Five-Year Review Report
Brewster Well Field Site
Village of Brewster
Putnam County, New York

April 2002

{tc \l4 "}

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Brewster Well field

EPA ID *(from WasteLAN)*: NYD980652275

Region: 2	**State:** NY	**City/County:** Brewster/Putnam

SITE STATUS

NPL status: O Final G Deleted G Other (specify)

Remediation status (choose all that apply): G Under Construction O Constructed O Operating

Multiple OUs?* O YES G NO	**Construction completion date:** 04/11/1997

Has site been put into reuse? G YES G NO O N/A (site involves groundwater plume and not real property)

REVIEW STATUS

Lead agency: O EPA G State G Tribe G Other Federal Agency

Author name: Frank Bales and Lisa Wong

Author title: Process Engineering Team Leader and Remedial Project Manager	**Author affiliation:** USACE and EPA

Review period:** 04/11/1997 to 04/11/2002

Date(s) of site inspection: 10/30/2001

Type of review:

G Post-SARA G Pre-SARA G NPL-Removal only
G Non-NPL Remedial Action Site G NPL State/Tribe-lead
O Policy G Regional Discretion

Review number: O 1 (first) G 2 (second) G 3 (third) G Other (specify)

Triggering action:

G Actual RA Onsite Construction at OU #____ G Actual RA Start at OU#____
O Construction Completion G Previous Five-Year Review Report
G Other (specify)

Triggering action date *(from WasteLAN)*: 04/11/1997

Does the report include recommendation(s) and follow-up action(s)? O yes G no
Is human exposure under control? O yes G no
Is contaminated groundwater under control? O yes G no
Is the remedy protective of the environment? O yes G no

* [AOU@ refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

I. Introduction

This five-year review was conducted in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001). The purpose of a five-year review is to ensure that a remedial action remains protective of public health and the environment and is functioning as designed. This document will become part of the site file.

This is the first five-year review for the Brewster Well Field site. Upon completion of the remedial action, contaminant levels will be reduced to levels that permit unlimited use and unrestricted exposure. Since the remedial action requires more than five years to complete, this five-year review is being conducted as a matter of Environmental Protection Agency (EPA) policy.

This site is being addressed in two phases, focusing on controlling the source of contamination and the clean up of the groundwater. Operable Unit 1 (OU1), which involves groundwater extraction and treatment, has been constructed and is currently operating. Operable Unit 2 (OU2), which addressed the source of the groundwater contamination, has been completed. This five-year review will evaluate both operable units.

II. Site Chronology{tc \l1 "II. Site Chronology}

Table 1, below, summarizes site-related events from discovery to construction completion.

Table 1: Chronology of Site Events

Event	Date
Volatile organic compounds detected in Brewster Well Field	1978
Site placed on National Priorities List	1982
Packed Tower installed for the Village=s Well Field	1984
Record of Decision for groundwater	1986
Remedial Design for groundwater started	1987
Record of Decision for source control	1988
Remedial Design for source control started	1988
Superfund State Contract executed	1988
Remedial Design for groundwater completed	1989
Remedial Action for groundwater started	1990

Remedial Design for source control completed	1990
Remedial Action for source control started	1991
Remedial Action for source control completed	1991
Explanation of Significant Differences for groundwater	1996
Remedial Action completed for groundwater	1997
Preliminary Site Close-Out Report	1997

III. Background{tc \l1 "III. Background}

Physical Characteristics{tc \l2 "*Physical Characteristics*}

The 30-acre Brewster Well Field site is located on the northern bank of the East Branch Croton River, approximately ： mile east of the Village of Brewster, Town of Southeast, Putnam County, New York. The site is approximately 3 miles west of the Connecticut/New York border and approximately 47 miles north of New York City. Interstate 84 passes just to the west of the site.

The area has a relief of over 500 feet in elevation from the valley floor to hilltops. Low areas north and south of the East Branch Croton River are classified as wetlands. Surface waters located adjacent to the site are classified as suitable as a drinking water supply and designated as suitable for trout.

Geology/Hydrogeology

The subsurface geology of the area is highly varied, giving rise to an extremely complex subsurface hydrogeology. Groundwater throughout the area may be found in both the bedrock and unconsolidated glacial sediments. Unconsolidated deposits range in thickness from a minimum of 25 feet to a maximum of 95 feet. Results of groundwater modeling and aquifer tests indicate contaminated groundwater south of the River is in hydraulic connection with waters being withdrawn from the Brewster Well Field for Village use.

Horizontal hydraulic conductivity tests revealed that the glacial till acts as an aquitard impeding migration from unconsolidated sediments into the underlying bedrock.

Land and Resource Use{tc \l2 "*Land and Resource Use*}

The Village of Brewster is the residential community located nearest to the site. The land to the north of the site is the community of Brewster Hill. This area is largely residential, with some agricultural use. Most of the land south of the site is occupied by commercial or light industrial facilities.

