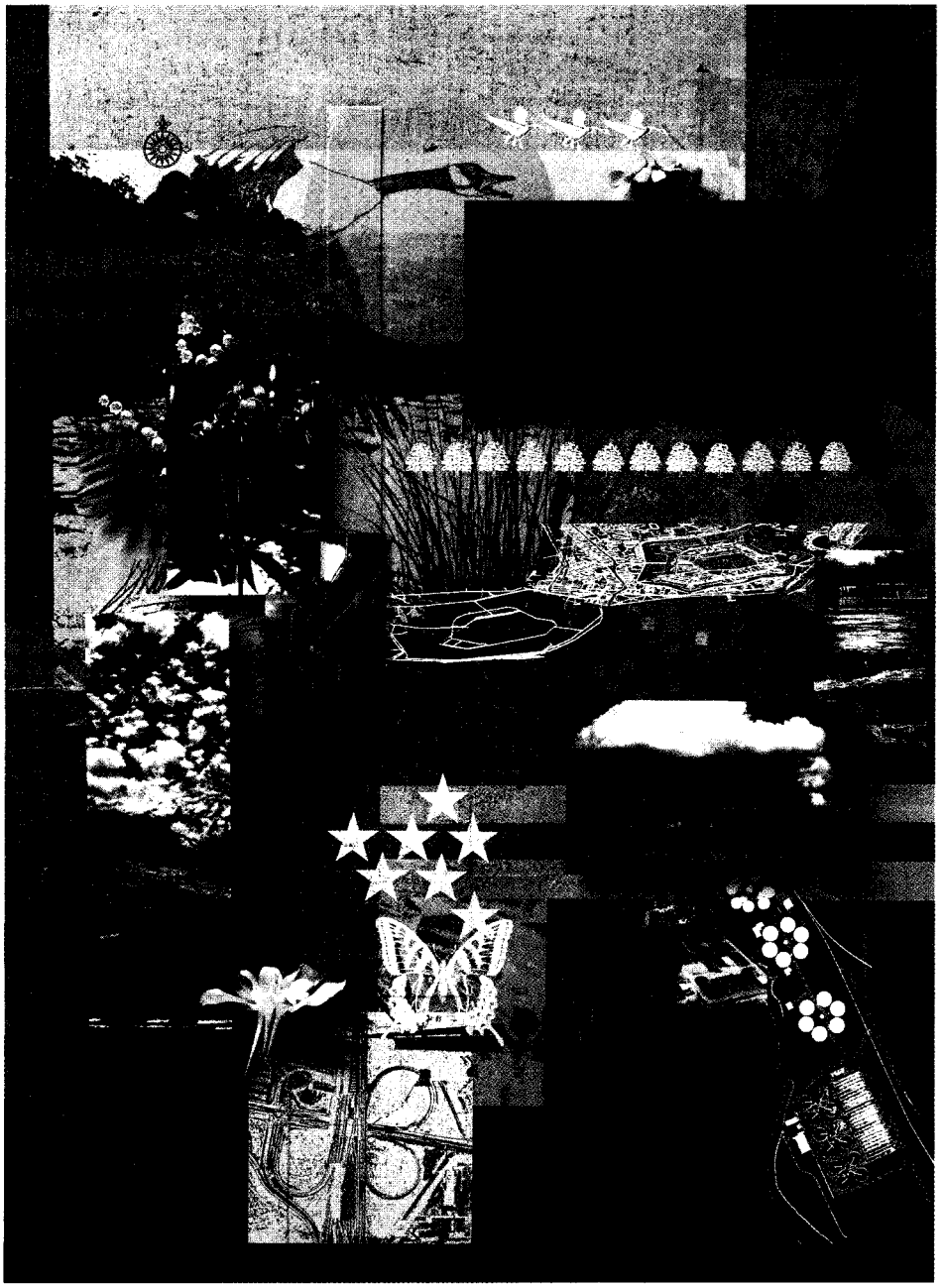
*Quality • Integrity • Creativity • Responsiveness*



*Quality through teamwork*

# FEASIBILITY STUDY

**GAESS INACTIVE HAZARDOUS WASTE DISPOSAL SITE**
**HARRIMAN, NEW YORK**

**SITE NUMBER 336018**

Prepared for:

Waste Management, Inc.
580 Edgewater Drive
Wakefield, Massachusetts

Prepared by:

Rust Environment &
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12 Metro Park Road
Albany, New York 12205

**February, 1996**

**Rust Environment & Infrastructure**

# TABLE OF CONTENTS

**Chapter** **Page**

EXECUTIVE SUMMARY ..... iii

1.0 INTRODUCTION ..... 1-1
1.1 PURPOSE AND ORGANIZATION OF REPORT ..... 1-1
1.2 BACKGROUND INFORMATION ..... 1-2
1.2.1 Description of the Gaess Site ..... 1-2
1.2.2 Site History ..... 1-2
1.2.3 Interim Remedial Measures ..... 1-5
1.3 SUMMARY OF GAESS REMEDIAL INVESTIGATION ..... 1-6
1.3.1 Objectives and Scope of the RI ..... 1-6
1.3.2 RI Findings ..... 1-8
1.3.2.1 Physical Setting ..... 1-8
1.3.2.2 Nature and Extent of Contamination ..... 1-10
1.3.2.3 Contaminant Fate and Transport ..... 1-11
1.3.2.4 Human Health Evaluation ..... 1-12
1.3.2.5 Ecological Assessment/Fish and Wildlife Impact Analysis ... 1-13
1.4 NYS STANDARDS, CRITERIA AND GUIDELINES ..... 1-13
1.4.1 Location-Specific SCGs ..... 1-14
1.4.3 Action-Specific SCGs ..... 1-14
1.4.4 Potential TBC Guidance ..... 1-14
1.5 FOCUS OF THE FEASIBILITY STUDY ..... 1-14

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES ..... 2-1
2.1 INTRODUCTION ..... 2-1
2.2 REMEDIAL ACTION OBJECTIVES ..... 2-1
2.3 GENERAL RESPONSE ACTIONS ..... 2-1
2.4 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES ..... 2-2
2.5 SUMMARY OF REMEDIAL TECHNOLOGIES ..... 2-11
2.5.1 Remedial Technologies Retained for Further Consideration ..... 2-11
2.5.2 Technologies Eliminated from Further Consideration ..... 2-11

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES ..... 3-1
3.1 DEVELOPMENT OF ALTERNATIVES ..... 3-1
3.2 SCREENING OF ALTERNATIVES ..... 3-2

4.0 DETAILED ANALYSIS OF ALTERNATIVES ..... 4-1
4.1 EVALUATION CRITERIA ..... 4-1
4.1.1 Compliance with New York State SCGs ..... 4-1
4.1.2 Overall Protection of Human Health and the Environment ..... 4-1

4.1.3 Short-Term Effectiveness ..... 4-2
4.1.4 Long-Term Effectiveness and Permanence ..... 4-2
4.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment ..... 4-2
4.1.6 Implementability ..... 4-3
4.1.7 Costs ..... 4-3
4.2 REMEDIAL ALTERNATIVES ANALYSIS ..... 4-5
4.2.1 Compliance with SCGs ..... 4-5
4.2.2 Overall Protection of Human Health and the Environment ..... 4-7
4.2.3 Short-Term Effectiveness ..... 4-7
4.2.4 Long-Term Effectiveness and Permanence ..... 4-7
4.2.5 Reduction of Toxicity, Mobility and Volume Through Treatment ..... 4-8
4.2.6 Implementability ..... 4-8
4.2.7 Cost ..... 4-9
4.2.8 Community Acceptance ..... 4-9
4.3 RECOMMENDED ALTERNATIVE ..... 4-9

## LIST OF FIGURES

Figure 1-1 Site Location Map ..... 1-3
Figure 1-2 Site Plan ..... 1-4

## LIST OF TABLES

Table 1-1 Summary of Air Stripper Influent and Effluent Data ..... 1-7
Table 1-2 Location-Specific SCGs ..... 1-15
Table 1-3 Chemical-Specific SCGs ..... 1-16
Table 1-4 Action-Specific SCGs ..... 1-17
Table 1-5 To Be Considered (TBC) Guidance ..... 1-18
Table 2-1 Groundwater: Remedial Action Objectives, General Response Actions and Remedial Technologies ..... 2-3
Table 2-2 Groundwater: Initial Screening of Remedial Technologies ..... 2-4
Table 2-3 Groundwater: Site Specific Technology Screening ..... 2-6
Table 4-1 Comparative Analysis of Remedial Alternatives ..... 4-6
Table 4-2 Cost Estimate - Alternative 2: Continue the Existing System (No Further Action) ..... 4-10

# EXECUTIVE SUMMARY

This report represents the results of a Feasibility Study (FS) for the Gaess Environmental inactive hazardous waste site (Site) located in the Village of Harriman, New York. The purpose of the FS is to identify and analyze remedial alternatives that are protective of human health and the environment and attain, to the maximum extent practicable, applicable or relevant and appropriate requirements (ARARs) and New York State Standards, Criteria and Guidelines (SCGs). The FS was performed for Waste Management, Inc. (WMI) (formerly Chemical Waste Management, Inc.) by Rust Environment and Infrastructure, Inc. (Rust). The Site has been identified by the New York State Department of Environmental Conservation (NYSDEC) as a Class 2 State Superfund Site. The FS was conducted as part of a Consent Order agreement between WMI and the NYSDEC, dated February 14, 1994.

In June, 1980, wastes were discovered abandoned on the Site by a NYSDEC Task Force. These wastes were contained in two industrial tank truck trailers and various other waste containers. The containers, the wastes contained in them and suspected contaminated soils were removed from the Site in May through July of 1981 under the supervision of the NYSDEC. Hydrogeological investigations of the Site conducted in 1984, 1990 and 1991 concluded that two volatile organic compounds (VOCs), TCE and 1,1,1-TCA, were present in groundwater at the Site at concentrations which exceeded applicable NYSDOH Drinking Water Standards. It was further concluded that these contaminants were entering the public water supply through the Village community water supply well (MH-1) located across Meadow Road from the main Site area. In addition, some Site soils still contained residuals of these VOCs. Following a Consent Order agreement with the NYSDEC, Chemical Waster Management, Inc. (CWM) began the operation of a treatment system in May, 1992 to remove VOCs from groundwater entering the water supply well MH-1. The treatment system (an air stripper unit), which was constructed as an Interim Remedial Measure (IRM) to remain in operation through the completion of the FS, is still in operation today and continues to provide an effective means of removing VOCs from groundwater entering the water supply well.

Between May 1994 and April 1995, Rust performed a Remedial Investigation (RI) to identify the source of the impacted groundwater contamination and to evaluate potential exposures to human health and the environment. The results of the RI indicate that there is no significant risk to human health or the environment associated with groundwater, surface water, soil or sediment at the Gaess Site. RI data indicates that trace concentrations of site-related volatile organics (TCE and 1,1,1-TCA) are transported through groundwater and ultimately captured by Village well MH-1 as it is being pumped; these VOCs are then removed by the air stripper.

This conclusion of the RI, that there is no significant risk to human health or the environment associated with groundwater, surface water, soil or sediment at the Gaess Site, supports "no action" as an appropriate remedial alternative for the Site. However, since compounds probably originating in the former Gaess operation area are present in downgradient groundwater and concentrations of these compounds still slightly exceed chemical-specific SCGs, other potentially applicable remedial alternatives were evaluated for groundwater in accordance with NYSDEC requirements to assure that remedial action objectives are met.

Numerous remedial technologies were screened with respect to their applicability in addressing the nature of contamination at the Site. Remedial technologies determined to be applicable were developed into two remedial alternatives. These included a "No Action" alternative and a "No Further Action" alternative. The specifics of each alternative are as follows.

**Alternative 1: No Action**

Since pumping from water supply well MH-1 is considered an applicable remedial technology for the Site, the No Action Alternative is defined as discontinuing the use of MH-1 and taking no other action at the Site. The impacted groundwater would not be pumped and treated and concentrations of constituents in groundwater would not be monitored. The concentrations of TCE and 1,1,1-TCA in groundwater would be reduced through natural attenuation and degradation processes such as dilution, dispersion, adsorption and possibly biological and chemical degradation.

**Alternative 2: Continue the Existing System (No Further Action)**

Under this alternative, groundwater extraction and treatment would continue to be performed by the current system to meet public water supply needs and influent monitoring would be performed periodically to evaluate the conditions at the Site. As with Alternative 1, the concentrations of VOCs in groundwater would be reduced through natural attenuation and degradation processes as well as through treatment using the existing air stripper system.

The two remedial alternatives were evaluated in accordance with NYSDEC guidelines and with consideration given to community acceptance. Based on this evaluation the recommended remedial alternative for the Gaess Site is Alternative 2, Continue the Existing System (No Further Action). Although there is no significant risk to human health or the environment associated with groundwater at the Gaess Site, treatment is necessary to comply with drinking water standards required by the NYSDEC and NYSDOH for MH-1. Alternative 2 would be highly implementable at a reasonable cost and would be acceptable to the community as the source of local public water supply would not be interrupted and the existing system has a history of proven effectiveness. The costs associated with the continuance of Alternative 2 are reasonable.

# 1.0 INTRODUCTION

## 1.1 PURPOSE AND ORGANIZATION OF REPORT

This report represents the results of a Feasibility Study (FS) for the Gaess Environmental inactive hazardous waste site (Site) located in the Village of Harriman, New York. The FS was performed for Waste Management, Inc. (WMI) (formerly Chemical Waste Management, Inc.) by Rust Environment and Infrastructure, Inc. (Rust). The Site has been identified by the New York State Department of Environmental Conservation (NYSDEC) as a Class 2 State Superfund Site, site number 3-36-018. The FS was conducted as part of a Consent Order agreement between WMI and the NYSDEC, dated February 14, 1994.

