiveness.

Cost

A summary of the estimated present value costs for capital and O&M is provided in Table 4 (Remedial Alternative Cost Estimates). The estimated present worth cost of this alternative ($1,319,800) includes 30 years of system O&M and monitoring.

4.3 Comparative Analysis of Alternatives

Overall Protectiveness of Human Health and the Environment

Based on the risk assessment, there are no complete human health exposure pathways under current site conditions. Alternatives 2 and 3 would assure that human health exposure pathways remain incomplete. Monitoring of groundwater quality under Alternative 1 would identify any unexpected significant increases in downgradient groundwater concentrations. Therefore, all three alternatives would be protective of human health.

However, the three alternatives provide differing levels of environmental protectiveness. Alternative 1 relies solely on natural attenuation processes to reduce contaminant concentrations and protect surface water quality. Alternative 3 provides the added assurance of hydraulic containment (barrier)/treatment of the majority of VOC-impacted groundwater. However, Alternative 2 provides the greatest level of protectiveness by providing hydraulic containment (collection) including a portion of the VOC-impacted shallow groundwater which has already migrated beyond the collection system trench. Therefore, Alternative 2 would be most protective with regard to environmental risk.

Compliance with SCGs

For relative comparison to one another, Alternative 1 (remediation by natural attenuation processes alone) is used as a baseline for comparison. The remedial timeframe for Alternatives 2 and 3 would be shorter than for Alternative 1 because by removing some of the contaminant mass (through removal or in-situ treatment), SCGs would be achieved in a shorter timeframe. The remedial timeframe associated with Alternative 2 is the shortest since this alternative increases the advective component of natural attenuation by increasing hydraulic gradients present at the site. However, based on a review of available site data and available literature, even under Alternative 2, it is anticipated that groundwater quality at portions of the site will not achieve groundwater SCGs (6 NYCRR Part 703) for a number of decades. Both Alternatives 2 and 3 would provide containment against further migration, thereby achieving the RAO of preventing migration of VOCs towards the South Branch of Ley Creek and Sanders Creek.

Action-specific and location-specific SCGs could be achieved for all alternatives.

Long-Term Effectiveness and Permanence

Given the absence of unacceptable risks associated with current conditions, all three alternatives may be effective long-term in protecting human health and the environment. Improvements in groundwater quality through removal, treatment, or natural attenuation would be permanent.

Alternatives 2 and 3 provide an additional level of assurance (hydraulic control) that VOC-impacted groundwater migration will not impact surface water quality in the nearby creeks. O&M of Alternative 2 would be required in order to maintain effective hydraulic control (i.e., shortly after discontinuance of groundwater collection, hydraulic control will not be maintained). Alternative 3 provides more permanent hydraulic control in that short-term cessation of system O&M will not relinquish hydraulic control.

Alternatives 2 and 3 provide an additional level of permanence relative to Alternative 1 by removing contaminant mass from groundwater through treatment. Natural degradation will provide permanent contaminant mass removal under all three alternatives.

Reduction of Source Toxicity, Mobility, and Volume

Only Alternative 3 provides a reduction in the volume of contaminants via treatment of the VOCs as the groundwater passes through the reactive gate. Alternative 2 removes VOC mass from the groundwater and discharges VOCs to the air. Alternative 1 relies solely on natural attenuation to provide contaminant reduction.

Short-Term Effectiveness

Alternative 1 or Alternative 2 would be implemented more quickly than Alternative 3. Implementation of Alternative 3 is anticipated to take between 2 to 3 years to implement. The potential for short-term community and worker impacts is minimal and is expected to be readily mitigated with standard engineering and health and safety practices.

None of the alternatives would have short-term effectiveness in achieving groundwater standards. However, hydraulic controls resulting from groundwater collection or in-situ treatment (Alternative 2 or 3) would achieve the RAO of preventing contaminant migration in groundwater, within the zone of influence of these systems, as soon as these systems are operational.

Implementability

All alternatives are considered to be implementable. Comparatively, the longest time to implement is associated with the groundwater funnel and reactive gate (Alternative 3).

Cost

A summary of the estimated present value costs for capital and O&M is provided in Table 4 (Remedial Alternative Cost Estimates). The estimated present worth cost of Alternatives 1, 2, and 3 are $101,600, $522,600, and $1,319,800, respectively. Of the alternatives evaluated, only Alternative 3 offers the additional technical benefit of contaminant volume reduction by in-situ treatment. However, the high incremental cost of Alternative 3 is not cost-effective as it does not provide any meaningful additional reduction in risk to human health and the environment relative to the Alternative 2. Furthermore, Alternative 2 offers an opportunity for improving groundwater quality, to the extent practicable, in a shorter timeframe via collection and treatment. The technical benefit of Alternative 2 over Alternative 1 (i.e., hydraulic control of the VOC-impacted area and additional VOC removal) appears to justify the higher cost of Alternative 2.

4.4 Recommended Alternative

Based on the detailed and comparative analyses, Alternative 2, No Further Remedial Action, is recommended for the Former GE Court Street Building 5/5A site. This alternative includes the following elements:

- Continued O&M of the existing groundwater collection and treatment system until groundwater concentrations have leveled off at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed, and it can be demonstrated that natural attenuation of VOCs will be protective of surface water quality in the South Branch of Ley Creek and Sanders Creek;

- Monitoring of groundwater elevations at the site will be performed in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of shallow groundwater quality at monitoring wells MW-1S, MW-2S, MW-8S, MW-10, MW-11R, MW-12, MW-16A, MW-17A, MW-18A, and MW-19S in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of groundwater collection and treatment system influent and effluent quality in accordance with the O&M Plan (EMCON, revised February 1998);

- Monitoring of the South Branch of Ley Creek storm sewer outfall quality in accordance with the Engineering Certification Report (EMCON, November 1997); and

- Decommissioning of deep (sand unit) monitoring wells (PZ-1, MW-1D, MW-3D, MW-5D, and MW-6D).

Alternative 2 will satisfy the RAO of preventing migration of VOC-impacted shallow groundwater upstream of the existing groundwater collection trench, and controlling the migration (to the extent feasible) of VOC-impacted shallow groundwater already downstream of the existing groundwater collection trench, towards the South Branch of Ley Creek and to Sanders Creek.Groundwater elevation measurements taken between February 1998 and June 1998 (i.e., since startup of the groundwater collection and treatment system) indicate that hydraulic control has been achieved for the site. Implementation of Alternative 2 will assure that hydraulic control of VOC-impacted shallow groundwater will be maintained until groundwater concentrations have leveled off at a relatively low concentration over the majority of the site, significant quantities of contaminants are no longer being removed and natural attenuation processes can be relied upon to protect downgradient surface water quality.

Alternative 2 will also provide removal of measurable contaminant mass from the groundwater, increase the rate of groundwater flow at the site, and increase the advective component of natural attenuation by increasing hydraulic gradients present at the site. Based on a review of available site data and available literature regarding groundwater collection and treatment systems at other sites with heterogeneous geology, it is anticipated that groundwater quality at portions of the site will not achieve groundwater SCGs (6 NYCRR Part 703) for a number of decades. However, this alternative is considered the best feasible approach to achieve RAOs at the site.

There are currently no unacceptable human health or environmental risks at the site, and Alternative 2 will provide long-term protection. The recommendations regarding intermittent pumping and termination criteria for shutdown of the collection and treatment system are also protective.

Other SCGs associated with O&M of Alternative 2 are satisfied by the existing approvals obtained for the existing groundwater collection and treatment system, and by continued performance and effluent monitoring.

Alternative 2 would not prevent the implementation of additional remedial measures if required in the future.

The estimated present worth cost of the recommended alternative is $522,600.

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TABLES

Table 1
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Summary of Chemical-Specific Groundwater SCGs

Parameter	New York State Groundwater (GA) Standard	New York State MCL
Vinyl Chloride	2	2
Chloroethane	5	NL
1,1-Dichloroethene	5	5
Methylene Chloride	5	5
1,1-Dichloroethane	5	5
c-1,2-Dichloroethene	5	5
1,2-Dichloroethane	0.6	5
1,1,1-Trichloroethane	5	5
Trichloroethene	5	5
4-Methyl-2-Pentanone	NL	NL

Notes:
1. For all compounds detected in RI samples.
2. NYS Groundwater GA Standards are from 6 NYCRR Part 703.
3. NYS MCL are from 10 NYCRR Part 5.
4. NL - Not listed.
5. All units are in ug/l.