A municipal water system serves the Village of Brewster, several areas in the Town of Southeast, and several business establishments and the Consolidated Rail Corporation=s Putnam Junction Rail Yard. The Village of Brewster accounts for 2,200 residential users.

The East Branch Croton River flows adjacent to the site. Three thousand feet to the east of the site, the river is impounded to form the East Branch Reservoir, part of New York City=s Croton watershed reservoir system. Three thousand feet from the site to the northeast, Bog Brook, a tributary to the East Branch Croton River, is impounded to form Bog Brook Reservoir, also owned by New York City. The river also contributes to the Croton Falls Reservoir, located approximately 3.5 miles downstream from the site.

General land use and drinking water sources in the vicinity of the site have not changed since the signing of the groundwater and source control Records of Decision (RODs).

*History of Contamination***{**tc \l2 "*History of Contamination***}**

The Brewster Well Field was found to be contaminated with volatile organic compounds (VOCs), primarily perchloroethylene (PCE), trichloroethylene (TCE), and 1,2-dichloroethylene (DCE) in 1978. Investigations found that the source of contamination was a dry well used for disposing of dry-cleaning wastes at Alben Dry Cleaners. The dry well had been used by the dry cleaners from the initial operation in 1965 until 1983.

*Initial Response***{**tc \l2 "*Initial Response***}**

From 1978 to 1984, the Village of Brewster used several drilling, blending, and pumping strategies to keep contaminant levels down. Under a cooperative agreement with EPA, the Village installed a full-scale air stripper in 1984, which is currently providing safe drinking water to the Village.

The site was placed on the National Priorities List of Superfund sites in December 1982.

Basis for Taking Action

From 1984 to 1986, through a cooperative agreement between the New York State Department of Conservation (NYSDEC) and EPA, NYSDEC's consultant, GHR Engineering Associates, performed a remedial investigation and feasibility study (RI/FS) to determine the nature and extent of the groundwater contamination, and to evaluate cleanup alternatives at the site. The RI concluded that the primary contaminants found in the groundwater are PCE, TCE, and 1,2-DCE, and that a plume of contamination was found to extend from the vicinity of Alben Dry Cleaners, a local dry-cleaning establishment, to the well field.

In 1988, a source control RI/FS was completed by EPA=s contractor, Ebasco Services, Inc. (Ebasco). The RI concluded that a dry well located adjacent to Alben Dry Cleaners was the source of the contamination present at the well field.

IV. Remedial Actions

*Remedy Selection***{**tc \l2 "**IV. Remedial Actions***Remedy Selection***}**

On September 30, 1986, a ROD was signed to address the groundwater. The selected remedy includes continuing to operate the existing air stripping system at the well field in order to continue to provide a safe and reliable water supply. The remedy also included the design and construction of a groundwater management system (GMS) to contain the groundwater contaminant plume and to restore groundwater quality south of the Croton River. The GMS was to consist of four extraction wells, treatment of the extracted groundwater by air stripping, and reinjection of the treated groundwater into eight reinjection wells. After it was constructed, due to operational difficulties related to the reinjection system, the remedy was modified via an Explanation of Significant Differences (ESD) in December 1996. The ESD changed the final disposition of the treated groundwater from reinjection to surface water discharge. The ESD also called for the monitoring of nearby wetlands and floodplains to determine whether not reinjecting the treated groundwater would have an adverse impact on them.

On September 29, 1988, a source control ROD was signed, which called for the excavation, removal, and off-site incineration of the contents of the dry well and the surrounding contaminated soils. The major objectives for this action were to ensure the viability of the GMS by removing any continuing source of contamination and minimize any potential risks associated with direct contact of contaminated soils.

Remedy Implementation

Groundwater

A packed tower air stripper was installed in 1984 to provide treatment of the Village of Brewster water supply. **{**tc \l2 "*Remedy Implementation*GroundwaterA packed tower air stripper was installed in 1984 to provide treatment of the Village of Brewster water supply. **}**

The remedial design (RD) related to the GMS was initiated by Ebasco in December 1987. The plans and specifications for the GMS were completed in April 1989.

Ebasco awarded a remedial action (RA) contract to YWC, Inc. to construct the GMS on October 13, 1989; the construction was completed in March 1991. The GMS consists of four extraction wells (EW-1, EW-2, EW-3, and EW-4) screened from approximately 20 to 32 ft below ground surface and having 3/4 HP Gould submersible pumps. Discharge from the wells is piped to the treatment system via a cast iron header. The combined flow from the four extraction wells was designed to be 45 to 50 gallons per minute (gpm).