The purpose of the FS is to identify and analyze remedial alternatives that are protective of human health and the environment and attain, to the maximum extent practicable, applicable or relevant and appropriate requirements (ARARs) and New York State Standards, Criteria and Guidelines (SCGs). Accordingly, the FS is based on objectives, methodologies, and evaluation criteria as generally set forth in the following Federal and State regulations and guidelines:

- the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) and the Superfund Reauthorization Act of 1986 (SARA);
- the National Oil and Hazardous Substances Contingency Plan (NCP);
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (US Environmental Protection Agency (EPA), October 1988);
- CERCLA Compliance with Other Laws Manual, 1988, OSWER Directive No. 9234.1-01 and -02;
- NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #HWR-89-4025 "Guidelines for RI/FSs";
- NYSDEC TAGM #HWR-90-4030 "Selection of Remedial Actions at Inactive Hazardous Waste Sites" ; and
- NYSDEC TAGM #HWR-89-4022 "Records of Decision for Remediation of Class 2 Inactive Hazardous Waste Disposal Sites".

The remainder of Section 1.0 contains background information about the Site, a brief summary of the scope of the Remedial Investigation (RI) and pertinent RI findings including the physical systems, nature and extent of contamination, and contaminant fate and transport. Section 2.0 identifies the remedial action objectives, general response actions, and candidate remedial technologies. Section 2.0 also presents the screening of the remedial technologies on the basis of effectiveness, technical implementability, and cost. In Section 3.0, the technologies are grouped into remedial alternatives, which are then screened to eliminate those that are not suitable. In Section 4.0,

a detailed analysis of the alternatives retained is presented, concluding with the identification and description of the recommended remedial alternative.

## 1.2 BACKGROUND INFORMATION

### 1.2.1 Description of the Gaess Site

The Site is located in the Village of Harriman, Orange County, New York. A Site Location Map is presented as Figure 1-1. The Site is located on Meadow Road, approximately one quarter mile west of New York State Highway 17, just southwest of the Ramapo River.

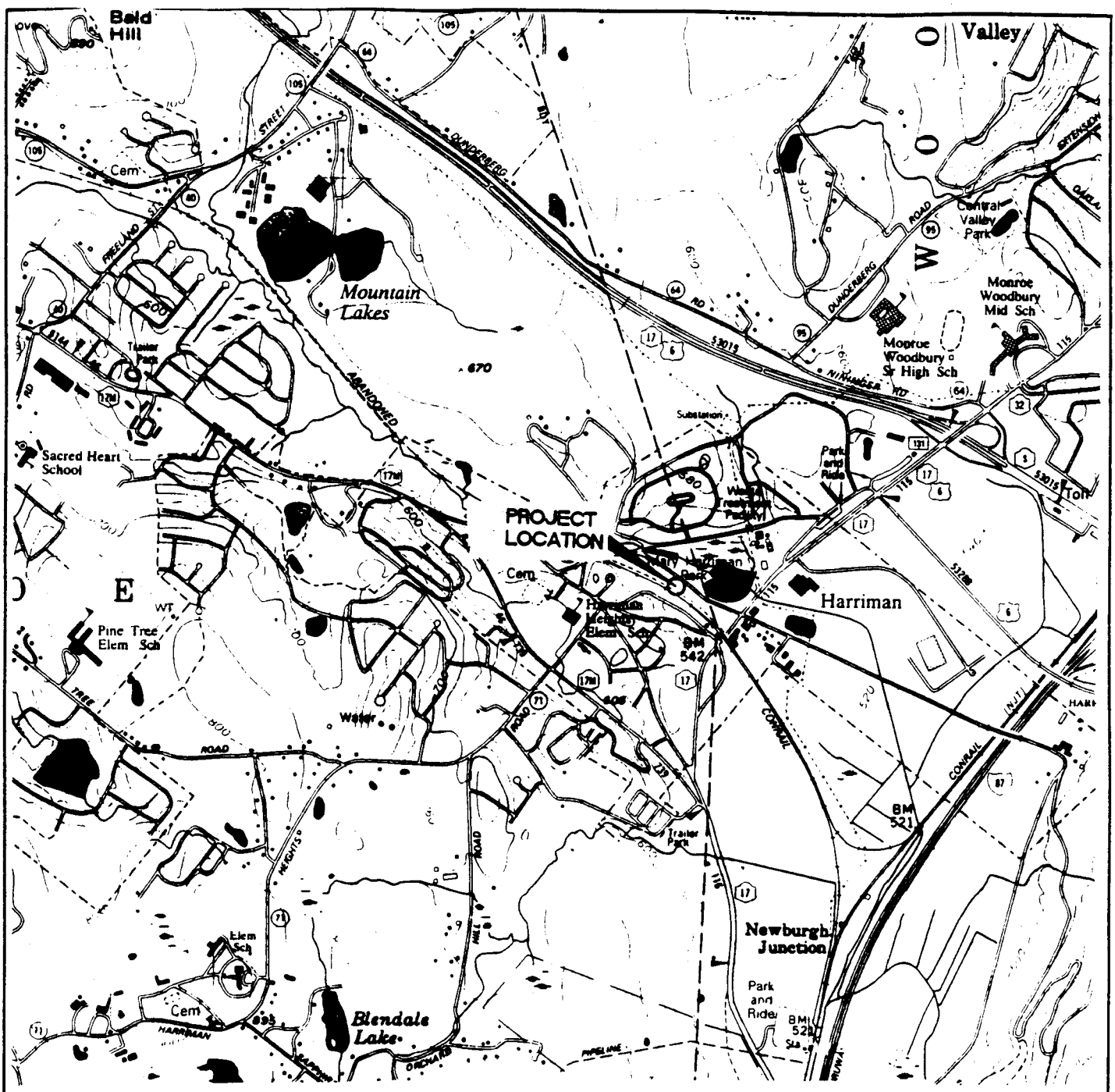
The Site consists of an approximate 4 acre parcel which extends along the north side of an inactive section of Consolidated Rail Corporation (Conrail) railroad spur. The Site is situated on a plateau which drops off rapidly to the northeast toward the Ramapo River. The topography rises rapidly to the southwest on the western side of the railroad spur. Based on past documentation and a review of historical aerial photographs, it is understood that previous site operations existed entirely on this plateau. A Site Plan is provided in Figure 1-2.

The property on which the Gaess Site is situated is owned by Conrail. The neighboring property immediately to the north, which is transected by Meadow Road and includes the flood plain, is owned by the Village of Harriman. This location serves as both a facility for the Department of Public Works and a Village recreational park. The Village of Harriman Department of Public Works (i.e., Water and Highway Departments) operate out of two maintenance buildings on the property and maintain two Village of Harriman water supply wells (Mary Harriman Wells MH-1 and MH-3) which are located near the center of the property. The Village recreation park, also known as the Mary Harriman Park, is located on the eastern side of the property and contains playgrounds, tennis courts, swimming areas and a Little League baseball diamond.

### 1.2.2 Site History

As described in Section 1.3 of the RI, in 1962, the Site was leased from the Erie-Lackawana Railroad (Conrail predecessor) by John Kalodziejski. Kalodziejski operated the Harriman Sewage Disposal Company at the Site until 1972 when he subleased the Site to Gaess Environmental Services (Gaess). Gaess and its successor, SCA Chemical Services (SCA), operated a waste handling transfer station on the Site until 1978. In June, 1980, wastes were discovered abandoned on the Site by a NYSDEC Task Force. These wastes were contained in two industrial tank truck trailers and various other waste containers. As a result of an investigation of the Site, an additional tank truck trailer, a vacuum tank truck and four 55-gallon drums were also discovered buried at the Site.

In April, 1981 a Consent Agreement was signed between SCA and NYSDEC. This agreement initiated a cleanup of the Site under the direction of the NYSDEC. The containers, the wastes contained in them and suspected contaminated soils were removed from the Site by SCA in May through July of 1981 under the supervision of the NYSDEC.




QUADRANGLE LOCATION

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
MONROE QUADRANGLE
NEW YORK-ORANGE CO.
7.5 MINUTE SERIES

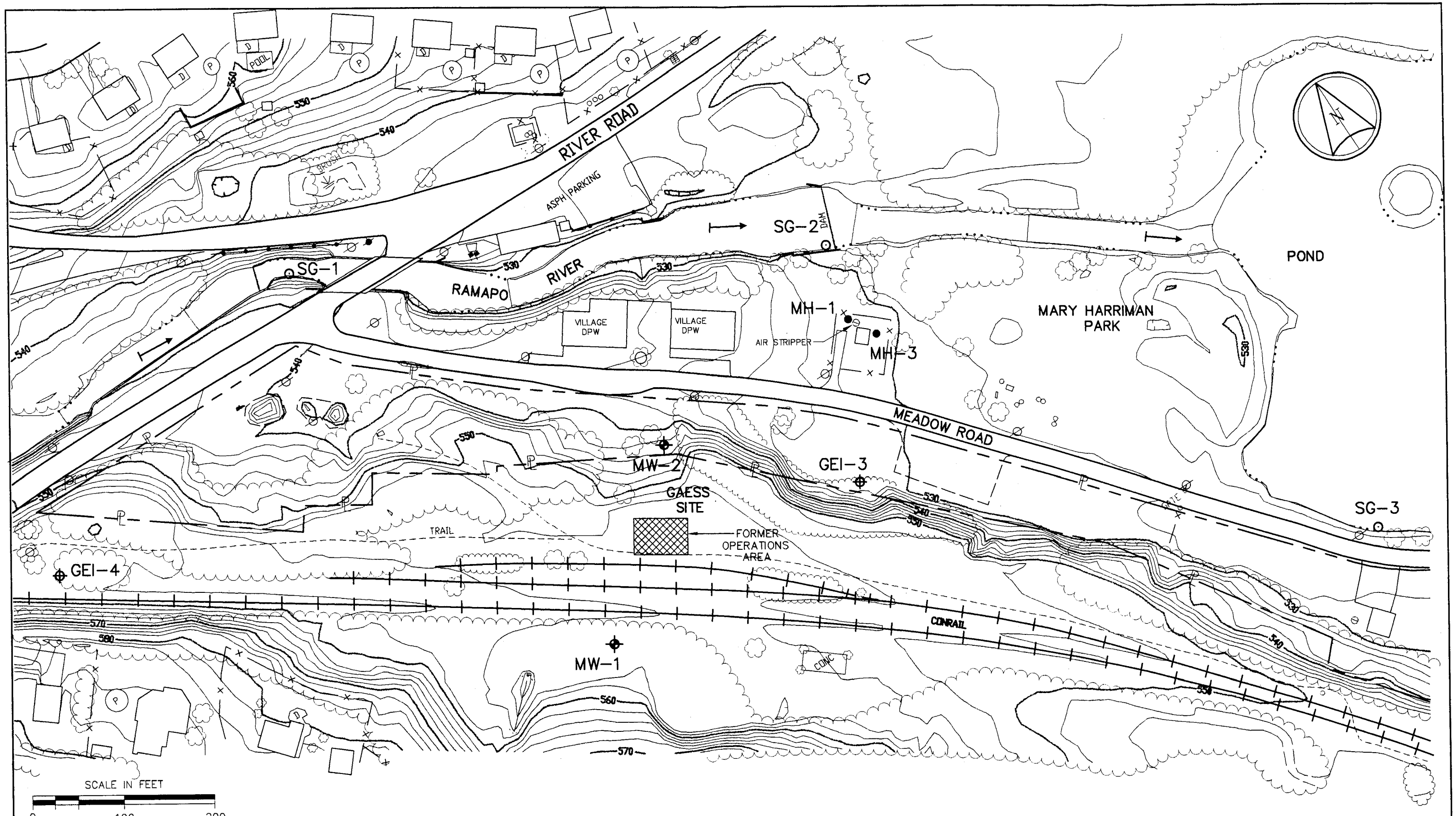
RUST ENVIRONMENT & INFRASTRUCTURE

# SITE LOCATION MAP

WASTE MANAGEMENT INC.
GAESS SITE RI / FS

| PROJECT No. 37673.209 | DATE 6/26/95 | DWG. No. 37673B1 | SCALE N.T.S. | FIGURE No. 1-1 |
|---|---|---|---|---|

DRAWING No. 37673B1.DWG




## LEGEND

- GEI-4 ⊕ EXISTING GEOMON SAMPLER (INSTALLED, 1984)
- MH-1 ● EXISTING VILLAGE WELL
- ⟶ SURFACE WATER FLOW DIRECTION
- MW-1 ⊕ MONITORING WELL (INSTALLED, 1995)
- SG-1 ⊙ RIVER STAFF GAUGE LOCATION

RUST ENVIRONMENT & INFRASTRUCTURE

# SITE PLAN

WASTE MANAGEMENT, INC
GAESS SITE RI /FS
VILLAGE OF HARRIMAN ORANGE COUNTY, NEW YORK

| PROJECT No. 37673.300 | DATE 2/7/96 | DWG. No. 37673-12 | SCALE 1"=100' | FIGURE No. 1-2 |
|---|---|---|---|---|

The drawings, specifications and other documents prepared by the Engineer for this project are instruments of the Engineer's service for use solely with respect to this project and,

PLOT DATE: 2/7/96

In 1984, SCA retained GeoEngineering, Inc. (GeoEngineering) to perform a site hydrogeological investigation which included the analysis of groundwater samples from the two Village of Harriman water supply wells (MH-1 and MH-3) and from two installed monitoring wells (Geomon Samplers™ GEI-3 and GEI-4). The results of this sampling, along with the results of the hydrogeological investigation, were documented in a report prepared by GeoEngineering, Inc. for CWM titled "Hydrogeological Investigation and Monitoring Plan" (GeoEngineering, 1985). This report was never approved by the NYSDEC. CWM became involved with the Site following the purchase of SCA in September, 1984.

Between October 1990 and July 1991, several phases of investigation were performed by various consultants for CWM and the Village of Harriman. These investigations included additional testing of the Village water supply wells, surface water samples from the Ramapo River, soil samples from around the former Site operations area and groundwater.

The conclusion of the investigations was that two volatile organic compounds (VOCs), TCE and 1,1,1-TCA, were present in groundwater at the Site at concentrations which exceeded applicable NYSDOH Drinking Water Standards. It was further concluded that these contaminants were entering the public water supply through the Village community water supply well (MH-1) located across Meadow Road from the main Site area. In addition, some Site soils were identified to contain residuals of these VOCs.