Table 2
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Summary of Potential Location-Specific and Action-Specific SCGs

Agency	Regulatory Compliance Activity/Requirements
NYSDEC	Treated Groundwater Discharge to Surface Water – 6 NYCRR Parts 750-758 (State Pollution Discharge Elimination System (SPDES) Requirements)
NYSDEC	Potential Air Emission from Selected Treatment Systems and/or Remedial Construction Activities On Site – 6 NYCRR Parts 212-254 (Air Emission Requirements) – 6 NYCRR Part 211 (General Prohibitions for Air Emissions) – Draft New York State Air- Guide - 1 (AG-1 1991) Guidelines for the Control of Toxic Ambient Air Contaminants – NYSDEC Technical Administrative Guidance Memorandum (TAGM) No. 4031 (Fugitive Dust Suppression and Particulate Monitoring)
NYSDEC/USEPA	Potential Transport of Materials or Wastes to/from Site – 6 NYCRR Part 364 (Waste transporter requirements) – 6 NYCRR Parts 370-372 (Hazardous waste management, including manifesting) – 6 NYCRR Part 374 (Standards for management of specific hazardous wastes) – 40 CFR Part 262 (Hazardous waste manifesting requirements) – 40 CFR Part 263 (Hazardous waste transporter requirements) – 49 CFR Part 107 (171.1-.500) (Rules for hazardous materials transport)
OSHA	Remedial Construction Activities – 29 CFR Parts 1910 & 1926 (Safety and health standards for worker safety and construction activities)
Local Agencies, as appropriate (e.g., Town and County)	Siting and Construction of Selected Treatment Systems (e.g., building and plumbing permits, etc.)

Table 3
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Identification and Screening of Remedial Technologies

General Response Action	General Technology	Specific Technology	Technology Description	Eliminated	Potentially Applicable	Elimination Basis
Containment	Surface Barriers	Capping	Reduce migration of residual VOCs by preventing infiltration/recharge upgradient of impacted zones	X		Shallow groundwater recharge tributary to the affected area is very large and mostly developed making capping too costly
	Subsurface Barriers	Vertical Barriers	Trench or physical structure barring horizontal contaminant migration	X		Horizontal control of groundwater migration is being provided by the existing collection system.
		Horizontal Barriers	Grouting or block displacement to form a horizontal bottom seal barring vertical migration	X		This technology could be applied with difficulty, however, it is not necessary due to the low vertical permeability of site soils and the presence of an upward gradient
	Hydraulic Containment	Groundwater Collection	Accomplish by groundwater collection (discussed below). Requires subsequent treatment/disposal.		X	
Collection	Wells	Well Point Dewatering	Suction lift pumps to extract shallow groundwater	X		Due to the heterogeneous nature of the materials present, trench drain recovery systems would be more effective
		Pumping Wells	Well point groundwater extraction for deeper wells, beyond suction pump capability	X		Due to the heterogeneous nature of the materials present, trench drain recovery systems would be more effective
	Drains	Trench Drains	Subsurface drains installed in or downgradient of impacted areas		X	
		Horizontal Drains	Subsurface drains installed with horizontal drilling techniques	X		Due to the heterogeneous nature of the materials present, trench drain recovery systems would be more effective
	Ancillary Aquifer Development	Various	Aquifer stimulation methods typically used to increase bedrock well yields	X		Generally not needed in unconsolidated depsoits

Table 3
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Identification and Screening of Remedial Technologies

General Response Action	General Technology	Specific Technology	Technology Description	Eliminated	Potentially Applicable	Elimination Basis
Treatment	In-Situ	Air Sparging	Volatilization of VOCs achieved by injecting air below the water table	X		Not effective in aquifer of low hydraulic conductivity; due to discontinuous strata and heterogeneous materials no assurance of hydraulic connection to all conductive zones
		Reactive Wall/Gate	Use of zero-valent iron permeable wall or zone across a contaminant plume to degrade chlorinated VOCs.		X	
		Various Catalysts	Introduction of biological or chemical agents to augment natural degradation of contaminants	X		Site geology is not conducive to uniform and reliable introduction of agents
	Ex-Situ	Physical - Carbon Adsorption	Adsorption of VOCs onto granular activated carbon (GAC)	X		No technological or economical advantage over other available methods
		Physical - Air Stripping	Removal of VOCs by transfer to gaseous phase using air; may require off-gas treatment		X	
		Physical - Steam Stripping	Removal of VOCs by transfer to gaseous phase using steam; may require off-gas treatment	X		No technological or economical advantage over other available methods
		Physical - Membrane Separation	Physical separation of contaminants at a molecular level, generally used as a polishing process	X		No technological or economical advantage over other available methods
		Physical - Rapid Sand or Gravity Filter	Removal of suspended solids by gravity filtration	X		Not applicable to dissolved VOC treatment, may be required or considered as an ancillary method to address suspended solids to meet discharge requirements
		Physical - Pressure Filter	Removal of suspended solids by pressure filtration	X		Not applicable to dissolved VOC treatment, may be required or considered as an ancillary method to address suspended solids to meet discharge requirements
		Biological - Aerobic/Anaerobic	Conventional aerobic or anaerobic wastewater treatment	X		Applicable to wastewaters with high organic strength

Table 3
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Identification and Screening of Remedial Technologies