Water is pumped from the four extraction wells to the top of an air stripper. The stripper tower is a Hydro Group 30-inch diameter, packed tower and is filled with 25 feet of one-inch Norton plastic intalox saddles. Air to the air stripper is provided by two parallel belt-driven centrifugal blowers located inside the treatment building. The system was originally designed such that treated water

would be reinjected through a series of wells, cross-gradient from the extraction wells. The intended purpose was to promote flushing of the impacted portion of the aquifer. The groundwater extraction and reinjection scenario was to create a flushing cycle between the extraction and injection wells through the center of the contaminant plume to remove additional mass adsorbed on soil particles. The RI surmised that clean up standards could be achieved south of the river in 10 years.

During the 90-day remedy shakedown, three of the four extraction wells were found not to be yielding sufficient volumes of water and the eight injection wells were not accepting sufficient volumes of water. In an attempt to rectify the operational problems, two new extraction wells were installed, two extraction wells were abandoned, and corrective actions for the third well were taken. The injection wells and new extraction wells were then redeveloped. During restart-up of the GMS, however, it was unable to process water consistent with the designed performance criteria.

In 1993, in an attempt to attain an operational and functional GMS, the U.S. Army Corps of Engineers (USACE), under an interagency agreement with EPA, commenced the redevelopment of the existing injection wells, the testing of the GMS, and the installation, development, and the testing of four new injection wells. During the performance of the injection well redevelopment field work, the USACE found buildup of fine materials and carbonate/metal oxide precipitates on the well casings, possibly due to the high dissolved solids/hardness content of the groundwater and resultant oxygenation of the water through the air stripping process. Subsequently, all of the injection wells were redeveloped and acid-cleaned.

From 1994 to 1995, the USACE performed a pH adjustment field study and Malcolm Pirnie, Inc. (Malcolm Pirnie), the USACE=s contractor, performed a softener/chelating agents/polymers addition bench-scale treatability study. The findings of these studies indicated that while these water treatment alternatives were viable, they were extremely expensive. Subsequently, an evaluation of the viability of discharging the air-stripped water to the Croton River, in lieu of reinjecting it on-site, was performed by Malcolm Pirnie. Based on the findings of this investigation, surface water discharge was determined to be the optimal alternative to reinjection[1].

Construction of a 150-foot, 4-inch, underground discharge pipe and outfall system for the GMS was completed in September 1996, and the GMS was restarted in October 1996. In April 1997, following a joint EPA/NYSDEC final inspection which confirmed that major punch list items were resolved, the system became fully operational. The treated effluent is allowed to flow via gravity down to a gabion outfall structure at the river. The GMS is required to treat contaminated groundwater to groundwater standards and applicable state surface water discharge criteria. Additionally, as part of the long-term performance monitoring of the GMS, potential wetland and flood plain related impacts associated with the surface water discharge are to be evaluated on an

[1] The modification to the selected remedy (*i.e.*, changing the final disposition of the treated groundwater from reinjection to surface water discharge) was documented in an ESD, which was issued in December 1996.

annual basis.

The Applicable or Relevant and Appropriate Requirements for groundwater cleanup include EPA=s Maximum Contaminant Levels (MCLs) and New York State=s groundwater quality standards. The action level established for TCE at the site is 5 micrograms per liter[2] (Φg/l). Based on the analytical results associated with the GMS influent and effluent sampling, it has been concluded that the GMS is effectively treating the VOC-contaminated water to concentrations meeting the action levels and is complying with the State Pollutant Discharge Elimination System (SPDES) surface water discharge criteria. Table 2 (see attached) summarizes the December 2001 GMS= influent and effluent sampling results and compares them to the ground water action levels and surface water discharge criteria.

Source Control

The source control RD was initiated by Ebasco in October 1988. The plans and specifications related to the removal of the dry well were completed in August 1990. Ebasco awarded an RA contract to GSX Services, Inc. to implement the RD in April 1991.

In August 1991, the drywell was excavated and confirmation sampling at the excavation limits was performed. Eight truckloads (approximately 20 tons each) of contaminated sediments and soils were removed. The excavation, which was accomplished using sheet piles, was completed down to 15 feet below the ground surface. Final confirmation samples showed that the target cleanup goal of 4 mg/kg for PCE in the unsaturated zone was accomplished[3]. **{**tc \l2 "In August 1991, the drywell was excavated and confirmation sampling at the excavation limits was performed. Eight truckloads (approximately 20 tons each) of contaminated sediments and soils were removed. The excavation, which was accomplished using sheet piles, was completed down to 15 feet below the ground surface. Final confirmation samples showed that the target cleanup goal of 4 mg/kg for PCE in the unsaturated zone was accomplished[11]Based on a risk assessment performed as part of the source control RI/FS, it was determined that soils containing less than 4 mg/kg of PCE would present excess carcinogenic risks of no more than $1x10^{-6}$, falling within EPA's target risk range of 10^{-4} to10^{-6}. . **}**Therefore, the remediation of the source of contamination has reduced contamination of the soils in the unsaturated zone to acceptable health-based levels. Residual soil contamination in the saturated zone is being addressed as part of the contamination plume by the GMS. The need to limit exposure to potentially residually-contaminated soil in the saturated zone should they be disturbed, such as in connection with new building construction, has been communicated to the Town Planning Board.