In December 1991, CWM and NYSDEC entered into an Order on Consent which required CWM to develop and construct, as an Interim Remedial Measure (IRM), a treatment system to remove VOCs from groundwater entering the Village of Harriman water supply well MH-1. CWM entered into a separate agreement with the Village of Harriman in December, 1991 which covers installation, operation and maintenance of the treatment system (an air stripper unit).

Between May 1994 and April 1995, Rust performed an RI to identify the source of the groundwater contamination and to evaluate potential exposures to human health and the environment. Soil gas and geophysical surveys were performed to characterize the subsurface soils, and a variety of environmental media were sampled for laboratory analysis. The scope and findings of the RI are discussed in further detail in Section 1.3.

### 1.2.3 Interim Remedial Measures

Two IRMs have been performed at the Site to date. The first of these included the removal of all tanks and contaminated soil during the Summer of 1981 under the direction of the NYSDEC. These activities were completed in compliance with the 1981 Consent Agreement between SCA and NYSDEC. The second IRM included the design, construction and operation of a treatment system (air stripper) for drinking water pumped from the Village of Harriman water supply well (MH-1) in accordance with the 1991 Order on Consent.

The IRM Order on Consent between the NYSDEC and CWM required CWM to develop and construct a treatment system for drinking water that would reduce the compounds of concern (COC) (i.e., TCE, 1,1,1-TCA) and their degradation products to a "non-detectable" level. The Order further

states that "non-detectable" shall mean a concentration for each constituent below 0.5 micrograms per liter (µg/l).

An air stripping system was designed for CWM by TERRA VAC (air stripping tower and related equipment) and SEC Donahue (concrete, plumbing and electrical work). The system was designed to meet the requirements of the Consent Order. The air stripper, an Aquifer Restoration Equipment (ARE) Air Stripper Model ARE-01-03-29/35, was installed in April, 1992, as specified in the Air Stripping Tower Engineering Report prepared by SEC Donohue, dated September, 1992. The air stripper is operated in accordance with the Instruction and Maintenance Manual prepared by TERRA VAC, dated May 21, 1992, attached as Appendix I to the Engineering Report.

Groundwater influent and effluent at the air stripper have been sampled on a quarterly basis since June, 1992. Influent samples are collected to monitor concentrations of VOCs in groundwater entering the air stripper. Effluent samples are collected as water exits the air stripper and are analyzed to confirm adequate removal of contaminants prior to the water entering the distribution system. Table 1-1 provides a summary of TCE and 1,1,1-TCA concentrations in the influent and effluent since June 10, 1992.

Thirteen (13) samples of influent to the air stripper, collected on a quarterly basis over the past three years (June, 1992 to August, 1995), indicated the presence of TCE at concentrations ranging from 2.6 µg/l to 6.9 µg/l. The highest concentration (6.9 µg/l) exceeded the NYSDOH Drinking Water Standard (5 µg/l) by only 1.9 µg/l. The average of the TCE concentration in all thirteen samples tested is 5.2 µg/l. The concentration of 1,1,1-TCA in the influent has consistently been well below the NYSDOH Drinking Water Standard of 5 µg/l since monitoring began, and was not detected in two of the last three samples analyzed. Based on this, the potential long-term health concerns from exposure to the volatile organic compounds in the groundwater entering the air stripper (influent), even prior to treatment, are minimal. Concentrations of VOCs in the treated effluent have been consistently non-detect confirming that the VOCs are being readily removed by the air stripper. Subsequent investigations at the Site (i.e., RI) have not detected any unusually high concentrations of TCE or 1,1,1-TCA that the air stripper cannot effectively remove. It is concluded therefore, that the air stripper that was installed as part of the 1991 IRM is satisfactorily removing all residual compounds of concern from groundwater.

## 1.3 SUMMARY OF GAESS REMEDIAL INVESTIGATION

### 1.3.1 Objectives and Scope of the RI

The RI was performed in accordance with the Consent Order to expand existing site data to: identify the source of the contamination; evaluate present and future potential risks to human health and the environment; and, provide the basis for a Feasibility Study. Several activities were performed during the RI to fulfill these objectives. These activities included the performance of soil gas and geophysical surveys and the collection and laboratory analysis of subsurface soil, groundwater, surface water and sediment samples. A detailed analysis of data generated from the RI as well as data obtained during previous investigations was performed to characterize Site hydrogeologic conditions and evaluate the nature and extent of contamination. In addition, human health and fish and wildlife evaluations were performed to assess potential present and future risks posed by the Site.

# Table 1-1
# Waste Management, Inc.
# Gaess Site RI/FS - Harriman, New York

Summary of Air Stipper Influent and Effluent Data

| Sample Date | Sample Number | INFLUENT TCA Result | INFLUENT TCE Result | EFFLUENT TCA Result | EFFLUENT TCE Result |
|---|---|---|---|---|---|
| Jun 10, 1992 | 112064-01 & 02 | 0.83 | 6.1 | ND | ND |
| Jan 12, 1993 | 119567-01 & 02 | 0.7 | 4.9 | ND | ND |
| Mar 12, 1993 | 121041-01 & 02 | 1 | 4.5 | ND | ND |
| Jun 1, 1993 | 124059-02 & 03 | 0.9 | 4.6 | ND | ND |
| Aug 9, 1993 | 127697-01 & 02 | 0.7 | 4.2 | ND | ND |
| Dec 5, 1993 | 131083-01 & 02 | 0.7 | 5.6 | ND | ND |
| Apr 4, 1994 | 134714-01 & 02 | 0.55 | 6.8 | ND | ND |
| Jun 2, 1994 | 137035-01 & 02 | 1.2 | 4.9 | ND | ND |
| Sep 7, 1994 | 140689-01 | 1.0 | 4.5 | NA | NA |
| Oct 6, 1994 | 141729-01 | NA | NA | ND | ND |
| Dec 1, 1994 | 143331-01 & 02 | ND | 2.6 | ND | ND |
| Mar 9, 1995 | 146445-01 & 02 | 0.6 | 6.1 | ND | ND |
| Jun 5, 1995 | 149300-01 & 02 | ND | 6.9 | ND | 1.0 * |
| Aug 14, 1995 | 152027-01 & 02 | ND | 6.2 | ND | ND |

NOTES: all results are specified in ug/l (ppb).
ND = not detected NA = Not Analyzed
* Discussions with the Village Water Department identified that the air stripper had not been "acid washed" since its installation in 1992. Following this procedure, an additional sample of effluent were analyzed to confirm proper removal.

### 1.3.2 RI Findings

The physical setting, nature and extent of contamination, and contaminant fate and transport are described below. Additionally the Human Health Evaluation and Ecological Assessment are summarized. Additional detail is provided in the Draft RI Report (Rust E&I, August, 1995).

#### 1.3.2.1 Physical Setting

*Site Geology*

The Draft RI indicates that the geologic materials at the Site are generally comprised of glacial drift, recent alluvial deposits associated with deposition along the Ramapo River, and man-made fill overlying lower Ordovician age limestone bedrock. The surface of the bedrock occurs at depths ranging from approximately 9 to 44 feet below ground surface in the vicinity of the Site. The bedrock surface slopes to the northeast from the Site generally toward the Village of Harriman water supply wells.

Overlying the bedrock is approximately 7 feet of glacial drift which incorporates both ice contact and glacial till materials composed of sand, gravel and clayey silt of varying densities. Recent alluvial deposits, associated with deposition along the floodplain of the Ramapo River, were observed in several of the borings, overlying the glacial drift. These deposits are composed primarily of layers of fine to medium sand with silt and clayey silt laminae. It is anticipated, based on subsurface soil samples, and on-site geomorphic conditions, that the alluvium extends laterally from the Ramapo River to the Site, where a thicker terrace of glacial drift is present. Fill materials were identified at nearly all soil boring locations. This unit consists primarily of reworked natural sediments including mostly coarse to fine sand with trace amounts of gravel and occasional clayey silt. Very little artificial matter was detected with the exception of occasional bricks and cinders in shallow sections. The thickness of fill ranges from 4 to 14 feet.

*Site Surface Water*

The principal surface water body identified in the vicinity of the Gaess Site is the Ramapo River. In the vicinity of the Site, the Ramapo River is characterized by man-made weir-controlled ponds. One such small pond is located just north of the Village of Harriman wells. A larger pond, that occupies approximately 4 ½ acres is located downstream of the Site. The Ramapo River flows in an easterly direction as it passes the Site before altering to a more southerly flow approximately 1000 yards downstream. The Harriman Waste Water Treatment Plant is situated approximately ¼ mile north of the Site and discharges its effluent to the downgradient pond.

Surface water runoff from precipitation flows from south to north across the Site onto the flat, low-lying, floodplain north of the Site where it infiltrates and recharges groundwater. Surface water from the Site most likely does not flow directly into the Ramapo River, except possibly during major storm events.

### *Site Groundwater*

Groundwater at the Site occurs both in the unconsolidated deposits and in bedrock. Groundwater within the bedrock is primarily stored in, and transmitted through, secondary porosity features such as joints, fractures and bedding plane separations within the bedrock. One of the Village water supply wells near the Site (MH-3) is a deep flowing artesian well that taps the bedrock aquifer and reportedly produces from fractures at depths between 470 and 530 feet below ground surface. The water in this well will flow to the ground surface after the well is shut down for an extended period of time. Based on this, and considering its depth, the deep bedrock unit is considered confined and not hydraulically connected with groundwater that may occur in either shallow bedrock horizons or the unconsolidated deposits.

The alluvium and glacial drift layers appear to be in direct contact and without an intervening confining layer. Based on this and the likely similarity of hydraulic conductivity, it is presumed that the glacial drift deposit at MW-2 is within the same hydrogeologic unit as the overlying alluvium. This hydrogeologic unit is under unconfined water table conditions. The saturated thickness of this unit at monitoring well MW-2 is approximately 20 feet. At MH-1, the saturated thickness is expected to increase mostly because of the greater depth to bedrock and overburden thickness. Recharge to the shallow overburden unit is almost entirely from precipitation which infiltrates the ground surface and percolates downward to the water table. Testing performed during the RI indicated that the average hydraulic conductivity for the glacial drift unit is approximately $2.6 \times 10^{-4}$ cm/sec (0.74 ft/day).

### *Village of Harriman Water Supply Wells*

Two Village of Harriman public water supply wells are located on the floodplain, approximately 350 feet northeast of the Gaess Site former main operations area. It is reported that Village well MH-1 produces water from a sand and gravel aquifer. Village well MH-3 is a deep bedrock well under confined artesian conditions. According to the Village Water Department, well MH-1 is 54 feet deep with an 8 foot long (8 inch diameter) screen at the base. The well historically has been used as a backup well during periods of high demand in summer months. Since the air stripper was installed on this well in 1992, the well has operated full time with the exception of two periods. From January to April, 1994 the well was shut down because the air stripper froze as a result of below normal temperatures. The well was again shut down from the beginning of April to the middle of May, 1994 for maintenance. When operating, well MH-1 pumps continuously (24 hours a day) and produces a sustained yield of approximately 75 gallons per minute.

### *Groundwater Flow*

The groundwater contour maps (Figures 4-1 and 4-2 of the RI) show that the direction of groundwater flow in the immediate vicinity of the Site is not influenced to any significant degree by the pumping of Village well MH-1. Under both pumping and non-pumping conditions, groundwater from the location of the former buried tank and former main site operations area flows in a easterly direction, towards monitoring well MW-2, and then to the southeast towards Village well MH-1. Considering that the capture zone from MH-1 extends laterally to GEI-3, as indicated by water level

monitoring results, groundwater along this flow path appears to be captured by well MH-1. Under non-pumping conditions, groundwater in the water table aquifer will continue to flow to the southeast, parallel to the river. This analysis confirms that monitoring well MW-2 is in an effective location to serve as a monitoring point for groundwater leaving the potential former source area.

The average horizontal groundwater flow velocity from the former buried tank to monitoring well MW-2 is estimated to range between 0.09 and 0.14 ft/day. At these flow velocities, the travel time along this flow path will range between 2.0 and 3.1 years. The average flow velocity from monitoring well MW-2 to Village well MH-1 is estimated to range between 0.12 and 0.18 ft/day when the Village well is pumping, and between 0.03 and 0.04 ft/day when MH-1 is not pumping. Conservatively estimating that MH-1 is not pumped an average of 10% of the time, the travel time from MW-2 to MH-1 is estimated to range between 4.1 and 6.2 years. The travel time from the former buried tank and main Site operations area to Village Well MH-1 is estimated to range between 6.1 years and 9.3 years.

#### 1.3.2.2 Nature and Extent of Contamination

Chemical constituents detected during the RI sampling activities include low levels of volatile organic compounds (VOCs), including PCE, 1,1,1-TCA, TCE and also petroleum hydrocarbons including toluene and C4-C9 cycloalkanes/alkenes. These constituents have been detected in either soil gas or subsurface soils.

##### *Soil Gas*

TCE, PCE and petroleum hydrocarbons including toluene and C4-C9 cycloalkanes/alkenes were detected with the Petrex™ soil gas survey. Inconsistencies between the soil gas sample results and historical groundwater analytical results likely indicate that the soil gas results are more reflective of shallow soil quality than of groundwater quality.

##### *Subsurface Soil*

Analytical results of subsurface soil samples collected in the vicinity of the former buried tank and main operations area did not detect any significant concentrations of Site contaminants of concern. VOCs were not detected in three of the eleven soil samples collected. Low part per billion levels of TCE and PCE were detected in the remaining samples. No other VOCs were detected in soil samples. Inorganic analytes were detected in soil samples at concentrations that are consistent with elemental concentrations shown to naturally occur in soil.

##### *Surface Water and Sediment*

Three surface water and three sediment samples were analyzed for the NYSDEC TCL volatile organic compounds and cyanide. The volatile organic compounds that have been detected at the Site (TCE, PCE and TCA) were not detected in any of the three surface water or sediment samples, indicating that the Site has not had an impact on surface water or sediment quality in the Ramapo River.