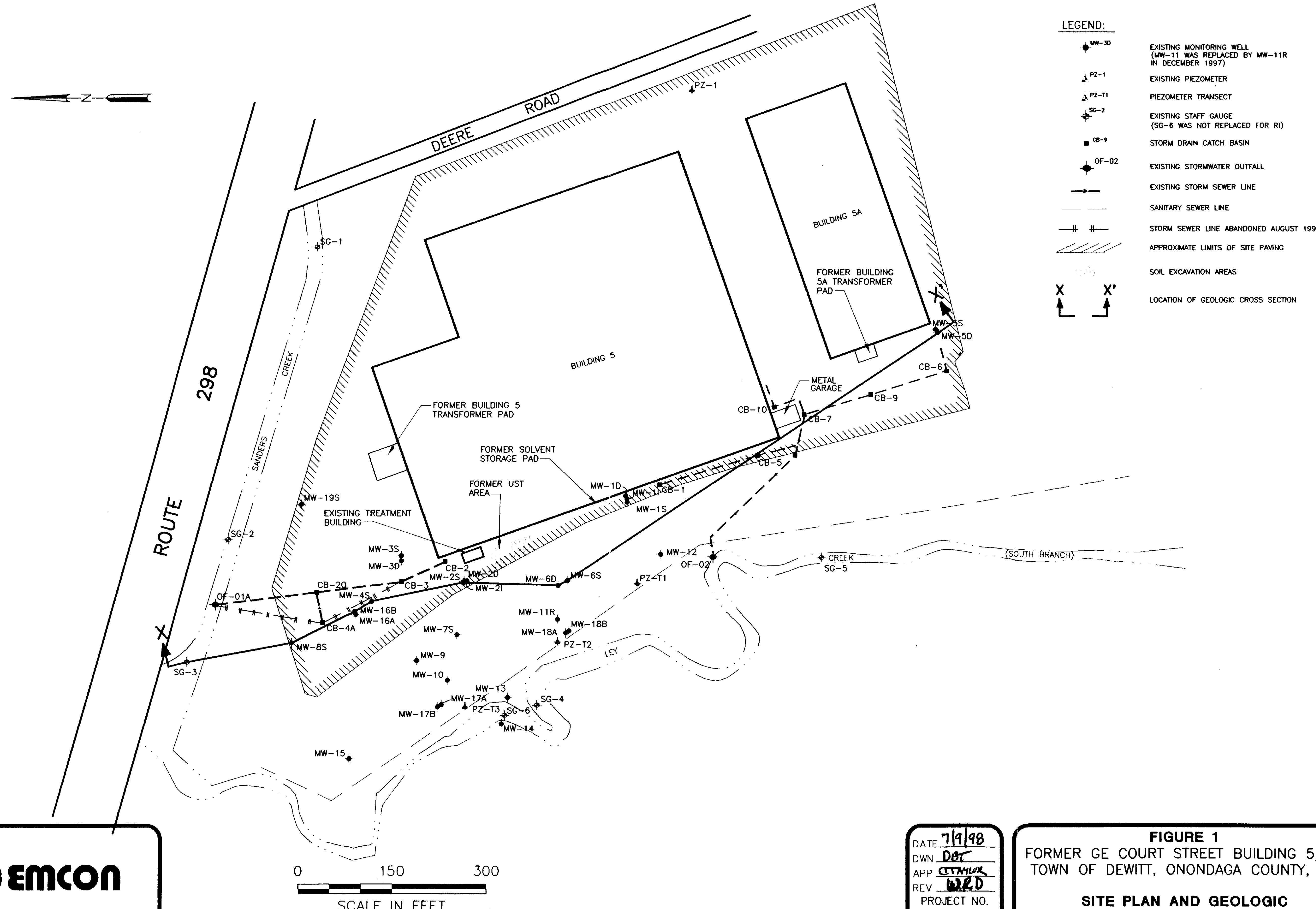
General Response Action	General Technology	Specific Technology	Technology Description	Eliminated	Potentially Applicable	Elimination Basis
Treatment *(continued)*	Ex-Situ *(continued)*	Biological - Biophysical	Adds physical processing to enhance biological treatment	X		Applicable to wastewaters with high organic strength
		Chemical - Oxidation	UV/ozone oxidation of VOCs and organic compounds	X		No technological or cost advantage over other available methods
		Chemical - Wet Air Oxidation	Oxidation of organics using air and water at high pressures and temperatures	X		No technological or economical advantage over other available methods
		Chemical - Plasma Arc Technology	High temperatures generated by electrical current pyrolize contaminants	X		No technological or economical advantage over other available methods
		Chemical - Precipitation	Coagulation/flocculation through chemical reagents	X		Not applicable to dissolved VOC treatment, may be required or considered as an ancillary method to address suspended solids to meet discharge requirements
		Chemical - Ion Exchange	Exchanges innocuous ions for toxic ions	X		Not applicable to dissolved VOC treatment
Disposal	On-Site Disposal	Discharge to Groundwater	Discharge treated effluent to groundwater	X		Application limited because of low hydraulic conductivities.
		Discharge to Surface Water	Discharge treated effluent to nearby surface water bodies		X	
	Off-Site Disposal	Sewer Connection to POTW	Discharge collected groundwater or treated effluent to public sewer system	X		Onondaga County Department of Drainage and Sanitation does not accept any wastewater from NYSDEC listed hazardous waste sites
		Transportation to Permitted Disposal Facility	Transport collected groundwater to permitted off-site disposal facilities.	X		Not cost effective for large quantities of impacted groundwater

Table 4
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York
Remedial Alternative Cost Estimates

Remedial Alternative	Capital Cost ($)	Annual O&M Cost ($)	O&M Period (years)	Present Worth Cost ($)
Alternative 1 - No Action	$9,800	$4,100	30	$101,600
Alternative 2 - No Further Remedial Action	$9,800	$28,300 $6,700	20[2] 30[3]	$522,600
Alternative 3 - Groundwater Funnel and Reactive Gate	$755,300	$25,200	30	$1,319,800

Notes: 1. All costs are rounded to the nearest $100.
2. Alternative 2 includes a 20 year period of groundwater collection.
3. Each alternative includes 30 years of site monitoring.

FIGURES



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PROJECT NO.
86143-008.000

FIGURE 1
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY

SITE PLAN AND GEOLOGIC CROSS SECTION LOCATION

ENE-MTOWN2/DATA: N:\DWG\01554-03\MALMF-02.dwg Xrefs: MALMB-00, MALMWE01, MALMBDB0
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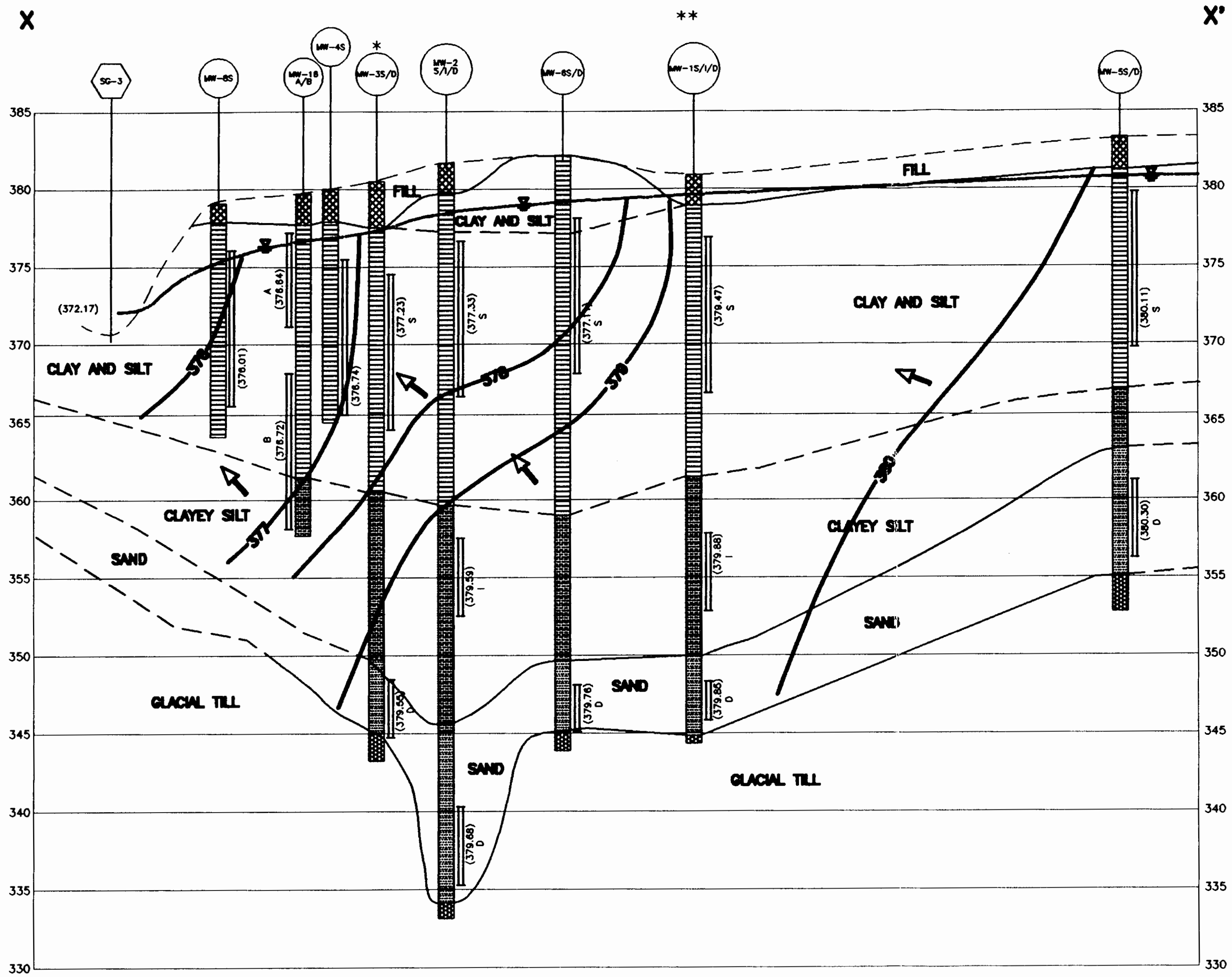