*System Operations/Operation and Maintenance***{**tc \l2 "*System Operations/Operation and Maintenance***}**

Since April 1997, the GMS has operated at a pumping rate of approximately 50 gpm. The system

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[2] Proposed MCL at the time of ROD issuance.

[3] Based on a risk assessment performed as part of the source control RI/FS, it was determined that soils containing less than 4 mg/kg of PCE would present excess carcinogenic risks of no more than $1x10^{-6}$, falling within EPA's target risk range of 10^{-4} to10^{-6}.

has consistently met cleanup action levels and surface water discharge standards. GMS staffing includes an operator, staff engineer, and field sampling technician. The operator attends to unscheduled system shutdowns after being notified via telemetry. The operator visits the site on a weekly basis for four to eight hours. The plant engineer does not routinely visit the site, but performs some site sampling, acid washing, and prepares project reports (monthly, quarterly and annual). The wells (extraction and monitoring) are sampled according to the schedule contained in the operation and maintenance (O&M) manual.

Routine maintenance of the system includes acid washing the packing and drain lines on a quarterly basis to prevent fouling of the system. The individual flow rate from each of the four extraction wells is not available because the system was not designed to allow individual measurement. The annual O&M costs are approximately $360,000 broken down as follows:

Table 3: Annual Operating Costs

Estimated Costs for Contract Performance	Cost per Year
Sampling and Analysis	$67,000
Equipment Rental	$15,000
Operator Checks	$9,000
Reports	$62,000
Electric	$15,000
Phone	$1,500
Emergency Monitor	$1,000
Tower and Effluent Line Rinse	$12,000
Site Maintenance	$10,000
Travel/per diem	$21,000
Contract Project Management	$12,000
Repairs and Field Supplies	$6,000
Shipping	$6,000
Misc.	$2,500
USACE	$120,000
Total Estimated Cost	$360,000

V. Five-Year Review Process

Administrative Components

On October 30, 2001, a 5-year review-related site inspection was conducted in conjunction with a Remedial System Evaluation (RSE)[4]. The five-year review team consisted of Julia Kisser, David Nelson, Debbie Snodgrass, and Frank Bales with the USACE and Lisa Wong with EPA.

A draft Five-Year Report was prepared in January 2002. It is anticipated that the five-year review will be completed in April 2002.

*Community Involvement***{**tc \l2 "*Community Involvement***}**

The EPA Community Relations Coordinator for the Brewster Well field site, Nicole Seltzer, published a notice in the *Putnam County Courier,* a local newspaper, on March 7, 2002, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review of the remedy for the site to ensure that the implemented remedy remains protective of public health and the environment and is functioning as designed. It was also indicated that once the five-year is completed, the results will be made available in the local site repository. In addition, the notice included the RPM=s address and telephone number for questions related to the five-year review process or the Brewster Well Field site. A similar notice will be sent when the review is completed.

*Document Review***{**tc \l2 "*Document Review***}**

The following documents, data, and information were reviewed in completing the five-year review:

X Remedial Investigation Report, GHR Engineering Associates, July 1986.
X Record of Decision, EPA, September 1986.
X Record of Decision, EPA, September 1988.
X Remedial Action Report, EPA, September 30, 1991.
X Revised Final Work Plan Malcolm Pirnie, Inc., January 1995.

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[4] In *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund ReformsStrategy, dated July 7,2000*, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead groundwater extraction and treatment systems. To fulfill this commitment, the EPA Technology Innovation Office (TIO) and Office of Emergency and Remedial Response, through a nationwide project, is assisting the ten EPA Regions in evaluating their Fund-lead groundwater extraction and treatment systems. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the USACE, using a process called RSE, which was developed by the USACE. The RSE process is meant to evaluate performance and effectiveness, identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and an exit strategy, and verify adequate maintenance of Government-owned equipment. The Brewster Well Field site was chosen to receive an RSE based on an initial screening of the groundwater extraction and treatment systems managed by EPA Region 2.