***Groundwater***

No VOCs were detected during the RI in the analysis of groundwater samples collected from monitoring wells MW-1 (upgradient well) or MW-2 (downgradient well). Concentrations of inorganic analytes were detected at similar levels in both groundwater samples indicating inorganics are not a Site contaminant of concern.

During previous investigations, low levels of TCE and 1,1,1-TCA were detected in groundwater sampled downgradient of the Site and in the influent to the air stripper at Village well MH-1.

### 1.3.2.3 Contaminant Fate and Transport

All environmental analytical data that have been collected at the Gaess Site were evaluated during the RI for the purpose of identifying Site contaminants of concern and characterizing their fate and transport. The environmental data collected at the Gaess Site indicate that the potential compounds of concern are the following volatile organics: TCE, PCE, 1,1,1-TCA, toluene and xylenes. Site analytical data indicate that these compounds were detected in subsurface soils with TCE being detected at the highest concentrations. Two of these compounds detected in soil, TCE and 1,1,1-TCA were also detected during previous investigations in groundwater sampled downgradient of the Site and in the influent to the air stripper at Village well MH-1. Analytical data gathered to date has indicated that subsurface soil and groundwater are the only media that have been impacted. Discussion of groundwater flow conditions presented in Section 4.0 of the RI indicate that groundwater emanating from the Site does not discharge to the Ramapo River during pumping of well MH-1. Consequently there are no feasible transport mechanism by which Site related contaminants pose a potential for future impact to the river. The following sections discuss the fate and transport of chemicals detected at the Site in soil and in groundwater.

***Subsurface Soil***

The relatively high solubility and low partition coefficient values (Koc and Kow) for TCE and 1,1,1-TCA indicate that they will be highly mobile in soil and will exhibit a tendency to leach to groundwater. This is consistent with the detection of both TCE and 1,1,1-TCA in both subsurface soils on the Site and in groundwater at locations downgradient of the Site.

It is probable that Site remedial activities performed in 1981 were successful in removing significant soil contamination, if it were present. Furthermore, in the 14 years since soils were excavated and removed from the Site, any residual concentrations of VOCs in these areas would have diminished through volatilization and leaching to groundwater, due to their high volatility and water solubility. The subsurface soil and analytical results support this rationale and indicate that there are no significant sources of groundwater impact from the Site.

***Groundwater***

Certain VOCs reached groundwater by leaching processes due to their relatively high solubility and low Koc and Kow as discussed above. RI data indicates that VOCs reached groundwater in a

dissolved state, below their solubility limits. In the dissolved state, VOCs are transported with groundwater flow, at trace concentrations, in solution. The VOCs will be transported, easterly, in the direction of groundwater flow, to the floodplain and then shifting to a more southeasterly direction, parallel to the Ramapo River. Ultimately, dissolved VOCs are captured by Village well MH-1 as it is being pumped; these VOCs are then removed by the air stripper.

Following source removal, VOC concentrations will begin to diminish in the aquifer through volatilization and abiotic and biotic degradation. Natural attenuation of VOCs may begin at the former source area and proceed in a downgradient direction as remaining molecules are transported via groundwater flow.

This scenario is supported by the groundwater analytical result of downgradient monitoring well MW-2 which did not indicate the presence of any detectable VOCs. The groundwater flow velocities and travel times calculated for the flow path from the former buried tank to monitoring well MW-2 support this condition as well. The travel time along this flow path is estimated to range between 2.1 and 3.0 years. As a conservative measure, it is assumed that migration of residual VOCs may be retarded and take as much as 4 times longer than groundwater to migrate, due to both flushing of compounds during seasonal fluctuations in the water table and sorptive processes. This results in an estimated travel time of 12 years for the VOC plume to complete its downgradient migration beyond well MW-2. Considering that it has been 14 years since the remedial actions were taken on the Site, it appears likely that any residual VOCs in groundwater would have migrated beyond this monitoring well.

#### 1.3.2.4 Human Health Evaluation

The Human Health Evaluation (HHE) characterized the potential for human exposure and the possibility of health effects associated with exposure to compounds of concern (COCs) at the Site. The COCs developed for use in the HHE are as follows:

COCs for groundwater:
- 1,1,1-Trichloroethane
- Trichloroethene

COCs for Site soils:
- Tetrachloroethene
- Toluene
- 1,1,1-Trichloroethane
- Trichloroethene
- Xylenes

An evaluation of previous Site investigation, RI, and exposure assessment data indicates that there are no current exposures to impacted media at the Site. Based on numerous conservative evaluations of these data and the characteristics of the Site, the potential future exposure points and pathways were considered to be: 1) the ingestion and household use of impacted groundwater by future Site residents; and, 2) the direct contact with Site subsurface soils by future Site residents.

The Human Health Evaluation utilized conservative assumptions in the analysis of the current and potential future exposure pathways. Under those assumptions, potential exposure to soils and groundwater by current and future residents are not expected to pose a long-term health concern. The chemical-specific hazard quotients (HQs) for the potential exposure scenarios were below 1.0, indicating no noncarcinogenic toxic effects. The carcinogenic risks for the exposure scenarios evaluated quantitatively did not exceed the USEPA risk level of $10^{-6}$. Estimated excess cancer risks above the lower end of the $10^{-6}$ to $10^{-4}$ range referenced in the National Contingency Plan (NCP) (USEPA, 1990b) were not observed for any of the potential exposure pathways evaluated in the HHE, confirming no risk for the Site.

#### 1.3.2.5 Ecological Assessment/Fish and Wildlife Impact Analysis

Recent inquiries to the United States Fish and Wildlife Service (USFWS) and the NYSDEC indicated that there are no known occurrences of Federal or State listed endangered or threatened wildlife or plant species located within a two mile radius of the Site. The available analytical data indicate that the Site does not represent a threat to aquatic life in the Ramapo River, or to terrestrial life that may potentially utilize the poor habitats located on the Site or that may be exposed to Ramapo River sediments, surface water or aquatic life. Thus, data indicates that further evaluation is not necessary and a toxic effects analysis and Steps IV and V of the NYSDEC Fish and Wildlife Impact Analysis (FWIA) are not required.

## 1.4 NYS STANDARDS, CRITERIA AND GUIDELINES

Applicable or relevant and appropriate requirements (ARARs) [as defined in Section 121(d) of CERCLA (P.L.96-510), as amended by SARA (P.L.99-499)], are any Federal or State standard, requirement, criteria, or limitation that is legally applicable to the contaminants of concern or which is relevant and appropriate under the circumstances of the contaminant release or threatened release. Section 121(d) of CERCLA, as amended by SARA, establishes standards that govern the degree of cleanup required at a site. The selected remedial measure must attain a level or standard of control that satisfies ARARs except under certain conditions.

New York State, in 6 NYCRR Part 375, has developed rules for activities at inactive hazardous waste sites which are not inconsistent with the CERCLA requirements. A remedial alternative must conform with NYS Standards, Criteria and Guidelines (SCGs) that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate. NYS SCGs include Federal ARARs.

The potential SCGs are identified in the sections below and summarized on the associated tables. SCGs may be specific to either the site location, the contaminants present, or the remedial actions planned. In addition, State and Federal guidance documents and other unpromulgated criteria are "to be considered" (TBC) and can be used to aid in the evaluation and selection of a remedial alternative. TBCs are also discussed below.

### 1.4.1 Location-Specific SCGs

Location-specific SCGs, which relate to requirements for wetlands protection, floodplain management, fish and wildlife conservation, and historic preservation apply to remedial alternatives within specific geographical locations. Potential location-specific SCGs and their applicability to the Site are identified in Table 1-2.

Chemical-specific SCGs are Federal or State standards (promulgated by regulation) or health/risk-based numerical values that are used to establish acceptable amounts or concentrations of constituents allowed in the environment. Sources of promulgated standards and criteria for groundwater are identified on Table 1-3.

### 1.4.3 Action-Specific SCGs

Action-specific SCGs apply to specific treatment and disposal activities and may set controls or restrictions on the design, performance and implementation of the remedial actions taken at a site. For example, RCRA requirements would be applicable if the remediation constitutes treatment, storage or disposal of a hazardous waste as defined under RCRA. Other examples of action-specific requirements are Clean Water Act standards for discharge of treated groundwater and New York State regulations 6 NYCRR Part 703, which establish surface water and groundwater quality standards and groundwater effluent standards.

Table 1-4 identifies the action-specific SCGs that are potentially applicable to the Gaess Site. Since action-specific SCGs apply to discrete remedial activities, their evaluation is presented with the detailed analysis of alternatives for each retained alternative. In addition, if a technology is used that may result in emissions of compounds into the air, emissions must comply with Federal and State air quality standards.

### 1.4.4 Potential TBC Guidance

There are instances when promulgated SCGs do not exist for a particular chemical or remedial action. In these instances, other State and Federal criteria, advisories and guidance may be used to aid in the evaluation and selection of a remedial alternative for a site. The "to be considered" TBC guidance or advisories that may be relevant to the Gaess Site are identified on Table 1-5.

## 1.5 FOCUS OF THE FEASIBILITY STUDY

The results of the RI, including the baseline Human Health Evaluation and Ecological Assessment, indicate that there is no significant risk to human health or the environment associated with groundwater, surface water, soil or sediment at the Gaess Site. This conclusion supports "no action" as an appropriate remedial alternative for the Site. However, since compounds probably originating in the former Gaess operation area are present in downgradient groundwater and concentrations of these compounds occasionally exceed chemical-specific SCGs, other potentially applicable remedial alternatives will be evaluated for groundwater in accordance with NYSDEC requirements to assure that remedial action objectives are met.

## Table 1-2

## Location-Specific SCGs*
## Gaess Site

| Requirement | Synopsis | Application |
|---|---|---|
| **STATE:** | | |
| Use and Protection of Waters (6 NYCRR Part 608; ECL 15-0501 and 15-0505) | Under this regulation, a permit is required to change, modify, or disturb any protected stream, its bed or banks, sand, gravel, or any other material; or to excavate or place fill in any of the navigable waters or in any marsh, estuary or wetland, contiguous to any of the navigable waters of the State. | Potentially applicable. If disturbance of the Ramapo River is required as part of the remedy, a permit from the NYSDEC may be required. |
| New York State Ambient Water Quality Standards (6 NYCRR Parts 700-705) | Defines surface water and aquifer classification and lists specific chemical standards. | Applicable. Classifications and standards can be used to help establish remedial cleanup goals. |
| Endangered and Threatened Species of Wildlife (6 NYCRR Part 182) | Site activities must minimize impact on identified endangered or threatened species of fish or wildlife. | Not applicable. No endangered or threatened wildlife or plant species have been identified within a 2 mile radius of the Site. |
| **FEDERAL:** | | |
| Clean Water Act, Section 404(b)(1)/U.S. Army Corps of Engineers Nationwide Permit Program (33 CFR 330) | Activities involving the construction or alteration of bulkheads, dikes, or navigable waters, including wetlands, are regulated by the Corps of Engineers. | Potentially applicable for activities related to the Ramapo River. |
| Fish and Wildlife Coordination Act (16 USC 662) | Any action that proposes to modify a body of water or wetland requires consultation with the U.S. Fish and Wildlife Service. | Potentially applicable if the Ramapo River is affected by a remedial action at the Site. |
| Endangered Species Act (50 CFR 200, 402) | Site activities must minimize impacts on identified endangered plant and animal species. | Not applicable. No endangered or threatened wildlife or plant species have been identified within a 2 mile radius of the Site. |

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* Local zoning ordinances and building codes may be applicable but are not listed. These will be evaluated further based on the selection of the Final Remedy.

## Table 1-3

## Chemical-Specific SCGs
## Gaess Site

| Requirement | Synopsis | Application |
|---|---|---|
| **STATE:** | | |
| NYSDEC Quality Standards for Groundwater (6 NYCRR Part 703) | Establishes standards for Class GA groundwater. | Applicable to groundwater in overburden/bedrock deposits. |
| NYS Surface Water Quality Standards and Discharge Limitations (6 NYCRR Parts 701, 702, and 704) | Establishes standards for surface water quality. | Applicable to surface waters of New York (i.e., Ramapo River). |
| NYSDOH Public Water Systems (10 NYCRR Part 5,Subpart 5-1) | Establishes maximum contaminant levels for drinking water. | Applicable to drinking waters. |
| **FEDERAL:** | | |
| Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (40 CFR 141.11-.16) | Enforceable standards for public drinking water systems. | Applicable to finished drinking water delivered to the consumer. |
| Effluent Limitations (40 CFR Part 301 and 302) | Enforceable standards for effluent discharges. | Applicable to liquid discharges from the Site. |

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Note: If RCRA hazardous wastes are identified on site, the appropriate RCRA requirements will be followed.