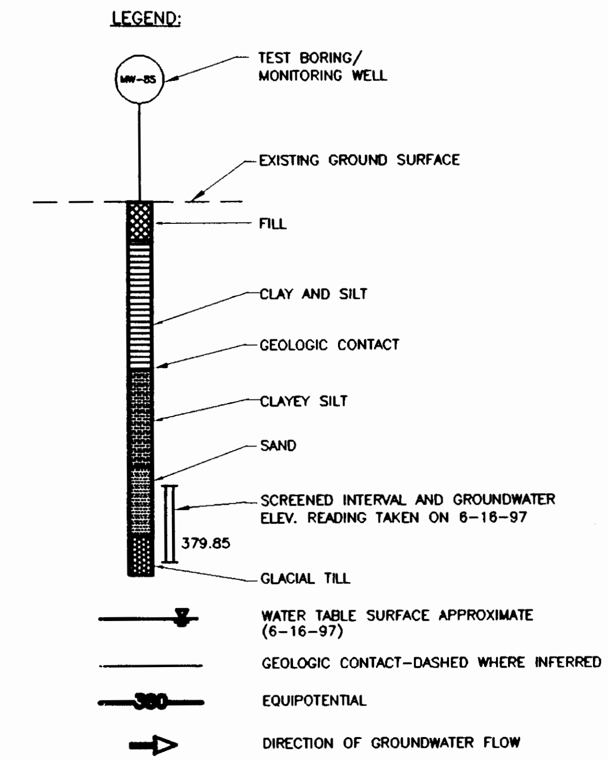

NOTES:

1. EXISTING GRADE ELEVATION BASED ON ELEVATIONS RECORDED ON BORING LOGS
2. THE FOLLOWING WELLS WERE PROJECTED TO CROSS SECTION AS FOLLOWS:
   * MW-3S/D PROJECTED 50 FEET WEST TO THE CROSS-SECTION
   ** MW-1S/D PROJECTED 50 FEET WEST TO THE CROSS-SECTION
3. MONITORING WELL NOTATIONS (i.e., S/I/D) REFER TO WELLS SCREENED AT A SHALLOW (S WELLS), INTERMEDIATE (I WELL), AND DEEP (D WELLS) INTERVAL.
4. MONITORING WELL NOTATIONS (i.e., A/B) REFER TO WELLS SCREENED AT A SHALLOW (A WELLS) AND DEEPER (B WELLS) INTERVAL.

GEOLOGIC CROSS SECTION

SECTION

SCALE: HORIZ: 1"=200'
VERT: 1"=10'

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FIGURE 2
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY

GEOLOGIC CROSS-SECTION AND PIEZOMETRIC PROFILE X-X' - JUNE 1997

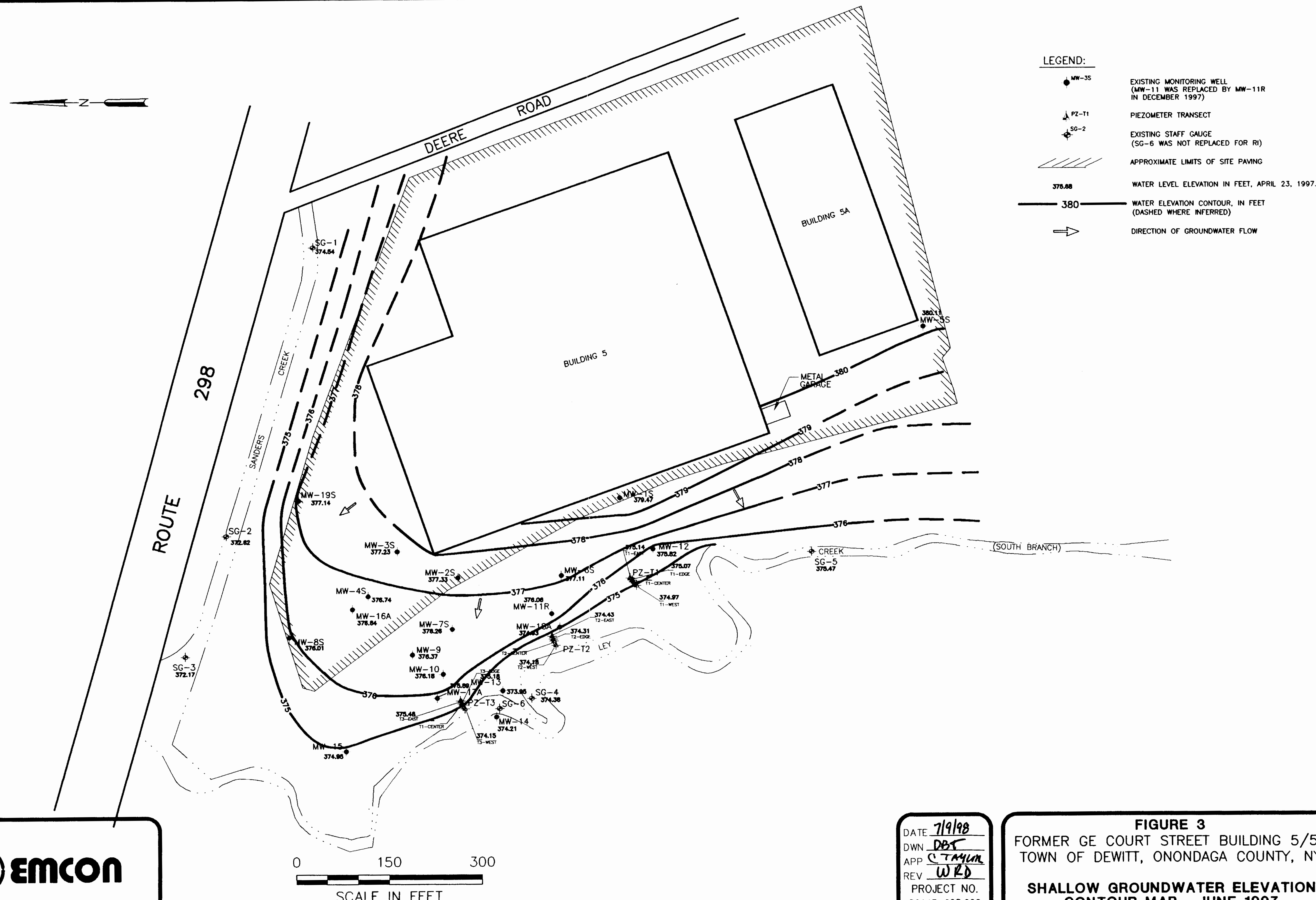

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FIGURE 3
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY

SHALLOW GROUNDWATER ELEVATION CONTOUR MAP - JUNE 1997

ENE-MTOWN2/DATA: N:\DWG\01554-03\MALMF-03.dwg Xrefs: MALMB-00, MALMBDB0
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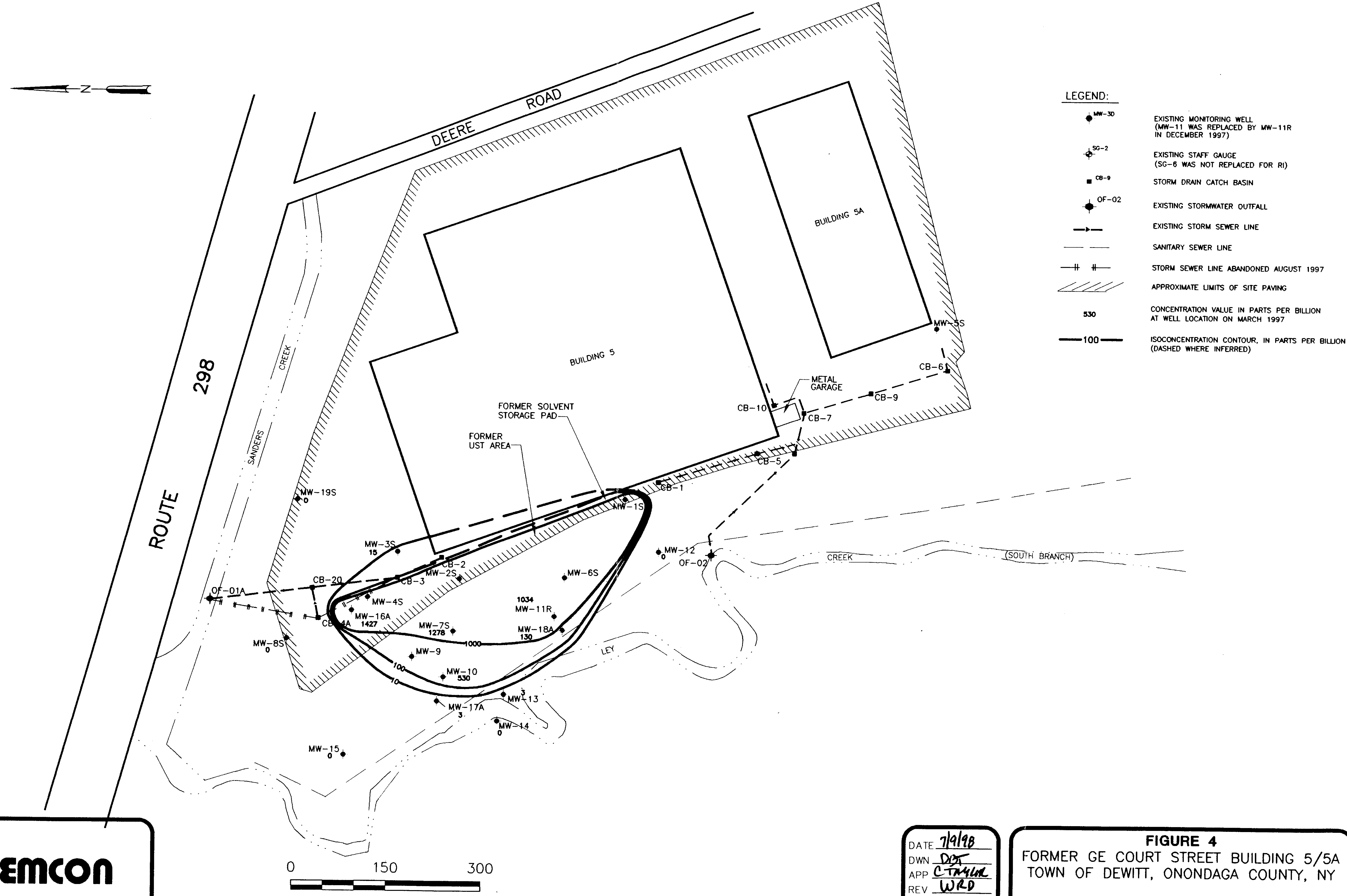

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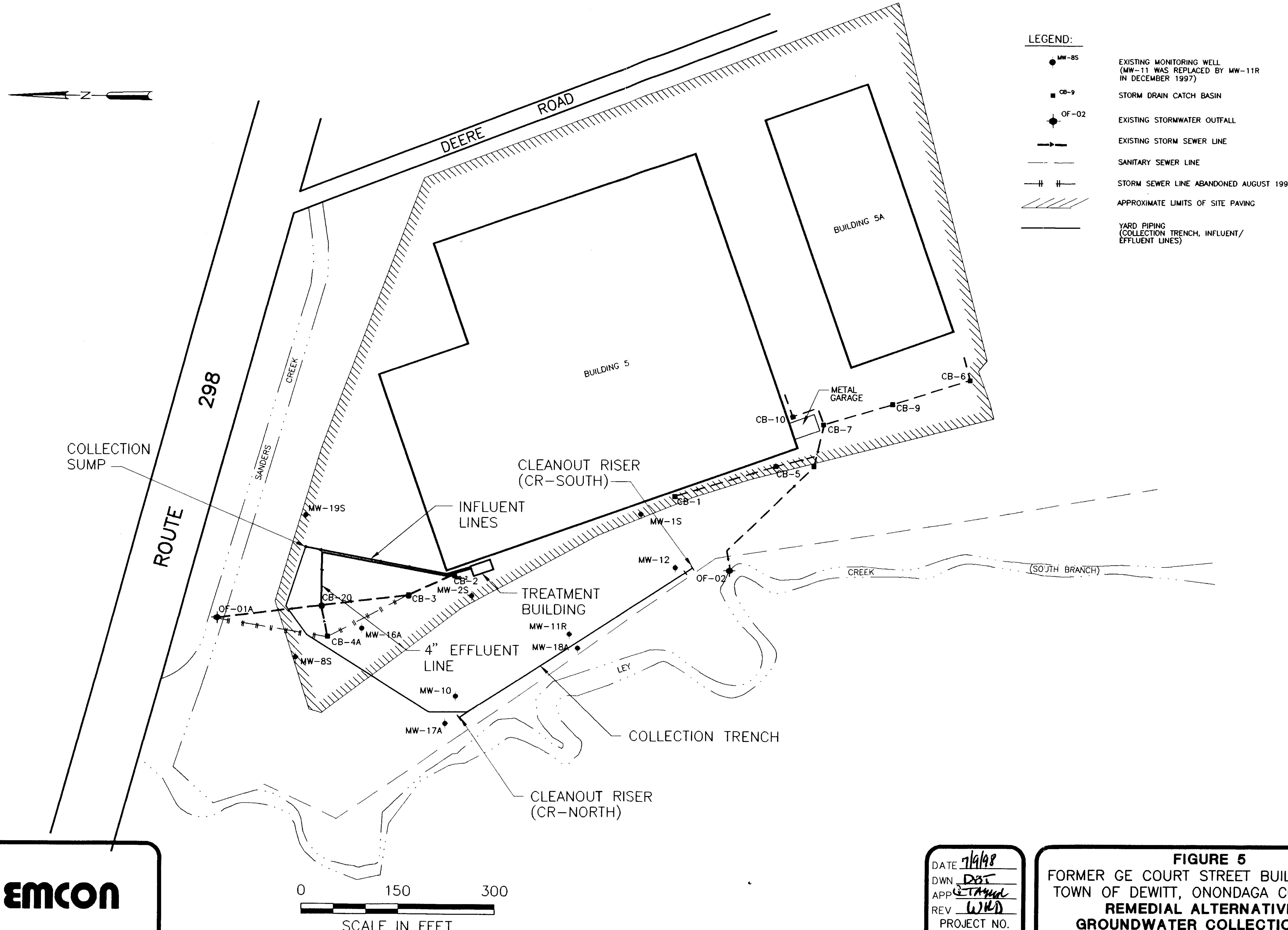
FIGURE 4
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY

ISOCONCENTRATION MAP OF VOCs IN SHALLOW GROUNDWATER - MARCH 1997

Date: 7/9/98 Time: 1:03 PM Operator: DTICE

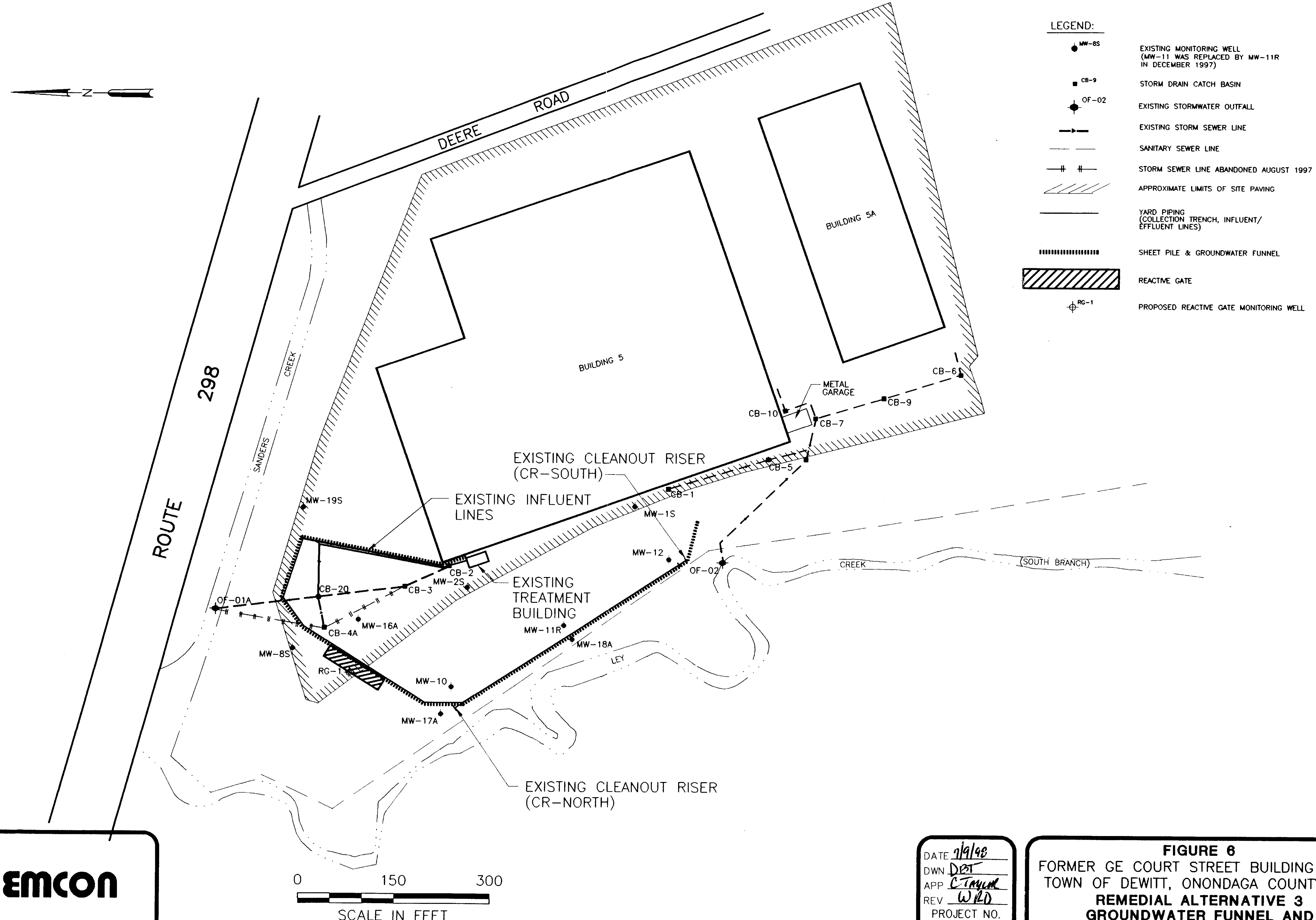


EMCON

DATE	7/9/98
DWN	DBT
APP	[illegible]
REV	WKD
PROJECT NO.	86143-008.000

FIGURE 5
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY
REMEDIAL ALTERNATIVE 2
GROUNDWATER COLLECTION AND TREATMENT SYSTEM

ENE-MTOWN2/DATA: N:\DWG\01554-03\MALMF-07.dwg Xrefs: MALMB-00, MALMBDB0
Scale: 1 = 1.00 DimScale: 1 = 150.00 Date: 7/9/98 Time: 1:07 PM Operator: DTICE



EMCON

DATE 7/9/98
DWN DBT
APP C. TAYLOR
REV WRD
PROJECT NO.
86143-008.000

FIGURE 6
FORMER GE COURT STREET BUILDING 5/5A
TOWN OF DEWITT, ONONDAGA COUNTY, NY
REMEDIAL ALTERNATIVE 3
GROUNDWATER FUNNEL AND REACTIVE GATE

APPENDIX A

GROUNDWATER COLLECTION AND TREATMENT SYSTEM OPERATIONAL DATA

ATTACHMENT A

LOCKHEED MARTIN CORPORATION
FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

FEBRUARY 1998

Event Identification	Date	Total Ground-water Treated [1] (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
Effluent Limits:			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Start-up Phase I Weekly Sample, Effluent	02/06/98	93,206	12.5	7.5	277	< 10	< 10	< 10	570	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Start-up Phase II 12-Hr. Sample, Influent				N.R.	N.R.	N.R.	N.R.	N.R.	240	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	57	< 10	150	68	< 5	< 5	< 5	< 5	< 5	< 5
Start-up Phase II 12-Hr. Sample, Effluent	02/11/98	141,783	10.2	7.5	N.R.	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #1 Weekly Sample, Influent				7.7	490	N.R.	N.R.	N.R.	180	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	47	< 10	95	45	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #1 Weekly Sample, Effluent	02/18/98	231,635	10.25	7.4	493	N.R.	N.R.	N.R.	870	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #2 Weekly Sample, Influent				7.1	748	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	77	< 10	140	49	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #2 Weekly Sample, Effluent	02/23/98	301,538	9.95	7.1	695	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

N.R.: Not Required to Sample.

Note (1): In accordance with the O&M Plan, collected construction water (previously characterized) was treated during Start-up Phase I.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

MARCH 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
		Effluent Limits:	Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Normal O&M Week #3 Weekly Sample, Influent				7.6	723	N.R.	N.R.	N.R.	180	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	58	< 10	160	51	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #3 Weekly Sample, Effluent	03/05/98	409,556	9.8	7.8	722	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	18	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #4 Weekly Sample, Influent				7.0	625	N.R.	N.R.	N.R.	650	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	44	< 10	110	39	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #4 Weekly Sample, Effluent	03/10/98	460,035	9.8	7.0	635	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #5 Weekly Sample, Influent				7.5	633	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	74	< 10	160	53	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #5 Weekly Sample, Effluent	03/17/98	529,728	10.0	7.8	660	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #6 Weekly Sample, Influent				6.9	639	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	80	< 10	180	59	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #6 Weekly Sample, Effluent	03/26/98	615,070	9.7	7.8	628	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #7 Weekly Sample, Influent				7.3	665	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	71	< 10	150	46	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #7 Weekly Sample, Effluent	03/31/98	662,837	9.9	7.1	642	N.R.	N.R.	N.R.	250	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Note: N.R. - Not Required to Sample.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

APRIL 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
Effluent Limits:			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Normal O&M Week #8 Weekly Sample, Influent				7.3	775	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	69	< 10	170	55	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #8 Weekly Sample, Effluent	04/07/98	726,277	9.9	7.6	760	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #9 Weekly Sample, Influent				7.4	824	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	110	< 10	200	61	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #9 Weekly Sample, Effluent	04/14/98	786,438	10.0	7.5	821	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #10 Weekly Sample, Influent				7.4	775	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	84	< 10	190	66	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #10 Weekly Sample, Effluent	04/21/98	835,053	9.7	8.1	760	N.R.	N.R.	N.R.	120	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #11 Weekly Sample, Influent				7.5	823	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	100	< 10	200	65	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #11 Weekly Sample, Effluent	04/28/98	883,559	10.0	7.6	751	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

N.R.: Not Required to Sample.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

MAY 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
Effluent Limits:			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Normal O&M Week #12 Weekly Sample, Influent				7.3	833	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	130	< 10	270	99	< 5	5	< 5	< 5	< 5	< 5
Normal O&M Week #12 Weekly Sample, Effluent	05/06/98	914,980	10.0	7.4	804	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #13 Weekly Sample, Influent				7.4	603	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	64	< 10	130	46	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #13 Weekly Sample, Effluent	05/12/98	954,198	9.7	7.7	575	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #14 Weekly Sample, Influent				7.7	806	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	75	< 10	170	80	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #14 Weekly Sample, Effluent	05/19/98	1,004,103	2.0	7.4	780	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #15 Weekly Sample, Influent				7.2	776	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	77	<20	160	88	< 10	< 10	< 10	< 10	< 10	< 10
Normal O&M Week #15 Weekly Sample, Effluent	05/27/98	1,028,436	10.0	7.2	720	N.R.	N.R.	N.R.	< 100	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	N.R.	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

JUNE 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
Normal O&M Week #16 Weekly Sample, Influent				7.0	552	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	14	29	< 10	120	37	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #16 Weekly Sample, Effluent	06/01/98	1,043,457	1.8	7.7	532	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	12	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes: 1. N.R.: Not Required to Sample.
2. Average Flow Rate for May 1998 (from April 28 to May 27, 1998) was 3.5 gallons per minute.
3. The influent sample collected on June 1, 1998 was analyzed for additional metals to evaluate the need for continued filtration of the treated groundwater.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

JUNE 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
Effluent Limits:			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Normal O&M Week #16/ Monthly Sample, Influent				7.0	552	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	14	29	< 10	120	37	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #16/ Monthly Sample, Effluent	06/01/98	1,043,457	1.8	7.7	532	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	12	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes: 1. Total volume of groundwater treated, as of July 7, 1998 was 1,265,822 gallons.
2. Average Flow Rate for June 1998 (from May 27 to July 7, 1998) was 4.0 gallons per minute.
3. The influent sample collected on June 1, 1998 was analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