- X Interim Treatability Study Report Malcolm Pirnie, Inc., February 1995.
- X Explanation of Significant Differences, EPA, December 1996.
- X Report of Findings, Volume 1: Aquifer Test Results, Malcolm Pirnie, Inc., February 1997.
- X Remedial Action Report, EPA, October 1, 1997.
- X Preliminary Site Close-Out Report, EPA, April 11, 1997.
- X Monthly Report for March 1999, KEMRON Environmental Services, May 1999.
- X Operations and Maintenance (1998 Annual Report), KEMRON Environmental Services, May 1999, amended, Sevenson Environmental Services, November 1999.
- X Monthly Report for April, June, July, and August 1999 and January 2000 Sevenson Environmental Services, Inc., June, August, September, and October 1999 and February 2000 respectively.
- X 1999 Annual Report, Sevenson Environmental Services, Inc. March 2000.
- X 2000 Annual Report, Sevenson Environmental Services, Inc. April 2000.
- X Contractor Quality Control Program, Sevenson Environmental Services, Inc. April 2000.
- X Draft Long-Term Remedial Action Work Plan, Sevenson Environmental Services, Inc. October 2000.
- X Draft Sampling and Analysis Plan for Long-Term Remedial Response Activities, Sevenson Environmental Services, Inc. November 2000.
- X Quality Control Summary Report Sevenson Environmental Services, Inc. January 2001.
- X Village of Brewster Water Quality Report, Village of Brewster May 2001.
- X EPA guidance for conducting five-year reviews and other guidance and regulations to determine if any new applicable or relevant and appropriate requirements relating to the protectiveness of the remedy have been developed since EPA issued the RODs.

*Data Review***{**tc \l2 "*Data Review***}**

The source removal is documented in a Remedial Action Report and a Preliminary Site Close-Out Report. These documents state that the analytical results from the post-excavation soil samples collected from the excavation limits indicated that the residual levels of PCE are below the action level of 4 mg/kg.

The groundwater monitoring network includes monitoring wells installed in the shallow, intermediate, and deep zones in the aquifer, as well as extraction wells and former injection wells. Since 2000, groundwater monitoring has been conducted on a quarterly basis in approximately eight shallow and intermediate wells. A more comprehensive sampling effort, consisting of 30 shallow, intermediate, and deep monitoring wells, took place in November 2000.

The primary groundwater contaminants are PCE and its reductive dehalogenation daughter products, TCE, 1,2-DCE, and vinyl chloride. The highest concentrations of VOCs during the RI were detected in an intermediate well located south of the river (DGC-6I) and a well located north of the river (TH-7) (see Figure 1, attached). South of the river, the plume centers between the extraction and former injection wells. Contaminants were detected in only one shallow monitoring well, DGC-17S, during the RI. The limits of the groundwater plume as defined by the RI are from the source at the former Alben Cleaners south of the East Branch Croton River north to the Village Well Field, defined by non-detects in wells DGC-2, DGC-11, and DGC-18. The highest concentrations of PCE and TCE are

currently in wells DGC-6I and TH-7. The concentrations of PCE and TCE in these two wells have decreased since the RI. Since the concentrations of DCE and vinyl chloride have increased in these wells, it is likely that biodegradation is occurring in combination with the extraction of the contaminated groundwater by the GMS. The groundwater sampling results are summarized in Table 4 (see attached). Figures 2 and 3 (see attached) show ground water sample results for PCE and cis-1,2-DCE.

The four extraction wells were fitted with hardware in 2000 to permit sampling of each well. This data indicates that the highest levels of PCE and TCE are extracted from wells EW-1 and EW-2, located the farthest distance from the river. Significantly lower levels of contamination are extracted from wells EW-3 and EW-4.

While all of the groundwater contamination to the south of the river does not appear to be within the capture zone of the GMS= extraction wells (in particular, the eastern side of the plume from well DGC-6I eastward), the Village of Brewster=s water supply extraction system, located to the north of the river, likely captures (and treats) any contaminated groundwater that passes under the river[5].

Although groundwater contamination was detected in a private bedrock well located to the east and upgradient of the site, the RI determined that this contamination was not associated with the dry cleaner, since site contaminants were not detected in bedrock monitoring wells or intermediate monitoring wells located between the source and the private well.

In February 1997, under state authorities, a gasoline service station=s leaking underground storage tanks and associated contaminated soil (located less than 100 feet upgradient from the Brewster Well Field site GMS) were removed and excavated, respectively. As a result of this leakage of gasoline, methyl tertiary butyl ether (MTBE) has been detected in several on-site monitoring wells and in the influent and effluent samples of the GMS= air stripper. The maximum concentration that has been detected is 23 micrograms per liter (µg/l); the MCL for MTBE is 50 µg/l. The Village monitors for MTBE and has not detected any MTBE in its water supply system.

Surface water samples collected during the RI detected low to trace levels of PCE. The detections demonstrate the potential for an interchange of contaminated groundwater with the river. However, no significant surface water contamination existed at and in the vicinity of the site, except for the culvert discharge northeast of Alben Cleaners. Currently, surface water is sampled upstream, downstream, and at the discharge of the treated effluent. Results indicate that the surface water does not contain site contaminants.