# Table 1-4

## Action-Specific SCGs
## Gaess Site

| | |
|---|---|
| FEDERAL | • CWA (Clean Water Act) - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125);<br>• CWA Discharge to Publicly-Owned Treatment Works (POTW) (40 CFR 403);<br>• Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926); and<br>• Underground Injection Control (UIC) Program (40 CFR Part 144). |
| STATE | • New York State Pollution Discharge Elimination System (SPDES) Requirements (Standards for Storm Water Runoff, Surface Water, and Groundwater Discharges) (6 NYCRR 750-757);<br>• New York State regulations regarding water quality standards and discharge limitations (6 NYCRR Parts 700 - 703);<br>• New York State Sanitary Code, Chapter 1, Subpart 5.1, which regulates public water supplies; and<br>• New York State Air Emission Requirements (VOC Emissions for Air Strippers and Process Vents, General Air Quality) (6 NYCRR Parts 200-212). |

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# Table 1-5

## To Be Considered (TBC) Guidance
## Gaess Site

| | |
|---|---|
| FEDERAL | • USEPA Office of Science and Technology, Interim Guidance on Interpretation and implementation of Aquatic Life Criteria for Metals;<br>• Safe Drinking Water Action National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs);<br>• Proposed Maximum Contaminant Levels (50 Federal Register 46936-47022);<br>• Proposed Federal Air Emission Standards for Volatile Organic Control Equipment (52 Federal Register 3748) (air stripper controls);<br>• USEPA Drinking Water Health Advisories;<br>• USEPA Health Effects Assessment (HEAs);<br>• TSCA Health Data;<br>• Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service;<br>• Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 9016);<br>• Cancer Assessment Group (National Academy of Science Guidance);<br>• Groundwater Classification Guidelines;<br>• Groundwater Protection Strategy;<br>• Waste Load Allocation Procedures;<br>• USEPA Soil Screening Guidance (EPA/540/R-94/101);<br>• Fish and Wildlife Coordination Act Advisories; and<br>• Executive Order 11990, "Protection of Wetlands". |
| STATE | • TAGM 4046, Determination of Soil Cleanup Objectives and Cleanup Levels, January 1994;<br>• NYSDEC, Spill Technlology and Remediation Series (STARS) Memorandum No. 1, Petroleum-Contaminated Soil Guidance Policy, August 1992;<br>• NYS Division of Fish and Wildlife, Technical Guidance for Screening Contaminated Sediments, November 1993;<br>• NYS Underground Injection/Recirculation at Groundwater Remediation Sites (Technical Operating Guidance Series (TOGS) 7.1.2);<br>• New York State Analytical Detectability for Toxic Pollutants;<br>• New York State Toxicity Testing for the SPDES Permit Program (TOGS 1.3.2);<br>• New York State Regional Authorization for Temporary Discharges (TOGS 1.6.1);<br>• New York State Air Guidelines for the Control of Toxic Ambient Air Contaminants (Air Guide 1);<br>• Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites (TAGM 4031);<br>• Selection of Remedial Actions at Inactive Hazardous Waste Sites (TAGM 4030); and<br>• Technical Guidance for Regulating and Permitting Air Emissions from Air Strippers, Soil Vapor Extraction Systems and Cold-Mix Asphalt Units (Air Guide 29) . |

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# 2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

## 2.1 INTRODUCTION

This section identifies the remedial action objectives, general response actions, and remedial technologies for groundwater at the Gaess Site. A wide range of remedial technologies are identified as potentially capable of meeting the remedial action objectives. Each remedial technology is evaluated, and the most appropriate technologies are retained for use in developing remedial action alternatives for the Site.

## 2.2 REMEDIAL ACTION OBJECTIVES

Remedial action objectives for the Site are developed based on the constituents of concern, media of concern, identified exposure pathways, and potential receptors identified in the RI. The remedial action objectives provide for protection of human health and the environment. They have been selected to minimize or reduce to target levels, the potential for human exposure to or environmental damage due to the presence or migration of site-related contaminants. The site-specific remedial action objectives for groundwater are as follows:

- Prevent ingestion of groundwater with concentrations of site-related constituents (TCE and 1,1,1-TCA) above current New York State groundwater standards.
- Prevent ingestion of groundwater with concentrations of site-related VOCs that pose an unacceptable risk to human health (total excess cancer risk greater than $1x10^{-4}$ or having a non-carcinogenic hazard index greater than 1).
- Prevent further migration of the groundwater plume containing site-related VOCs.
- Restore groundwater quality so that concentrations of site-related VOCs in the water bearing zone are reduced to current New York State groundwater standards.

## 2.3 GENERAL RESPONSE ACTIONS

General response actions are actions that individually or in combination will satisfy the remedial action objectives. The general response actions selected for groundwater at the Gaess Site are identified below.

- no action
- institutional controls
- containment
- collection, treatment, and discharge

## 2.4 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

NYSDEC TAGM 4030 recommends screening alternative remedial technologies using the criteria of effectiveness and implementability (NYSDEC, 1989). In this section, a broad range of remedial technologies is identified and screened to eliminate from further consideration those technologies and processes that may be of limited effectiveness or may not be able to be implemented at the Site. The purpose of this screening is to better focus the FS on those technologies that can be implemented at the Site with the greatest effectiveness.

Potentially applicable remedial technologies are identified for groundwater to satisfy each of the general response actions specified in Section 2.3. The remedial action objectives, general response actions, and remedial technologies are identified on Table 2-1. These remedial technologies are evaluated based on site-specific information and are screened initially for technical applicability. Technologies are considered applicable if, either individually or in combination, they would achieve the remedial action objectives. Table 2-2 provides the results of the initial screening of the remedial technologies, including the technical justification for eliminating technologies from further consideration.

Those technologies retained after the initial screening are further evaluated/screened based on effectiveness and implementability. The anticipated effectiveness of a technology refers to the ability of that technology to contribute to a remedial program that is protective of human health and the environment, and capable of meeting the stated remedial action objectives. In assessing the effectiveness of each technology, the demonstrated successful performance of each technology is considered. Implementability is the feasibility and the ease with which the technology can be applied at the Site. Implementability takes into consideration such practical factors as:

- Are the hazardous substances present at the Site compatible with the technology?
- Is there sufficient room at the Site to install and/or operate the technology?
- Is the use of the technology compatible with surrounding land uses?
- Will application of the technology unacceptably interfere with other ongoing uses of the Site?
- What permitting and other regulatory requirements apply to use of the technology?
- Does the technology require resources of a type or in a quantity that is not readily available at the Site?
- Are there experienced contractors that can provide, install, and operate the technology?

During this secondary phase of the screening process, the relative costs of the alternative technologies are also considered. Tables 2-3 presents the results of the second level of screening for groundwater.

# Table 2-1
## Groundwater: Remedial Action Objectives, General Response Actions and Remedial Technologies
## Gaess Site

| Environmental Media/ Remedial Action Objectives | General Response Action | Remedial Technology | Process Options |
|---|---|---|---|
| Groundwater<br>• Prevent ingestion of groundwater with concentrations of site-related constituents (TCE and 1,1,1-TCA) above current New York State groundwater standards.<br>• Prevent ingestion of groundwater with concentrations of site-related VOCs that pose an unacceptable risk to human health (total excess cancer risk greater than $1x10^{-4}$ or having a non-carcinogenic hazard index greater than 1).<br>• Prevent further migration of the groundwater plume containing site-related VOCs.<br>• Restore groundwater quality so that concentrations of site-related VOCs in the water bearing zone are reduced to current New York State groundwater standards. | No Action | Non-technology based | Non-technology based |
| | Institutional Controls | Access Restrictions (Non-technology based) | Deed Restrictions |
| | | Alternate Water Supply | Altern. Water Supply Well |
| | | | New Community Well |
| | | Monitoring | Groundwater Monitoring |
| | Collection | Extraction | Extraction Wells |
| | | | Extraction/Injection Wells |
| | | Subsurface Drains | Interceptor Trenches |
| | Discharge | Onsite Discharge | Local Surface Water Body |
| | | | Recharge (Reinjection/Infiltration) |
| | | | Stormwater System |
| | | | Sanitary System |
| | | Offsite Discharge | Deep Well Injection |
| | | | POTW |
| | Containment | Extraction | Extraction Wells |
| | | Subsurface Drains | Interceptor Trench |
| | | Cap | Clay, Asphalt or Concrete |
| | | | Multimedia Cap |
| | | Vertical Barriers | Slurry Wall |
| | | | Grout Curtain |
| | | | Vibrating Beam |
| | | Horizontal Barriers | Grout Injection |
| | | | Block Displacement |
| | Treatment | Biological treatment | Aerobic |
| | | | Anaerobic |
| | | Physical/Chemical Treatment | Precipitation |
| | | | Stripping |
| | | | Carbon Adsorption |
| | | | Oxidation |
| | | | Reverse Osmosis |
| | | | Ion Exchange |
| | | Offsite Treatment | POTW |
| | | | RCRA Facility |
| | | In Situ Treatment | Bioremediation |
| | | | Air Sparging |
| | | | Permeable Treatment Beds |
| | | | Chemical Reaction |

# Table 2-2
## Groundwater: Initial Screening of Remedial Technologies
## Gaess Site

| General Response Action | Remedial Technology | Process Options | Description | Screening Comments |
|---|---|---|---|---|
| No Action | Non-technology Based | Not Applicable | No action is taken. | Potentially Applicable |
| Institutional Actions | Access Restrictions (non-technology based) | Deed Restrictions | Deeds would include restrictions on groundwater use, as appropriate | Potentially Applicable |
| | Alternate Water Supply | Alternate Water Supply Well | Extension of alternate existing municipal well systems to serve residents in the Site area | Potentially Applicable |
| | | New Community Well | New uncontaminated wells to serve residents in the area of influence | Potentially Applicable |
| | Monitoring | Groundwater Monitoring | Ongoing Monitoring of Wells | Potentially Applicable |
| Collection | Extraction | Extraction Wells | Series of wells to extract contaminated groundwater | Potentially Applicable |
| | | Extraction/Injection wells | Injection wells inject uncon-taminated water to increase flow to extraction wells | Potentially Applicable |
| | Subsurface Drains | Interceptor Trenches | Perforated pipe in trenches backfilled with porous media to collect contaminated water | Potentially Applicable |
| Discharge | On-site Discharge | Local Surface Water Body | Extracted water discharged to local surface water body | Potentially Applicable |
| | | Recharge (Reinjection/Infiltration) | Extracted water discharged to on-site through reinjection/infiltration. | Potentially Applicable |
| | | Stormwater System | Extracted water discharged to on-site stormwater system | Potentially Applicable |
| | | Sanitary System | Extracted water discharged to on-site sanitary system | Potentially Applicable |
| | Off-site Discharge | Deep Well Injection | Extracted water discharged to deep well injection system | Not Applicable. Deep aquifer not suitable for injection of contaminated water. |
| | | POTW | Extracted water discharged to local POTW for treatment | Potentially Applicable |
| Containment | Extraction | Extraction Wells | Recovery wells pumped to extract groundwater and hydraulically contain flow | Potentially Applicable |
| | Subsurface Drains | Interceptor Trenches | Perforated pipe in trenches backfilled with porous media to collect groundwater and hydraulically contain flow | Potentially Applicable |
| | Cap | Clay and Soil | Compacted clay, asphalt or concrete over areas of contamination | Not applicable due to large size of site and lack of significant groundwater contamination source |
| | | Multimedia Cap | Clay and synthetic membrane covered by soil over areas of contamination | Not applicable due to large size of site and lack of significant groundwater contamination source |
| | Vertical barriers | Slurry Wall | Trench around areas of con-amination is filled with a soil (or cement) bentonite slurry | Potentially Applicable |
| | | Grout curtain | Pressure injection of grout in a regular pattern of drilled holes | Potentially Applicable |
| | | Vibrating Beam | Force to advance beams into the ground with injection of slurry as beam is withdrawn | Potentially Applicable |
| | Horizontal Barriers | Grout Injection | Pressure injection of grout at depth through closely spaced drilled holes | Not applicable due to large size of site and lack of significant groundwater contamination source |
| | | Block Displacement | In conjunction with vertical barriers, injection of slurry in notched injection holes. | Not applicable due to large size of site and lack of significant groundwater contamination source |

# Table 2-2
## Groundwater: Initial Screening of Remedial Technologies
## Gaess Site

| General Response Action | Remedial Technology | Process Options | Description | Screening Comments |
|---|---|---|---|---|
| Treatment | Biological Treatment | Aerobic | Degradation of organics using microorganisms in an aerobic environment | Not applicable; existing air stripper is proven effective; adding this technology would unduly complicate existing system |
| | | Anaerobic | Degradation of organics using microorganisms in an anaerobic environment | Not applicable; existing air stripper is proven effective; adding this technology would unduly complicate existing system |
| | Physical/Chemical Treatment | Precipitation | Alteration of chemical equilibria to reduce solubility of the contaminants | Not applicable to organic contaminants found in groundwater at the site |
| | | Stripping | Mixing large volumes of air with water in a packed column or shallow trays to promote transfer of VOCs to air | Potentially Applicable |
| | | Carbon Adsorption | Adsorption of contaminants onto activated carbon by passing water through carbon column | Potentially Applicable |
| | | Oxidation | Dissolved organic contaminants are destroyed using chemical or thermal (supercritical) oxidation | Not applicable; existing air stripper is effective; adding this technology would unduly complicate existing system |
| | | Reverse Osmosis | Use of high pressure to force water through a membrane leaving contaminants behind | Not applicable to organic contaminants |
| | | Ion Exchange | Contaminated water is passed through a resin bed where ions are exchanged between resin and water | Not applicable; existing air stripper is proven effective; adding this technology would unduly complicate existing system |
| | Off-site Treatment | POTW | Extracted groundwater discharged to local POTW for treatment | Potentially Applicable |
| | | RCRA Facility | Extracted groundwater discharged to licensed RCRA facility for treatment and/or disposal | Potentially Applicable |
| | In Situ Treatment | Bioremediation | System of injection and extraction wells, introduce bacteria and nutrient to degrade contamination | Potentially Applicable |
| | | Air Sparging | System of wells to inject air into groundwater to remove volatiles by air stripping | Potentially Applicable |
| | | Permeable Treatment Beds | Downgradient trenches backfilled with activated carbon to remove contaminants from water | Potentially Applicable |
| | | Chemical Reaction | System of injection wells to inject oxidizer such as hydrogen peroxide to degrade contaminants | Not proven applicable to organic contaminants |