JULY 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant. Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
	Effluent Limits:		Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
Normal O&M Week #21 Weekly Sample, Influent				7.4	522	< 10	< 10	< 10	260	< 3	< 20	< 5	< 10	< 10	< 10	120	65	< 10	180	50	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #21 Weekly Sample, Effluent	07/07/98	1,265,822	1.9	7.7	498	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes: 1. The influent sample collected on July 7, 1998 was analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

AUGUST 1998

Event Identification	Date	Total Ground water Treated (gallons)	Instant Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)
NYSDEC Water Discharge Limits (Effluent):			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400
NYSDEC Air Evaluation Criteria (Influent)			10 (average)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Normal O&M Week #25 Weekly Sample Influent				7.0	653	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	71
Normal O&M Week #25 Weekly Sample Effluent	08/04/98	1,399,543	1.4	7.5	545	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10

Event Identification	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
NYSDEC Water Discharge Limits (Effluent):	50	170	30	30	10	10	6	10	10	10
NYSDEC Air Evaluation Criteria (Influent)	312.6	30	1901.6	200	15	15	16.2	39	43.9	156.3
Normal O&M Week #25 Weekly Sample Influent	98	< 10	210	58	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #25 Weekly Sample Effluent	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes:

1. The influent sample collected on August 4, 1998 was analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater.
2. Total volume of groundwater treated, as of September 1, 1998 was 1,518,633 gallons.
3. Average Flow Rate for August 1998 (from August 4 to September 1, 1998) was 2.95 gallons per minute.
4. NA - Air Evaluation Criteria are not applicable.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

SEPTEMBER 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
NYSDEC Water Discharge Limits (Effluent):			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
NYSDEC Air Evaluation Criteria (Influent):			10 (average	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	312.6	30	1901.6	200	15	15	16.2	39	43.9	156.3
Normal O&M Week #29 Weekly Sample, Influent				7.4	668	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	56	86	< 10	180	58	< 5	5	< 5	< 5	< 5	< 5
Normal O&M Week #29 Weekly Sample, Effluent	09/01/98	1,518,633	1.9	7.0	569	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	9	< 5	< 5	< 5	< 5	< 5	< 5	< 5

Notes

1. The influent sample collected on September 1, 1998 was analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater
2. Total volume of groundwater treated, as of October 6, 1998 was 1,650,996 gallons.
3. Average Flow Rate for September 1998 (from September 1 to October 6, 1998) was 2.63 gallons per minute.
4. NA - Air Evaluation Criteria are not applicable.
5. An effluent concentration of 9 ug/l of 1,1-DCA was identified during this period. Although this concentration is below NYSDEC effluent limits, measures are being taken to verify that effective treatment conditions are being maintained, including contacting the air stripper manufacturer and reviewing the operating condition of treatment and control equipment.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

OCTOBER 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
NYSDEC Water Discharge Limits (Effluent)			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
NYSDEC Air Evaluation Criteria (Influent)			10 (average)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	312.6	30	1901.6	200	15	15	16.2	39	43.9	156.3
Normal O&M Week #34 Monthly Sample, Influent				7.5	690	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	41	49	< 10	140	48	< 5	5	< 5	< 5	< 5	< 5
Normal O&M Week #34 Monthly Sample, Effluent	10/06/98	1,650,996	2.0	7.7	600	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #35 Influent Metals Only	10/13/98	NM	NM	NM	NM	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	36	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Normal O&M Week #36 Influent Metals Only	10/20/98	NM	NM	NM	NM	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	22	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Normal O&M Week #37 Influent Metals Only	10/27/98	1,718,804	2.0	NM	NM	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	34	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

Notes

1. The influent samples collected in October 1998 were analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater
2. Total volume of groundwater treated, as of November 2, 1998 was 1,733,678 gallons.
3. Average Flow Rate for October 1998 (from October 6, 1998 to November 2, 1998) was 2.1 gallons per minute.
4. NA - Air Evaluation Criteria are not applicable.
5. NM - Not measured.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

NOVEMBER 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
NYSDEC Water Discharge Limits (Effluent):			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
NYSDEC Air Evaluation Criteria (Influent):			10 (average)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	312.6	30	1901.6	200	15	15	16.2	39	43.9	156.3
Normal O&M Week #38 Monthly Sample, Influent				6.8	706	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	37	37	< 10	140	51	< 5	5	< 5	< 5	< 5	< 5
Normal O&M Week #38 Monthly Sample, Effluent	11/02/98	1,733,706	2.0	6.9	613	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #39 Influent Metals Only	11/10/98	1,752,960	1.7	N.M.	N.M.	< 10	< 10	< 10	< 100	11	< 20	< 5	< 10	< 10	< 10	44	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.
Normal O&M Week #40 Influent Metals Only	11/17/98	1,776,439	N.M.	N.M.	N.M.	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	28	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.
Normal O&M Week #41 Influent Metals Only	11/24/98	1,798,149	2.0	N.M.	N.M.	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	23	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.

Notes:

1. The influent samples collected in November 1998 were analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater.
2. Total volume of groundwater treated, as of December 1, 1998 was 1,825,083 gallons.
3. Average Flow Rate for November 1998 (from November 2, 1998 to December 1, 1998) was 2.2 gallons per minute.
4. NA - Air Evaluation Criteria are not applicable.
5. NM - Not measured.

ATTACHMENT A

FORMER GE COURT STREET 5/5A SITE
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
OPERATIONS & MAINTENANCE DATA

DECEMBER 1998

Event Identification	Date	Total Ground-water Treated (gallons)	Instant Flow Rate (gpm)	pH (S.U.)	Total Dis. Solids (mg/L)	As Total (µg/L)	Cr Total (µg/L)	Cu Total (µg/L)	Fe Total (µg/L)	Pb Total (µg/L)	Ni Total (µg/L)	Se Total (µg/L)	Ag Total (µg/L)	Tl Total (µg/L)	V Total (µg/L)	Zn Total (µg/L)	Vinyl Chloride (µg/L)	Chloro-ethane (µg/L)	1,1-DCA (µg/L)	1,2-DCE (Total) (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Total Xylenes (µg/L)
NYSDEC Water Discharge Limits (Effluent)			Monitor	6 - 9	Monitor	30	25	30	1,700	20	25	10	10	15	30	400	50	170	30	30	10	10	6	10	10	10
NYSDEC Air Evaluation Criteria (Influent)			10 (average)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	312 6	30	1901 6	200	15	15	16 2	39	43 9	156 3
Normal O&M Week #42 Monthly Sample, Influent				7 0	689	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	37	46	< 10	160	56	< 5	5	< 5	< 5	< 5	< 5
Normal O&M Week #42 Monthly Sample, Effluent	12/01/98	1,825,083	9 9	7 2	677	< 10	< 10	< 10	< 100	< 3	< 20	< 5	< 10	< 10	< 10	18	< 10	< 10	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Normal O&M Week #43 Influent Metals Only	12/08/98	1,845,874	1 7	N M	N M	< 10	< 10	< 10	< 100	< 10	< 20	< 5	< 10	< 10	< 10	33	N M	N M	N M	N M	N M	N M	N M	N M	N M	N M

Notes

1 The influent samples collected in December 1998 were analyzed for all inorganic compounds on the NYSDEC effluent limitations list to evaluate the need for continued filtration of the treated groundwater

2 Total volume of groundwater treated, as of January 5, 1999 was 1,945,104 gallons.

3 Average Flow Rate for December 1998 (from December 1, 1998 to January 5, 1999) was 2 4 gallons per minute

4 NA - Air Evaluation Criteria are not applicable

5 NM - Not measured

APPENDIX B

REMEDIAL ALTERNATIVE COST ESTIMATES

Alternative 1
Cost Estimate for No Action Alternative
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York

Task	Description	Estimated Quantity	Units	Unit Cost		Estimated Cost
	CAPITAL COSTS					
Monitoring Well Decommissioning	Labor and Expenses	7	days	$ 1,400.00	/day	$ 9,800
	ANNUAL OPERATION AND MAINTENANCE					
Monitoring Well Sampling	Labor and Expenses	20	hrs	$ 60.00	/hr	$ 1,200
	Sample Analysis	12	samples	$ 125.00	/sample	$ 1,500
Annual O&M Reporting	Project Management and Reporting	20	hrs	$ 70.00	/hr	$ 1,400
Estimated Yearly Operation and Maintenance		*per*	*year*			$ 4,100