Currently, the Brewster Well Field pumps approximately 250,000 to 300,000 gallons per day from four wells. While VOCs have been detected in the influent, they are not detected in the treated water. Table 5 (see attached) summarizes the Village of Brewster=s influent water supply sampling results for 2000 and 2001.

[5] Monitoring well DGC-5, located downgradient of the Village=s well field, is not contaminated.

Site Inspection

A site inspection and an RSE were performed on October 30, 2001. The following parties were in attendance.

Lisa Wong, EPA Region II RPM
Mike Scorca, EPA Hydrogeologist, Region II
Arbor Drinkwine, USACE Project Manager
Doug Sutton, Geotrans, Inc., RSE team member
Peter Rich, Geotrans, Inc., RSE team member
Rob Greenwald, Geotrans, Inc., RSE team member
Edward Mead, USACE RSE team member
Lou Gasparini, Plant Operator, Sevenson
Dawn Cermak, Plant Engineer, Sevenson
Paul Fronczkowski, Sevenson
John La Padula, EPA, Region II
Vince Pitruzzello, EPA, Region II
Frank Bales, USACE Project Engineer
Julia Kisser, USACE Project Geologist
Dave Nelson, USACE Project Engineer

The inspection and RSE found a well-maintained and functional facility. However, the underground discharge line and valves are currently fouled by calcium carbonate, so the surface water discharge is currently occurring through a temporary aboveground PVC line. In addition, the packing in the air stripper becomes fouled with calcium carbonate deposits. To prevent plugging, the column is cleaned quarterly by shutting down the wells and circulating acetic acid through the column packing for 24 hours. After cleaning the used acid is diluted and discharged slowly to the river. The biological accumulation on the distribution plate at the top of the air stripper is removed and cleaned using a bleach solution once per year.

EPA and the USACE have evaluated the problem and will be adding a sequestering agent to the water to prevent the effluent line from plugging, which could also eliminate the need or minimize the frequency for periodic cleaning of the air stripper packing. The USACE has also designed fitting improvement modifications for the discharge line.

*Interviews***{**tc \l2 "*Interviews***}**

Interviews were conducted on October 30, 2001. The site history was provided by Ms. Wong and Mr. Drinkwine. The GMS operations and maintenance were described by Mr. Gasparini and Ms. Cermak. A site tour to the Brewster Well Field included a discussion with Dan Crawford, Superintendent, regarding operation of the Village=s wells. Mr. Gasparini, who retired as the water engineer for the facility, provided information regarding the Village=s water supply operations.

VII. Technical Assessment{tc \l1 "VII. Technical Assessment}

Question A: Is the remedy functioning as intended by the decision documents?{tc \l2 "*Question A: Is the remedy functioning as intended by the decision documents?*}

Plume Containment{tc \l5 "Plume Containment}

The 1986 ROD called for the continued operation of the existing air stripping system at the well field so as to continue to provide a safe and reliable water supply. It also called for the design and construction of a GMS to contain the groundwater contaminant plume and to restore groundwater quality south of the East Branch Croton River. While all of the groundwater contamination to the south of the river does not appear to be within the capture zone of the GMS= four extraction wells, the Village of Brewster=s water supply extraction system, located to the north of the river, likely captures any contaminated groundwater that passes under the river. Therefore, the Village of Brewster=s water supply extraction system in combination with the GMS have effectively contained the groundwater plume.

The Village of Brewster=s air stripping system is well maintained and meets all treatment goals as described earlier. The system is properly operated and has no history of noncompliance.

The GMS= effluent also meets all surface water discharge requirements[6].

Groundwater monitoring results indicate that a significant mass reduction of PCE is occurring. Data also indicate the significant presence of PCE daughter products TCE, DCE and vinyl chloride (presumably, as a result of bacterial degradation).

The DGC-14 monitoring well cluster (located directly upgradient from the dry well) has been damaged and should be repaired or replaced. In addition, monitoring wells DGC-11I and DGC-17I are nonfunctional from suspected frost damage. These wells should be repaired or replaced. Monitoring well integrity inspection and maintenance should be performed on a regular basis.

There are three private water supply wells located downgradient of the source area. Treatment of the water extracted from these wells is required by the Putnam County Department of Heath. These wells are also periodically sampled. Therefore, these wells are protected.

There appears to be some interest in developing an area downgradient of the Brewster Well Field. Concerns related to limiting potential exposure to contaminated groundwater, minimizing potential impacts to the packed tower air stripper at the Brewster Well Field and the GMS, and insuring that the plume control that is currently in place is not adversely affected have been communicated to the

[6] Groundwater treatment to EPA=s MCLs and New York State=s groundwater quality standards is also being met under the ROD=s originally called for treatment of extracted groundwater and reinjection of the treated groundwater into the subsurface.

Town Planning Board by EPA.