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# Table 2-3
# Groundwater: Site Specific Technology Screening
# Gaess Site

| General Response Action | Remedial Technology | Description | Screening |
|---|---|---|---|
| No Action | Non-technology Based | No action is taken to remove, treat or control groundwater. | **Comments:** RETAINED. As required by the NCP and EPA Guidance (1988), this technology is retained for comparison to other alternatives. |
| Institutional Actions | Deed Restriction/ Institutional Controls | Restrictions to future use of the Site, portions of the Site, or groundwater, as appropriate, are specified in property deeds. | **Effectiveness:** A deed restriction could be an effective means of controlling future use of the Site or groundwater. Restrictions could apply to the Site or portions of the Site, and could include such things as restricted Site access or restricted use of groundwater. Deed restrictions are not considered necessary at the Gaess Site because the property is owned by the Village of Harriman who could provide adequate control of the future use of the Site and Site groundwater.<br><br>**Implementability/Cost:** Deed restrictions could be implemented.<br><br>**Comments:** ELIMINATED. Ownership of the Site property by the Village of Harriman provides adequate control of the future use of Site groundwater. |
| | Alternate Water Supply | Extension of an existing municipal water supply or installation of a new water supply well. | **Effectiveness:** The water supply wells on the Site are currently used to supplement the supply of other Village wells. Therefore, eliminating the use of MH-1 would likely leave the Village short on water supply. Any new wells installed in unconsolidated material on site would likely require treatment prior to use for water supply. The unconsolidated material is underlain by bedrock which could possibly support installation of a new water supply well.<br><br>**Implementability/Cost:** Extending an existing off-site water supplies to the residents in the vicinity of the Site would require construction of piping systems. Use of the existing treatment system would require less effort and would be less costly than extending an off-site water supply.<br><br>**Comments:** ELIMINATED. Supplying off-site water or installing a new Village well would require more effort and cost than using the on-site treatment system. Also, pumping at MH-1 hydraulically contains the impacted groundwater, preventing further migration. |
| | Monitoring | Ongoing Monitoring of Wells | **Effectiveness:** Monitoring wells are effective for characterizing groundwater quality and flow conditions over time. Conditions at the Site were characterized during the RI and the results indicate that there are no potential downgradient receptors for the VOCs in groundwater except through the public water supply well and there is no impact to surface water. Due to the low levels of VOCs present in groundwater and their eventual degradation or attenuation through natural processes, no additional monitoring is considered necessary other than continued influent monitoring at water supply well MH-1.<br><br>**Implementability/Cost:** Monitoring could be readily performed at existing monitoring wells or the water supply well.<br><br>**Comments:** ELIMINATED. Ongoing monitoring is not considered necessary under the existing Site conditions. Monitoring of water supply well MH-1 influent and effluent would be performed as part of the water treatment system. |
| Collection | Extraction Wells (1) | An extraction well or system of extraction wells is used to extract groundwater from the saturated zone of the underlying water bearing unit. | **Effectiveness:** Groundwater recovery wells have proven effective in sandy unconsolidated aquifers such as that present at the Site. The RI concludes that impacted groundwater is captured by the water supply well MH-1.<br><br>**Implementability/Cost:** Continued pumping at water supply well MH-1 will continue to control hydraulic gradients and optimize recovery of imapcted groundwater. This technology is already implemented.<br><br>Comments: RETAINED. |

# Table 2-3
## Groundwater: Site Specific Technology Screening
## Gaess Site

| General Response Action | Remedial Technology | Description | Screening |
|---|---|---|---|
| Collection | Subsurface Drains (Interceptor Trench) | A gravel-filled trench is placed towards the downgradient edge of the impacted groundwater. | **Effectiveness:** A trench is ordinarily an effective and simple means of collecting groundwater. However, given the apparent capture zone of the water supply well, a trench would not necessarily be more effective than the existing well. A collection trench could also have a negative affect on the yield of the water supply wells.<br><br>**Implementability/Cost:** Construction of an interceptor trench requires commonly available equipment and methods.<br><br>**Comments:** ELIMINATED. Use of the existing recovery well (MH-1), a technology demonstrated to be effective at the Site and retained for further evaluation, could achieve the same objective and would have lower capital costs than a collection trench. |
| Discharge | Off-site Discharge at a POTW | Off-site discharge involves piping or trucking extracted groundwater to a publicly owned treatment works (POTW). The discharge water must be either pretreated or contain levels of contaminants that can be treated by the particular POTW. | **Effectiveness:** Sewer use ordinances typically require pretreatment of water containing hazardous constituents.<br><br>**Implementability/Cost:** Local POTWs are available near the Site. This technology would likely require construction of laterals to connect the Site to a local sewer. Alternatively, on-site storage tanks and provision for trucking of effluent to the POTW would be required.<br><br>**Comments:** ELIMINATED. The effort involved with connecting to a sewer or trucking effluent water and the potential pretreatment requirements make this technology impractical compared to use of the existing treatment system. |
| | On-site Discharge of Treated Groundwater | On-site discharge requires treatment of groundwater to applicable standards prior to discharge to the ground or surface water. | **Effectiveness:** Routing of treated water to the Site storm water drainageways, retention basins, sanitary system, a surface water location, or recharge (reinjection/infiltration) point would be effective as long as water quality is in compliance with Federal, State or local water discharge requirements.<br><br>**Implementability/Cost:** Treated water could be discharged to any of the above referenced points. Recharge points (reinjection/infiltration) could be readily installed. Currently, treated water is being used as a public water supply.<br><br>**Comments:** RETAINED. The actual point and manner of discharge will be addressed as part of the detailed analysis of alternatives. |
| Containment | Extraction Wells | A groundwater recovery well (or wells) is pumped at a rate such that hydraulic gradients are reversed and off-site migration of groundwater is prevented. | **Effectiveness:** Hydraulic containment using recovery wells is a proven effective means of controlling the migration of groundwater contaminants in unconsolidated water bearing units. The water bearing unit underlying the Gaess Site can yield adequate production rates to reverse gradients, as demonstrated by the effect of the Village water supply well, MH-1 on the groundwater contours.<br><br>**Implementability/Cost:** Use of the existing water supply well is ongoing and therefore readily implemented.<br><br>**Comments:** RETAINED. |

# Table 2-3
## Groundwater: Site Specific Technology Screening
## Gaess Site

| General Response Action | Remedial Technology | Description | Screening |
|---|---|---|---|
| Containment | Subsurface Drains (Interceptor Trench) | A gravel-filled trench is placed on the downgradient edge of the impacted groundwater. The elevation of groundwater within the trench is lowered only enough to mitigate downgradient migration of VOCs. | **Effectiveness:** A trench is ordinarily an effective and simple means of collecting groundwater. However, given the apparent capture zone of the water supply well, a trench would not necessarily be more effective than the existing well. A collection trench could also have a negative affect on the yield of the water supply wells.<br><br>**Implementability/Cost:** Construction of an interceptor trench requires commonly available equipment and methods.<br><br>**Comments:** ELIMINATED. Use of the existing recovery well (MH-1), a technology demonstrated to be effective at the Site and retained for further evaluation, could achieve the same objective and would have lower capital costs than a collection trench. |
| | Vertical Groundwater Flow Barrier | A low permeability vertical barrier to groundwater flow is created using a cutoff wall, grout curtain or sheet piling. | **Effectiveness:** Groundwater flow barriers are used frequently with other gradient control technologies. If properly constructed cut-off wall, grout curtain or sheet pile could ordinarily create an effective barrier to groundwater flow, potentially increasing the effectiveness of a groundwater recovery system and reducing the inflow of groundwater that is not impacted. However, a vertical cutoff wall would need to be keyed into a low permeability unit such as the lake clay and silt which are not present underlying the Gaess site. The location of the confining layer within the bedrock is not evident from the RI data. Keying a cutoff wall into bedrock (at 20 to 30 feet below ground surface) would not necessarily provide an adequate hydraulic barrier. No localized source area has been identified to contain within vertical barriers.<br><br>**Implementability/Cost:** Installation of a cut-off wall, grout curtain or sheet pile could be readily implemented at the Site using commonly available equipment.<br><br>**Comments:** ELIMINATED. This technology is necessary for the effectiveness of the water supply well MH-1 to provide hydraulic containment of the impacted groundwater. Its effectiveness at the Site is also in question due to the absence of an obvious low permeability unit. |
| Treatment | Aeration/ Stripping | Volatile and some semi-volatile compounds are removed from extracted groundwater by creating turbulence or mixing to expedite partitioning into air. | **Effectiveness:** Aeration/stripping has been proven effective for the removal of TCE and 1,1,1-TCA from groundwater.<br><br>**Implementability/Cost:** This is a common technology and could easily be implemented. Pretreatment of groundwater may be necessary to remove iron or suspended solids which can foul the aeration/stripping process. Air emissions sometimes require treatment but may not be necessary at the Gaess Site due to the low concentrations of VOCs in groundwater.<br><br>**Comments:** RETAINED. |
| | Carbon Adsorption | This process is used to remove constituents by passing the flow over or through a medium such as granular activated carbon (GAC) which adsorbs the constituents. | **Effectiveness:** Adsorption by GAC is commonly applied to remove a wide range of organics, including TCE and 1,1,1-TCA from aqueous streams. It would be an effective technology for treatment of extracted groundwater or air containing these compounds. The GAC could become a hazardous waste as a result of its use and be subject to the regulatory restrictions associated with those wastes.<br><br>**Implementability/Cost:** Adsorption equipment is readily available, compact, and could be used on-site. Pretreatment of groundwater may be necessary to remove suspended solids which can foul the GAC. Since the aeration/stripping technology is equally as effective as carbon adsorption, and an air stripping system already exists on the Site, air stripping would be more practical and cost effective than carbon adsorption.<br><br>**Comments:** ELIMINATED. Air stripping is more practical for the Gaess Site than carbon treatment because a system is already located on Site. |

# Table 2-3
# Groundwater: Site Specific Technology Screening
# Gaess Site

| General Response Action | Remedial Technology | Description | Screening |
|---|---|---|---|
| Treatment | Off-site Treatment at POTW | Extracted water is discharged or transported to a local POTW for treatment. | **Effectiveness:** Sewer use ordinances typically require pretreatment of water containing hazardous constituents.<br><br>**Implementability/Cost:** Local POTWs are available near the Site. This technology would likely require construction of laterals to connect the Site to a local sewer. Alternatively, on-site storage tanks and provision for trucking of effluent to the POTW would be required.<br><br>**Comments:** ELIMINATED. The effort involved with connecting to a sewer or trucking effluent water and the potential pretreatment requirements make this technology impractical compared to use of the existing treatment system. |
| | Off-Site Treatment at RCRA Facility | Extracted water is discharged or transported to a RCRA facility for treatment. | **Effectiveness:** A RCRA facility could effectively treat groundwater collected at the Site to levels below applicable standards.<br><br>**Implementability/Cost:** No RCRA facility is located near the Site. The closest RCRA permitted facilities are located in northern New Jersey, western New York and Boston, MA. It would be impractical and costly to transport water via tanker truck to one of these facilities compared with on-site treatment.<br><br>**Comments:** ELIMINATED. The lack of a nearby RCRA facility and the costs associated with transporting water over long distances makes this technology impractical. |
| | Air Sparging | Sparging wells are used to inject air below the water table, allowing VOCs to partition into the air and be extracted by a vapor extraction system. | **Effectiveness:** Air sparging has been used effectively at sites with VOCs in groundwater. Higher concentrations of VOCs partition more readily and are therefore recovered more efficiently than lower concentrations. The thickness of the water bearing unit and the depth to groundwater are amenable to air sparging in conjunction with vapor extraction.<br><br>**Implementability/Cost:** This technology is not practical for low concentrations of VOCs over wide-spread areas. A large air sparging system would require many air sparging and vapor extraction points and a large source of compressed air. Construction of a subsurface air sparging/vapor extraction system would be complicated by the presence of buildings and other Site structures. Construction and installation of an air sparging/vapor extraction system would be more costly than groundwater recovery with only a minimal increase of VOC recovery.<br><br>**Comments:** ELIMINATED. Due to the wide distribution of low levels of VOCs in the groundwater and the lack of an obvious source area, air sparging combined with vapor extraction would be only marginally effective, impractical to build, and costly. |
| | Bio-remediation | In situ biodegradation of VOCs in groundwater is enhanced by injecting VOC digesting bacteria and other supporting compounds into the area of the groundwater plume. | **Effectiveness:** Under appropriate conditions, certain bacteria degrade TCE and 1,1,1-TCA to daughter compounds, such as dichloroethenes or dichloromethanes, that are more mobile than their parent compounds and thus more amenable to certain types of groundwater remediation. The marginal increase in mobility of certain TCE and 1,1,1-TCA daughter products that bioremediation might provide is not likely to provide significant gains in the efficiency of groundwater recovery technologies. Concentrations of TCE and 1,1,1-TCA may not be high enough to support high populations of VOC metabolizing bacteria.<br><br>**Implementability/Cost:** The absence of compounds resulting from the biodegradation of TCE and 1,1,1-TCA suggests that appropriate conditions for biodegradation are not overly favorable at the Site. Implementation may require injection of carbon substrates such as acetone or methanol, with their own potentially negative environmental effects. Heating necessary to encourage bacterial growth could require significant energy costs.<br><br>**Comments:** ELIMINATED. Conditions at the Site do not appear to be conducive to growth of TCE and 1,1,1-TCA metabolizing bacteria. |

# Table 2-3
# Groundwater: Site Specific Technology Screening
# Gaess Site

| General Response Action | Remedial Technology | Description | Screening |
|---|---|---|---|
| Treatment | Permeable Treatment Beds | Downgradient trenches are backfilled with activated carbon to remove contaminants from water. | **Effectiveness:** A treatment bed would have to be keyed into the bedrock to capture the VOCs in the overlying units. The bed would also have to be long to fully capture impacted groundwater. The VOC-containing carbon may require removal and disposal at a future date. This process also has the potential to be reversible (i.e., if concentrations in the bed become too high, the VOCs could begin to desorb and reenter the groundwater systerm).<br><br>**Implementability/Cost:** Installation of a relatively long (400 foot), deep (20 to 30 foot) trench and future removal and disposal would be costly.<br><br>**Comments:** ELIMINATED. The cost and effort to install and maintain a long, deep trench make this technology impractical compared to use of the existing treatment system. |

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(1) Injection wells in association with extraction wells are assessed under On-site Discharge of Treated Water.

## 2.5 SUMMARY OF REMEDIAL TECHNOLOGIES

### 2.5.1 Remedial Technologies Retained for Further Consideration

The general response actions and associated remedial technologies retained for further consideration following the secondary phase of the screening process are listed below:

***No Action***
Consideration of the no action alternative is required by the NCP and EPA guidance. This general response action is non-technology based.

***Plume Management and Groundwater collection using extraction wells***
Groundwater recovery wells are proven effective in sandy unconsolidated aquifers, such as that at the Site, for the collection of impacted groundwater. Use of the existing water supply well MH-1 could be readily implemented to hydraulically manage the affected plume.