Notes: 1. All costs have been rounded to the nearest $100.
2. Present worth of No Action Alternative (capital cost + 30 years of O&M @ 2% discount rate):
PW = Capital Cost + ($22.40 * Annual O&M Cost) = $101,600

Alternative 2
No Further Remedial Action
Cost Estimate for Groundwater Collection and Treatment System
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York

Task	Description	Estimated Quantity	Units	Unit Cost		Estimated Cost
CAPITAL COST						
Monitoring Well Decommissioning	Labor and Expenses	7	days	$ 1,400.00	/day	$ 9,800
ANNUAL OPERATION AND MAINTENANCE FOR GROUNDWATER COLLECTION AND TREATMENT						
Utilities	Electricity Usage	63,400	Kwhr	$ 0.12	/Kwhr	$ 7,600
	Water	4	quarters	$ 50.00	/quarter	$ 200
Maintenance	O&M Site Visits (24 visits annually)	96	hrs	$ 60.00	/hr	$ 5,800
	Equipment Parts	12	months	$ 500.00	/month	$ 6,000
	Waste Disposal (e.g., spent filter cartridges)	2	drum	$ 200.00	/drum	$ 400
	Influent/Effluent Sample Analysis (Monthly)	24	samples	$ 200.00	/sample	$ 4,800
Annual O&M Reporting	Project Management and Reporting	50	hrs	$ 70.00	/hr	$ 3,500
Estimated Yearly O&M for Groundwater Collection and Treatment		*per*	*year*			$ 28,300
ANNUAL OPERATION AND MAINTENANCE FOR SITE MONITORING						
Monitoring Well Sampling	Labor and Expenses	30	hrs	$ 60.00	/hr	$ 1,800
	Sample Analysis	22	samples	$ 125.00	per sample	$ 2,800
Annual Monitoring Reporting	Project Management and Reporting	30	hrs	$ 70.00	/hr	$ 2,100
Estimated Yearly O&M for Site Monitoring		*per*	*year*			$ 6,700

Notes:
1. All costs are rounded to the nearest $100.
2. Present worth cost estimate assumes 20 years of groundwater collection and treatment, and 30 years of site monitoring (i.e., during the groundwater collection period and 10 years thereafter).
3. Present worth of No Further Remedial Action Alternative (capital cost + 20 years of groundwater collection and treatment @ 2% discount rate + 30 years of site monitoring @ 2% discount rate):
   PW = Capital Cost + ($16.35 * Annual Groundwater Collection and Treatment Cost) + ($22.40 * Annual Site Monitoring Cost) = $522,600

Alternative 3
Cost Estimate for Funnel and Reactive Gate
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York

Task	Description	Estimated Quantity	Units	Unit Cost		Estimated Cost
		CAPITAL				
Engineering	Design/Construction Management					$ 103,200
Licensing	Enviro-Metals Patent					$ 77,400
Permitting	Provision for Required Permits/Permit Equivalencies					$ 10,000
Health & Safety	Provision for Construction Personnel Protection					$ 10,300
Monitoring Well Decommissioning	Labor and Expenses	7	days	$ 1,400.00	/day	$ 9,800
Well/Piezometer Installation	Labor and Expenses	2	days	$ 1,500.00	/day	$ 3,000
System Components	Equipment Mobilization/Demobilization	1	LS	$ 25,800.00	/LS	$ 25,800
	Funnel (Sheet Piling)	12000	SF	$ 25.00	/SF	$ 300,000
	Reactive Gate Excavation	220	CY	$ 140.00	/CY	$ 30,800
	Excavation Soils Disposal	120	CY	$ 75.00	/CY	$ 9,000
	Reactive Gate Backfill	220	CY	$ 800.00	/CY	$ 176,000
Subtotal Capital Costs						$ 755,300
		ANNUAL OPERATION AND MAINTENANCE				
Maintenance	Replacement of Reactive Media	0.200	LS (5 yrs)	$ 88,000.00	/LS	$ 17,600
Site Visits (Monitoring)	Labor and Expenses (Sampling Visits)	30	hrs	$ 60.00	/hr	$ 1,800
	Labor and Expenses (GW Elev. Measurement)	12	hrs	$ 60.00	/hr	$ 700
Project Management	Project Management and Reporting	30	hrs	$ 70.00	/hr	$ 2,100
Sampling	Sample Analysis	24	samples	$ 125.00	per sample	$ 3,000
Estimated Yearly Operation and Maintenance		*per*	*year*			$ 25,200

Notes: 1. All costs are rounded to the nearest $100.
2. Present worth of Funnel and Reactive Gate Alternative (capital cost + 30 years of O&M @ 2% discount rate):
PW = Capital Cost + ($22.40 * Annual O&M Cost) = $1,319,800

Alternative 3
Funnel and Gate Design
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York

	Ci	Ce		$N_{1/2}$	$t_{1/2}$	t	t
	µg/l	µg/l	Cf/Ci		hours	hours	days
1,1-Dichloroethane	2000.0	5.0	0.003	8.644	40.0	345.75	14.4

$$\boxed{N_{1/2} = \frac{\ln\left(C_i / C_e\right)}{\ln(2)}}$$

$$\boxed{t = t_{1/2} \times N_{1/2}}$$

$$\boxed{Gate\ thickness = t \times v}$$

Gate Width	100	ft
Funnel Width	800	ft
Gate Depth (Saturated Thickness)	8	ft
Natural Seepage Velocity	11.000	ft/yr
	0.030	ft/d
Resultant Seepage Velocity	0.271	ft/d
Gate Thickness	3.9	ft
Funnel Depth (Depth to Confining Layer)	15	ft
Funnel Surface Area	12000	ft^2
Density of Iron Filings	275	lbs/ft3
In-Place Density	3.7	tons/CY
Cost of Iron Filings	70.0	$/ft3
Cost of Iron Filings	400	$/ton
Cost of Iron Filings	1500	$/CY

Alternative 3
Funnel and Gate Cost Backup
Former GE Court Street Building 5/5A Site
Town of Dewitt, Onondaga County, New York

I. Construction Cost Breakdown

A. Sheet Piling

Assembly	Description	Number	Units	Unit Cost	Units	Cost
M021-614	Regression for 15-25 ft depth	12000	SF	$22.50	/SF	$270,000.00
	Location Factor					1.00
	Total Sheet Piling Cost					$270,000.00
	Unit Sheet Piling Cost					$22.50
	Estimated Sheet Piling Cost				say	$25.00

B. Trench Excavation

Assembly	Description	Number	Units	Unit Cost	Units	Cost
M021-614	Temp Sheet Piling (Regression for 15-25 ft depth)	3000	SF	$9.80	/SF	$29,400.00
M022-254-0500	Excavate & Reuse Unsaturated Soils	101	CY	$4.97	/CY	$503.49
M022-254	Excavate Saturated Soils	116	CY	$3.83	/CY	$443.43
	Subtotal					$30,346.92
	Location Factor					1.00
	Total Cost for all Trench Excavation					$30,346.92
	Unit Trench Excavation Cost					$139.79
	Estimated Unit Excavation Cost				say	$140.00

C. Reactive Gate Backfill

Assembly	Description	Number	Units	Unit Cost	Units	Cost
	Iron Fillings	116	CY	$1,500.00	/CY	$173,666.52
M022-254-3040	Backfill Unsaturated Soil	101	CY	$3.44	/CY	$348.49
	Subtotal					$174,015.01
	Location Factor					1.00
	Total Cost for Reactive Gate Backfill					$174,015.01
	Unit Reactive Gate Backfill Cost					$801.61
	Estimated Unit Reactive Gate Backfill Cost				say	$800.00

D. Other Construction Costs

Engineering	0.2
Health & Safety	0.02
Mobilization/Demobilization	0.05
Licensing	0.15

II. Operations & Maintenance

Replacement of 25% of Media	5 yrs