Wetlands

The original remedy called for the reinjection of the treated groundwater so as not to adversely impact area wetlands and flood plains. Because of operational difficulties related to reinjecting the treated effluent, a surface water discharge system was installed pursuant to an ESD. Review of available pumping and non-pumping monitoring well water level data indicate relatively little changes in groundwater elevations, apparently, associated with temporal and/or seasonal variations. While not recharging the 50 gpm that is extracted and treated is unlikely to adversely affect the wetland areas at the site, as part of the long-term performance monitoring of the GMS, potential wetland- and floodplain-related impacts associated with the surface water discharge, if any, will be evaluated. The evaluation, which will consist of continued water level monitoring, data compilation, and if necessary evaluation of soil, vegetation, and hydrology, will be conducted pursuant to the procedures outlined in a Draft Long-Term Remedial Action Work Plan, which is currently being finalized.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?{tc \l2 "*Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*}

Source Control{tc \l5 "Source Control}

Contaminated soil was removed from the dry well in 1991 to reduce the risk to receptors who may become exposed to contaminated soil and to remove a continuing source of contamination to the groundwater. The criteria for the cleanup was 4 mg/kg PCE. Post-excavation confirmational samples indicated that this was achieved. While PCE toxicity values have changed since the ROD, the new risk-based concentrations (calculated to protect long-term exposure) are now set at 6 mg/kg. Therefore, while the toxicity has changed for PCE, the residual levels of PCE in soil do not pose an unacceptable risk.

Groundwater

The exposure assumptions regarding the groundwater remedy were to protect the public water supply. This is being accomplished via the existing well head treatment system (packed tower) on the water supply system.

The 1986 ROD=s remedial action objectives were the continued operation of the packed tower on the Village=s water supply to provide safe water and to contain and restore the groundwater. The packed tower is effectively providing potable drinking water. The Village=s extraction system in combination with the GMS will continue to contain the plume. While the ROD anticipated 10 years of extraction and treatment to meet MCLs, the anticipated duration of pumping and treating to reach MCLs is not presently known.

The risk assessment related to the groundwater was conducted prior to implementation of the current guidances for human health and ecological risk assessments. While the process for selecting chemicals of potential concern is not the same as the one that is used today, the outcome is the sameCthe potential carcinogenic risk related to exposure to the groundwater is in excess of the target risk range of 10^{-4} to10^{-6}. While the methodology and toxicity levels have changed, the concentrations of the chemicals of potential concern in tap water remain non-detect. Therefore, there is no exposure to human receptors from site-related contaminants.

An ecological evaluation was conducted in 1986. It cited studies regarding the low likelihood of chlorinated solvent bioaccumulation in fish. It also emphasized the high volatility of these chemicals that translates to a low residency time in surface water. Since the time of this evaluation, new ecological risk guidance has been published as well as benchmark surface water concentrations that can be used to screen data for potential problems and further evaluation. The 2001 quarterly samples taken upstream and downstream of the treatment system outfall have been non-detect for the chemicals of potential concern. This indicates that neither the groundwater plume nor the treatment effluent are impacting surface water in the river.

*Question C: Has any other information come to light that could call into question the protectiveness of the remedy?***{**tc \l2 "*Question C: Has any other information come to light that could call into question the protectiveness of the remedy?***}**

No.

*Technical Assessment Summary***{**tc \l2 "*Technical Assessment Summary***}**

Based upon the results of the RSE (a draft RSE report was submitted in December 2001) and the 5-year review, the following findings and recommendations are being made:

X The Village-supplied drinking water meets water quality standards.

X The GMS treated water meets the surface water discharge criteria[7].

X The 2001 quarterly surface water samples collected upstream and downstream of the treatment system outfall did not show VOCs. This indicates that the GMS= effluent and the contaminated groundwater are not impacting the surface water in the river.

X While the toxicity level for PCE in soil has changed, the residual levels of PCE in soil do not pose an unacceptable risk.

X The groundwater plume will not likely be remedied to MCLs in ten years as estimated in the ROD; however, the PCE is showing significant degradation. Enhanced biodegradation should be evaluated. If it is found to be viable, it could be employed to speed up the biodegradation process.

X The effluent line leading from the air stripper discharge sump to the river has recently

[7] Groundwater treatment to EPA=s MCLs and New York State=s groundwater quality standards is also being met under the ROD=s originally called for treatment of extracted groundwater and reinjection of the treated groundwater into the subsurface.

plugged with calcium carbonate. EPA and the USACE have evaluated the problem and will be adding a sequestering agent to the water to prevent the effluent line from plugging, which could also eliminate the need or minimize the frequency for periodic cleaning of the air stripper packing. The USACE has also designed fitting improvement modifications for discharge line.

X Two extraction wells (EW-3 and EW-4) are pumping relatively low VOC concentration water. To maximize efficiency, these flows could be replaced or supplemented by extracting groundwater in more highly contaminated areas.