***Treatment through aeration/stripping***
Aeration/stripping is retained since it has been proven effective for the removal of TCE and 1,1,1-TCA from groundwater. This treatment technology could be easily implemented as it is already being utilized.

***On-site discharge of extracted groundwater***
Routing of treated water to storm water drainageways, retention basins, sanitary system, a surface water location (such as the Ramapo River), or reinjection/infiltration would be effective as long as water quality is in compliance with State or local water discharge requirements.

### 2.5.2 Technologies Eliminated from Further Consideration

Groundwater technologies that are not retained for further consideration include the following:

***Deed Restrictions***
Deed restrictions are not considered necessary at the Gaess Site because the Village of Harriman owns the Site property and can adequately control the future use of the Site and Site groundwater.

***Alternate Water Supply***
Although extending an off-site water supply to the Site could be an effective means of supplying potable water, currently the water supply well MH-1 is used as a supplement to village water supplies. Eliminating the use of MH-1 would likely cause a shortage of water supply for the village, creating a need for a new well. Supplying off-site water or installing a new water supply well for the village would require more effort and cost than using MH-1 with the existing treatment system. Also, pumping MH-1 provides for

hydraulic containment of the impacted groundwater in the vicinity of the Site. Therefore, an alternative water supply is not retained for further consideration.

***Monitoring***

Ongoing monitoring is not considered necessary due to the low VOC concentrations in groundwater and the lack of potential receptors. Monitoring of the water treatment system influent would be performed as long as this well is used for public water supply production and would provide an indication of the reduction in VOC concentrations in groundwater over time.

***Plume Management using Interceptor Trench/Vertical Groundwater Flow Barrier***

Plume management or groundwater collection using an interceptor trench is ordinarily an effective and simple means of collecting groundwater. However, given the apparent capture zone of the water supply well, a trench would not necessarily be more effective than the existing well. A collection trench could also have a negative effect on the yield of the water supply wells. The use of the existing recovery well (MH-1), a technology which is retained for further evaluation because it has been demonstrated to be effective at the Site, could achieve the same objective and would have lower capital costs than a collection trench. Therefore, the collection trench technology is eliminated from further consideration.

Plume management using a vertical groundwater flow barrier is not retained for further consideration. A groundwater flow barrier such as a cut-off wall, grout curtain or sheet pile wall may not be effective because of the absence of a defined low permeability layer. It would likely only divert flow and, to be effective at the Site, may need to be combined with a groundwater extraction technology. This technology is not practical for a site with wide-spread, low-level concentrations of VOCs. Furthermore, recovery wells, a technology already demonstrated to be effective at the Site and retained for further evaluation, could achieve the same objective alone and would have lower capital costs.

***Treatment***

The following treatment technologies are not retained:

- carbon adsorption,
- air sparging,
- bioremediation, and
- permeable treatment beds.

Treatment technologies such as carbon adsorption, air sparging, bioremediation, or permeable treatment beds are not retained. Adsorption by granular activated carbon (GAC) is effective, and adsorption equipment is readily available; however, the GAC could become classified as a hazardous waste as a result of its use and be subject to regulatory restrictions. Pretreatment of groundwater may be necessary to remove suspended solids that can foul the GAC. Since the aeration/stripping technology is equally as effective as carbon adsorption, and an air stripping system already exists on the Site, air stripping would be more practical and cost effective than carbon adsorption.

Although air sparging has been used effectively at sites with VOCs in groundwater, this technology is not practical for low concentrations of VOCs over wide-spread areas. Due to the wide distribution of low levels of VOCs in the groundwater and the lack of an obvious source area, air sparging combined with vapor extraction would be only marginally effective, impractical to build, and costly.

Although bioremediation cannot be completely ruled out as a possible mechanism for decreasing the concentration of VOCs at the Site, observations at the Site (the absence of compounds resulting from the biodegradation of TCE and 1,1,1-TCA) do not demonstrate that bioremediation of TCE and 1,1,1-TCA is actively occurring. A treatment bed would have to be very long and keyed into the bedrock to capture VOCs in the overlying units, and the VOC-containing carbon may require removal and disposal at a future date. The cost and effort to install a long, deep trench make this technology impractical.

***Off-Site Treatment at a POTW or RCRA Facility***

Off-site discharge at a POTW or a RCRA water treatment facility is not retained. Sewer-use ordinances typically require pretreatment of water containing hazardous constituents. The lack of a nearby sanitary sewer line and the potential pretreatment requirements make this technology impractical. The lack of a nearby RCRA water treatment facility and the costs associated with transporting water over long distances makes off-site treatment at a RCRA facility impractical. Also, these two off-site disposal technologies would result in the loss of a water supply.

# 3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

## 3.1 DEVELOPMENT OF ALTERNATIVES

In this section, the remedial technologies selected for further consideration are assembled into appropriate remedial alternatives that achieve the remedial objectives. As required by the NCP, the "No Action" remedial alternative is included.

The remedial alternatives for groundwater are as follows:

### Alternative 1: No Action

Since pumping from water supply well MH-1 is considered an applicable remedial technology for the Site, the No Action Alternative is defined as discontinuing the use of MH-1 and taking no other action at the Site. The impacted groundwater would not be pumped and treated and concentrations of constituents in groundwater would not be monitored. The concentrations of TCE and 1,1,1-TCA in groundwater would be reduced through natural attenuation and degradation processes such as dilution, dispersion, adsorption and possibly biological and chemical degradation. During non-pumping conditions, groundwater flows in an easterly direction, then southeast parallel to and eventually into the Ramapo River.

### Alternative 2: Continue the Existing System (No Further Action)

Under this alternative, groundwater extraction and treatment would continue to be performed by the current system to meet public water supply needs and influent monitoring would be performed periodically to evaluate the conditions at the Site. As with Alternative 1, the concentrations of VOCs in groundwater would be reduced through natural attenuation and degradation processes as well as through treatment using the existing air stripper system.

Groundwater is pumped from MH-1 at approximately 75 gpm. The recovered groundwater is pumped directly to the air stripping tower for removal of VOCs and then to the public water distribution system. The air stripper, an Aquifer Restoration Equipment (ARE) Air Stripper Model ARE-01-03-29/35, was installed in April, 1992 and operates under a NYSDEC permit and with NYSDOH approval. Monitoring of TCE and 1,1,1-TCA concentrations in influent and effluent samples is performed every 3 months (quarterly).

Influent monitoring would provide a basis for determining when NYSDEC groundwater standards are consistently being met in the affected water bearing formation in the Site area. The stripper would be operated until concentrations of TCE and 1,1,1-TCA in the influent decreased to below the NYSDEC standard of 5 ppb for four consecutive quarterly sampling rounds. At such time WMI would reserve the right to discontinue operation of the air stripper or decrease monitoring frequency, with concurrence of the NYSDEC. The relatively low concentrations of VOCs measured in the influent indicate that discontinuation of system operation could be anticipated in a reasonably short time frame (within 5 years).

## 3.2 SCREENING OF ALTERNATIVES

NYSDEC TAGM 4030 addresses the process for selecting remedial actions (NYSDEC, 1989; revised 1990). This TAGM recommends that the remedial alternatives identified and described in Section 3.1 be screened to narrow the range of alternatives that will be carried forward through the detailed evaluation. The alternatives are ordinarily screened on the basis of effectiveness and implementability (both technical and administrative).

Since the screening of technologies narrowed the range of practical remedial alternatives to two, both alternatives will be carried through the detailed analysis of alternatives. An evaluation of effectiveness and implementability is included in the detailed analysis.

# 4.0 DETAILED ANALYSIS OF ALTERNATIVES

This section describes and applies the evaluation criteria for the detailed analysis of the remedial alternatives. Section 4.1 identifies and describes the evaluation criteria. Sections 4.2 presents a systematic assessment of these alternatives on an individual basis relative to the evaluation criteria, and then provides a comparison of the alternatives. Section 4.3 identifies the recommended remedial alternative for the Gaess Site.

## 4.1 EVALUATION CRITERIA

NYSDEC TAGM 4030 on selection of remedial actions (NYSDEC, 1989; revised, 1990) presents seven criteria to be used for evaluating remedial alternatives that have passed the preliminary screening process. There are two tiers to the above seven criteria. The first two are threshold factors and the next five are primary balancing factors. These criteria are as follows:

Tier I

1. Compliance with New York State Standards, Criteria and Guidelines (SCGs);
2. Overall protection of human health and the environment;

Tier II

3. Short-term effectiveness;
4. Long-term effectiveness and permanence;
5. Reduction of toxicity, mobility or volume through treatment;
6. Implementability; and
7. Costs (capital, annual operation and maintenance, present worth).

Additionally, community acceptance will be considered by the regulatory agency as a modifying consideration. Further description of the seven criteria is provided below.

**TIER I**

### 4.1.1 Compliance with New York State SCGs

This evaluation criterion is used to assess compliance with promulgated chemical-specific, action-specific, and location-specific SCGs, and other "to be considered" (TBC) criteria, advisories and guidance. SCGs for the Gaess Site are discussed in Section 1.4. Proposed remedial alternatives are analyzed to assess whether they achieve SCGs under Federal and State environmental laws, public health laws, and State facility siting laws, or whether they may be subject to one of the six waivers allowed under CERCLA.

### 4.1.2 Overall Protection of Human Health and the Environment

This evaluation criterion is designed to determine whether a proposed remedial alternative is adequate with respect to protection of human health and the environment. The evaluation focuses on how each proposed alternative achieves protection over time, how Site risks are eliminated,

reduced, or controlled, and whether any unacceptable short-term impacts would result from implementation of the alternative. The overall protection of human health and the environment evaluation draws on the assessments for long-term effectiveness and permanence, short-term effectiveness, and compliance with SCGs.

**TIER II**

### 4.1.3 Short-Term Effectiveness

This evaluation criterion is used to assess short-term potential impacts associated with the construction and implementation phase of remediation. Alternatives are evaluated with regard to their effects on human health and the environment. These considerations include:

- Protection of the community during implementation of the proposed remedial action (i.e., dust, inhalation of volatile gases);
- Protection of workers during implementation;
- Environmental impacts that may result from the implementation of the remedial alternative and the reliability of mitigative measures to prevent or reduce these impacts; and
- Time until remedial response objectives are met, including the estimated time required to achieve protection.

### 4.1.4 Long-Term Effectiveness and Permanence

This criterion addresses the long-term effectiveness and permanence of the remedial alternative with respect to the quantity of residual chemicals remaining at the Site after response goals have been met. The principal focus of this analysis is the adequacy and reliability of controls necessary to manage any untreated media and treatment residuals. Characteristics of the residual chemicals such as volume, toxicity, mobility, degree to which they remain hazardous, and tendency to bioaccumulate must also be examined. Specifically, these considerations are:

- Magnitude of residual risk to human health and the environment;
- Adequacy of controls; and
- Reliability of controls.

### 4.1.5 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion assesses the degree to which the remedial alternative utilizes recycling and/or treatment technologies that permanently decrease toxicity, mobility, or volume of the chemicals as their primary element. It also assesses the effectiveness of the treatment in addressing the predominant health and environmental threats presented by the Site. The specific factors considered under this evaluation criterion include:

- Treatment process that the remedy would employ and the materials it would treat;
- Amount of contaminants that would be treated or destroyed;
- Degree of expected reduction in toxicity, mobility, or volume (expressed as a percentage of reduction or order of magnitude);
- Degree to which the treatment would be irreversible;
- Type and quantity of treatment residuals that would remain following treatment accounting for persistence, natural attenuation, toxicity, mobility and the tendency to bioaccumulate; and
- Whether the alternative would satisfy the statutory preference for treatment as a primary element.

### 4.1.6 Implementability

This criterion assesses the technical and administrative feasibility of implementing a remedial alternative and the availability of various services and materials that would be required during its implementation. Factors considered include the following.

- Technical feasibility: includes the difficulties and unknowns relating to construction and operation of a technology, the reliability of the technology (including problems resulting in schedule delays), the ease of performing additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility: involves coordinating with land owners and governmental agencies to obtain necessary access, permits or approvals.
- Availability of services and materials: includes sufficiency of off-site treatment, storage and disposal capacity; access to necessary equipment, specialists and additional resources; potential for obtaining competitive bids especially for new and innovative technologies; and availability of state-of-the-art technologies.

### 4.1.7 Costs

This criterion assesses the costs associated with a remedial action. It can be divided into capital costs, annual operation and maintenance (O&M) costs, and net present worth costs. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs.

### Direct Capital Costs

Direct capital costs pertain to the initial, one-time costs for construction, materials, and related items including the following:

- Construction and equipment costs: materials, labor, equipment required to install/perform a remedial action.
- Land and site-development costs: land purchase and associated expenses, site preparation of existing property.
- Building and service costs: process and non-process buildings, utility connections, and purchased services.
- Disposal costs: transporting and disposing of materials.

### Indirect Capital Costs

Indirect capital costs pertain to engineering, legal or related costs associated with the construction and start up of a remedial action including the following:

- Engineering expenses: administration, design, construction, supervision, drafting, and treatability testing.
- Legal fees and license or permit costs: administrative and technical costs expended to obtain licenses and permits for installation and operation.
- Start up costs incurred during initiation of remedial action.
- Contingency allowances: costs resulting from unpredicted circumstances (i.e., adverse weather, strikes, etc.).

### Annual Operation and Maintenance

Annual O&M costs are post-construction costs expended to maintain and ensure the effectiveness of a remedial action. The following are annual O&M costs evaluated:

- Labor costs: wages, salaries, training, overhead, and fringe benefits for operational labor.
- Maintenance materials and maintenance labor costs: labor and parts, etc. necessary for routine maintenance of facilities and equipment.
- Auxiliary materials and utilities: chemicals and electricity needed for treatment plant operations, water and sewer services.
- Disposal of residue: disposal or treatment and disposal of residues such as sludges from treatment processes.
- Purchased services: sampling costs, laboratory fees, and professional fees as necessary.
- Administrative costs: costs associated with the administration of O&M that have not already been accounted for elsewhere.

- Insurance, taxes, and licensing costs: liability and sudden accidental insurance, real estate taxes on purchased land or rights-of-way, licensing fees for certain technologies, permit renewal and reporting costs.
- Replacement costs: maintenance of equipment or structures that wear out over time.
- Cost of periodic Site reviews if a remedial action leaves residual contamination.

**Net Present Worth**

Net present worth consists of capital and O&M costs calculated over the lifetime of the remedial action and expressed in present day value. The lifetime of the remedial action is considered to be a maximum of 30 years for costing purposes.

## 4.2 REMEDIAL ALTERNATIVES ANALYSIS

This detailed analysis evaluates the remedial alternatives that were developed and described in Section 3.0. It focuses on the relative performance of each alternative. The purpose of the detailed analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs that must be balanced can be identified. The remedial alternatives that are evaluated in the detailed analysis are as follows:

Alternative 1: No Action
Alternative 2: Continue the Existing System (No Further Action)

The comparative analysis focuses mainly on those aspects of the alternatives that are unique for each alternative. A summary of each of the criteria for each of the remedial alternatives carried through the detailed analysis is provided on Table 4-1. This summary can be used to quickly compare the alternatives and facilitate selection of an appropriate remedy for the Gaess Site.

### 4.2.1 Compliance with SCGs

Alternative 1: Attainment of groundwater standards across the Site would eventually occur under this alternative as a result of the natural flushing and gradual attenuation and degradation of the VOC plume. In the absence of pumping-induced drawdown and active groundwater capture, groundwater in the water bearing zones underlying the Site would flow to the Ramapo River. The VOCs in the groundwater would be passively remediated by volatilization, natural degradation and attenuation processes such as dilution, dispersion, and chemical or biological degradation. This alternative would provide no means of monitoring the reduction of VOC levels.

Alternative 2: Attainment of groundwater standards across the Site would eventually occur as a result of both pumping from the water supply well plus natural flushing and gradual attenuation and degradation of VOCs as described for Alternative 1. Pumping MH-1 would provide for hydraulic containment of the impacted groundwater in the vicinity of the Site. The reduction in VOC concentrations at the production well would be monitored during quarterly sampling of the influent. Achieving SCGs at this measuring point would provide confirmation that SCGs for groundwater have been met across the Site.

# Table 4-1
# Comparative Analysis of Remedial Alternatives
# Gaess Site

| | Alternative 1<br>No Action | Alternative 2<br>Continue Existing System (No Further Action) |
|---|---|---|
| Compliance with SCGs | Attainment of NYSDEC groundwater standards across the Site would occur as a result of volatilization, natural dilution, dispersion and degradation of VOCs over time. This alternative would provide no means of monitoring reduction in VOC levels. | Attainment of NYSDEC groundwater standards across the Site would occur as a result of continued pumping and natural dilution, dispersion and degradation of VOCs over time. Reduction of VOC would be monitored through treatment system influent monitoring. |
| Overall Protectiveness of Human Health and the Environment | The results of the RI, including the baseline Human Health Evaluation and the Ecological Assessment, indicate that there is no significant risk to human health or the environment associated with groundwater, surface water, soil or sediment at the Gaess Site. This conclusion supports "no action" as an appropriate remedial alternative for the Site. | This alternative would provide added protectiveness to human health and the environment, since ingestion of groundwater containing compounds that slightly exceed groundwater standards would be prevented through on-site groundwater treatment. This groundwater would also be contained within the capture zone of the water supply pumping well. It is anticipated, as described under Alternative 1, that natural attenuation and degradation would also reduce groundwater concentrations to below groundwater standards over time. |
| Short-term Effectiveness | Discontinuing pumping of the water supply well could cause a local water supply shortage. Since no remedial activities are proposed, no associated short-term risks would be created. | This alternative would cause no short-term risks. |
| Long-term Effectiveness and Permanence | This alternative would be effective in meeting the remedial action objectives since there is low risk to receptors for existing and reasonable future groundwater land use scenarios and since natural attenuation and degradation in the water bearing formation will eventually effectively reduce the groundwater concentrations to below groundwater standards. The reduction would not be monitored since no sampling is included in this alternative. | The pumping well would provide capture of the impacted groundwater and reduction of VOCs via the groundwater treatment program. Treatment system influent monitoring would provide an indication of the reduction of VOC concentrations over time. |
| Reduction of Toxicity, Mobility & Volume Through Treatment | Natural attenuation and degradation of VOCs in the water bearing zone would contribute to the overall reduction of the toxicity, volume, and mobility of the affected groundwater. | Water supply pumping would enhance the overall reduction of the toxicity, volume, and mobility of VOCs in groundwater. Pumping at MH-1 would provide hydraulic containment of the VOCs, mitigating downgradient mobility. Air stripping of recovered groundwater would eliminate risks of exposure to VOCs in the extracted groundwater. Air stripper emissions are within acceptable levels without treatment. |
| Implementability | No additional remedial activities are proposed for this alternative, and therefore, implementability does not apply. | This alternative is readily implemented. |
| Cost | There are no remedial costs directly associated with this alternative. There may be costs associated with losses due to the discontinuance or interruption or replacement of the treated water supply, but these have not been quantified. | Capital: $0<br>Annual O&M: $10,600<br>Present Worth: $45,900<br>(based on a 5% discount rate over 5 years) |
| Community Acceptance | This alternative may not achieve community acceptance because of the shortage of water supply that could be caused. | This alternative has been meeting the remedial action objectives for several years. |

Comparison: Both Alternatives 1 and 2 would eventually meet all SCGs as a result of natural attenuation and degradation in the water bearing formation. Attainment of SCGs would be enhanced by pumping under Alternative 2.

### 4.2.2 Overall Protection of Human Health and the Environment

Alternative 1: The results of the RI, including the baseline Human Health Evaluation and the Ecological Assessment, indicate that there is no significant risk to human health or the environment associated with groundwater, surface water, soil or sediment at the Gaess Site. This conclusion supports "no action" as an appropriate remedial alternative for the Site.

Alternative 2: This alternative would provide added protectiveness to human health and the environment, since ingestion of groundwater containing compounds that slightly exceed groundwater standards would be prevented through on-site groundwater treatment. This groundwater would also be contained within the capture zone of the water supply pumping well. It is anticipated, as described under Alternative 1, that natural attenuation and degradation would also reduce groundwater concentrations to below groundwater standards over time. No short-term risks would be posed, since there would be no construction associated with this alternative.

Comparison: Both alternatives would be protective of human health and the environment since there is no significant risk present under existing and reasonable future groundwater land use scenarios and since natural processes will eventually reduce the groundwater concentrations to below groundwater standards.

### 4.2.3 Short-Term Effectiveness

Alternative 1: Discontinuing pumping at MH-1 would potentially cause a shortage in the public water supply. Development of an alternate off-site water supply may be necessary, but the feasibility of developing an alternate supply is considered impractical compared with continuing use of the existing on-site pumping well and treatment system. Since no construction activities are proposed for the No Action Alternative, no associated short-term risks would be created.

Alternative 2: This alternative proposes no activities other than continuing the operation and maintenance of the existing water supply and treatment system. These activities would cause no short-term risks to the community, workers or the environment.

Comparison: No short-term impacts to human health or the environment would result from Alternatives 1 or 2 since no additional activities are proposed. However, under Alternative 1, use of water supply well (MH-1) would be discontinued and would most likely cause a shortage in the local public water supply.

### 4.2.4 Long-Term Effectiveness and Permanence

Alternative 1: This alternative would be effective in meeting the remedial action objectives, since there is low risk to receptors for existing and reasonable future groundwater land use scenarios, and

since natural attenuation and degradation in the water bearing formation will eventually effectively reduce the groundwater concentrations to below groundwater standards. The reduction would not be monitored since no sampling is included in this alternative.

Alternative 2: Same as Alternative 1. Additionally, Alternative 2 would provide capture of the impacted groundwater plume and reduction of VOCs via the groundwater treatment program. Treatment system influent monitoring would provide an indication of the reduction of VOC concentrations over time. During monitoring events, the water supply wells and treatment system would be visually inspected and the results would be evaluated to determine if these long-term controls are operating reliably. Maintenance of the well and treatment system would be performed, as appropriate, based on the recommendations set forth in the monitoring reports. Performance of these controls would continue until SCGs are achieved in Site groundwater, or otherwise waived.

Comparison: Both alternatives would be effective since natural processes will eventually reduce the groundwater concentrations to below groundwater standards. Without monitoring, Alternative 1 provides no means for evaluating long-term effectiveness and permanence. Under Alternative 2, effluent monitoring would ensure long-term protection to the public water supply and influent monitoring would provide a basis for evaluating groundwater quality enhancements.

### 4.2.5 Reduction of Toxicity, Mobility and Volume Through Treatment

Alternative 1: Natural attenuation and degradation of VOCs in the water bearing zone would contribute to the overall reduction of the toxicity, volume, and mobility of these compounds in groundwater.

Alternative 2: Water supply pumping would enhance the overall reduction of the toxicity, volume, and mobility of VOCs in groundwater. Pumping at MH-1 would provide hydraulic containment of the VOCs, mitigating downgradient migration. Air stripping of recovered groundwater would eliminate risks of exposure to VOCs in the extracted groundwater. Air stripper emissions are within acceptable levels without treatment.

Comparison: Toxicity, mobility and volume of VOCs in groundwater would be reduced under both Alternatives 1 and 2 as a result of natural attenuation and degradation in the water bearing formation. This reduction would be enhanced by pumping and treatment of groundwater under Alternative 2.

### 4.2.6 Implementability

Alternative 1: No additional remedial activities are proposed for this alternative, and therefore, implementability does not apply.

Alternative 2: Since this alternative makes use of an existing system that is currently in operation, it is considered readily implementable.

Comparison: Either alternative is readily implementable.

### 4.2.7 Cost

Alternative 1: There are no remedial costs directly associated with this alternative. There may be costs associated with losses due to the discontinuance or interruption of the treated water supply, but these are not quantified.

Alternative 2: The costs associated with Alternative 2 have been estimated as shown on Table 4-2. There are no capital costs associated with this alternative. Operation and maintenance of the existing system is expected to continue for remedial purposes until the remedial action objectives are achieved or as long as the water supply is needed. Since the current system has almost met the groundwater concentrations SCGs, the anticipated length of treatment system operation is relatively short (five years or less). Five years of operation and maintenance have been assumed.

Comparison: There are no costs associated with Alternative 1. Annual O&M costs under Alternative 2 are estimated to be $10,600.

### 4.2.8 Community Acceptance

Alternative 1: Community input on specific alternatives will be documented and addressed after a public comment period following agency review of the FS. Public comments will be addressed and agency responses incorporated into the ROD. Although this alternative would eventually meet the remedial action objectives, the result would cause a potential shortage of water supply. This will most likely not be acceptable the community.

Alternative 2: Since this alternative would meet the remedial action objectives this alternative should be acceptable to the community. This alternative has been meeting the remedial action objectives for several years.

Comparison: The community is more likely to accept Alternative 2 since it would meet the remedial action objectives and would cause no potential for interruption in the public water supply.

## 4.3 RECOMMENDED ALTERNATIVE

The recommended remedial alternative for the Gaess Site is Alternative 2, Continue the Existing System (No Further Action). This recommendation is based on the findings of the RI, including the baseline Human Health Evaluation and Ecological Risk Assessment, and the evaluation conducted in this report.

Under Alternative 2 groundwater standards across the Site would eventually be attained as a result of pumping from the water supply well plus, natural flushing and gradual attenuation and degradation of the VOC's. Pumping MH-1 would provide for hydraulic containment of the impacted groundwater in the vicinity of the Site. Treatment of the water in the existing on-site air stripper system would reduce the VOC concentration to below State drinking water standards prior to its use in the public water supply system. The reduction in groundwater VOC concentrations at the production well would be monitored during quarterly sampling of the influent. Consistently

**TABLE 4-2**
**Cost Estimate**
**ALTERNATIVE 2: Continue the Existing System (No Further Action)**

| | Item | Quant. | Unit Cost | Unit | Cost |
|---|---|---|---|---|---|
| | No Direct or Indirect Capital Costs | | | | |
| | Annual O & M Costs: | | | | |
| 1 | Electric for well pump and treatment system | 12 | $700 | month | $8,400 |
| 2 | O & M and performance monitoring | 12 | $100 | month | $1,200 |
| 3 | Periodic acid wash/parts replacement | 1 | $1,000 | yr | $1,000 |
| | Total Annual O&M Costs | | | | $10,600 |
| | Present Worth Costs: | | | | |
| 1 | Present Worth of Annual O&M Costs (5% discount rate, 5 years) | | | | $45,900 |
| 2 | Total Capital Costs | | | | $0 |
| | TOTAL PRESENT WORTH | | | | $45,900 |

Note:
Operation and maintenance (O & M) and performance monitoring are performed by the Village and include sampling of system influent and effluent, system inspection and reporting. Periodic maintanence assumes acid wash every 3 years (approx. $2,500) and blower replacement every 10 years (approx. $2,000).

achieving SCGs at this measuring point (for four consecutive quarterly sampling rounds) would provide documentation that SCGs for groundwater have been effectively met across the Site area, thereby indicating that operation of the treatment system could be discontinued, with NYSDEC concurrence.

The results of the RI indicate that there is no significant risk to human health or the environment associated with groundwater at the Gaess Site. Therefore, treatment of water pumped from water supply well MH-1 is not considered necessary to ensure protection to human health and the environment. However, treatment is necessary to comply with drinking water standards required by the NYSDEC and NYSDOH for MH-1. No short-term risks would be posed, as there are no construction activities associated with this alternative.

Alternative 2 would be highly implementable and would be acceptable to the community as the source of local public water supply would not be interrupted and the existing system has a history of proven effectiveness. The costs associated with the continuance of Alternative 2 are reasonable. Further, the termination of the system in the near future (5 years) is foreseeable based on the low concentrations of the volatiles (TCE and 1,1,1-TCA) currently being detected and the pumping rate of MH-1.