X Monitor for potential impacts on the wetlands and floodplains.

X The third-party notification system should be replaced with an autodialer.

X A capture zone analysis should be performed to determine current plume containment status and system influence boundary estimates. The findings of this analysis would assist in assessing if additional monitoring wells/piezometers might provide better plume delineation and the development of a VOC capture profile. This information could potentially provide more efficient groundwater extraction scenarios, anticipated VOC mass removal, and help determine the overall remediation time frame.

X There are three private water supply wells located downgradient of the source area. Treatment of the water extracted from these wells is required by the Putnam County Department of Heath. These wells are also periodically sampled. Therefore, these wells are protected.

X There appears to be some interest in developing an area downgradient of the Brewster Well Field. Concerns related to limiting potential exposure to contaminated groundwater, minimizing potential impacts to the packed tower air stripper at the Brewster Well Field and the GMS, and insuring that the plume control that is currently in place is not adversely affected have been communicated to the Town Planning Board by EPA.

VIII. {tc \l1 " VIII. } Recommendations and Follow-up Actions{tc \l1 "Recommendations and Follow-up Actions}

Table 6, below, summarizes the recommendations and follow-up actions stemming from this 5-year review.

Table 6: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
The effluent line leading from the air stripper discharge sump to the river has plugged with calcium carbonate and a	Sequestering agent addition, underground discharge piping modifications, and failsafe system	USACE	EPA	June 2002	N	N

Table 6: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
third-party notification system needs to be replaced with an autodialer	autodialer installation.					
Determine whether additional monitoring wells/piezometers would provide better plume delineation, determine anticipated VOC mass removal, and determine the overall remediation time frame.	Perform capture zone analysis	USACE	EPA	September 2002	N	N
Wetlands and floodplains impact evaluation	Evaluate impacts of groundwater extraction without reinjection on wetlands and floodplains	USACE	EPA	December 2002	N	Y
Damaged/non-functioning monitoring wells	Properly abandon, repair, or reconstruct	USACE	EPA	December 2002	N	N
Two extraction wells are pumping low VOC concentration water	Replace, relocate, or install supplemental wells (following capture zone analysis and damaged/non-functioning monitoring wells repair or reconstruction).	USACE	EPA	December 2003	N	N
The groundwater plume will not likely be remedied to MCLs in ten years; however, the PCE is showing significant degradation.	Evaluate viability of enhanced biodegradation (following capture zone analysis, monitoring well abandon, repair, or reconstruction; extraction well replacement, relocation, or supplemental well installation; and	UASCE	EPA	December 2003	N	N

Table 6: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
	enhanced biodegradation field pilot study).					
Potential exposure to contaminated groundwater and impacts to treatment systems and plume control as a result of land development	Notified Town of Southeast Planning Board regarding concerns related to limiting potential exposure and minimizing potential impacts to the treatment systems and plume control. To insure that the groundwater plume control that is currently in place will not be adversely affected by pumping groundwater at the new development, field studies and/or flow modeling would need to be conducted. EPA would need to review the work plans related to the performance of these studies and the results of such studies.	EPA	EPA	As needed	N	N
Potential exposure to contaminated groundwater and subsurface (below 15 feet) residual soil contamination in the vicinity of the former dry well if construction is performed in this area in the future.	Notified Town of Southeast Planning Board regarding concerns related to preventing potential exposure to contaminated groundwater and should this area be disturbed as a result of construction activities below 15 feet in this area. Requested that EPA be contacted prior to approval of any construction in this	EPA	EPA	As needed	N	N

Table 6: Recommendations and Follow-up Actions						
Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
	area.					

X. Protectiveness Statement{tc \l1 "X. Protectiveness Statement}

The groundwater contamination at the Brewster Well field site is under control and there is no exposure to human receptors from site-related contaminants. The site is protective and expected to remain so, at least until the next five-year review. The remedy is protective of the environment; however, further study of the wetlands/floodplains impacts, if any, will be completed before the next five-year review.

XI. Next Review

The next five-year review for the Brewster Well Field Site should be completed before April 2007.

Approved:

Date
Emergency and Remedial Response Division

List of Acronyms

DCE	1,2-Dichloroethene
DGC	Dunn Geoscience Corporation
EPA	(United States) Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
GMS	Groundwater Management System
MCL	Maximum Contaminant Level
NYSDEC	New York State Department of Environmental Conservation
PCE	Tetrachloroethene
OU	Operable Unit
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SPDES	State Pollutant Discharge Elimination System
TCE	Trichloroethene
TH	(New York State Department of Transportation) Test Holes
USACE	United States Army Corps of Engineers
VOCs	Volatile organic compounds

Figure 1: General Map of Well Locations for Brewster Superfund Site

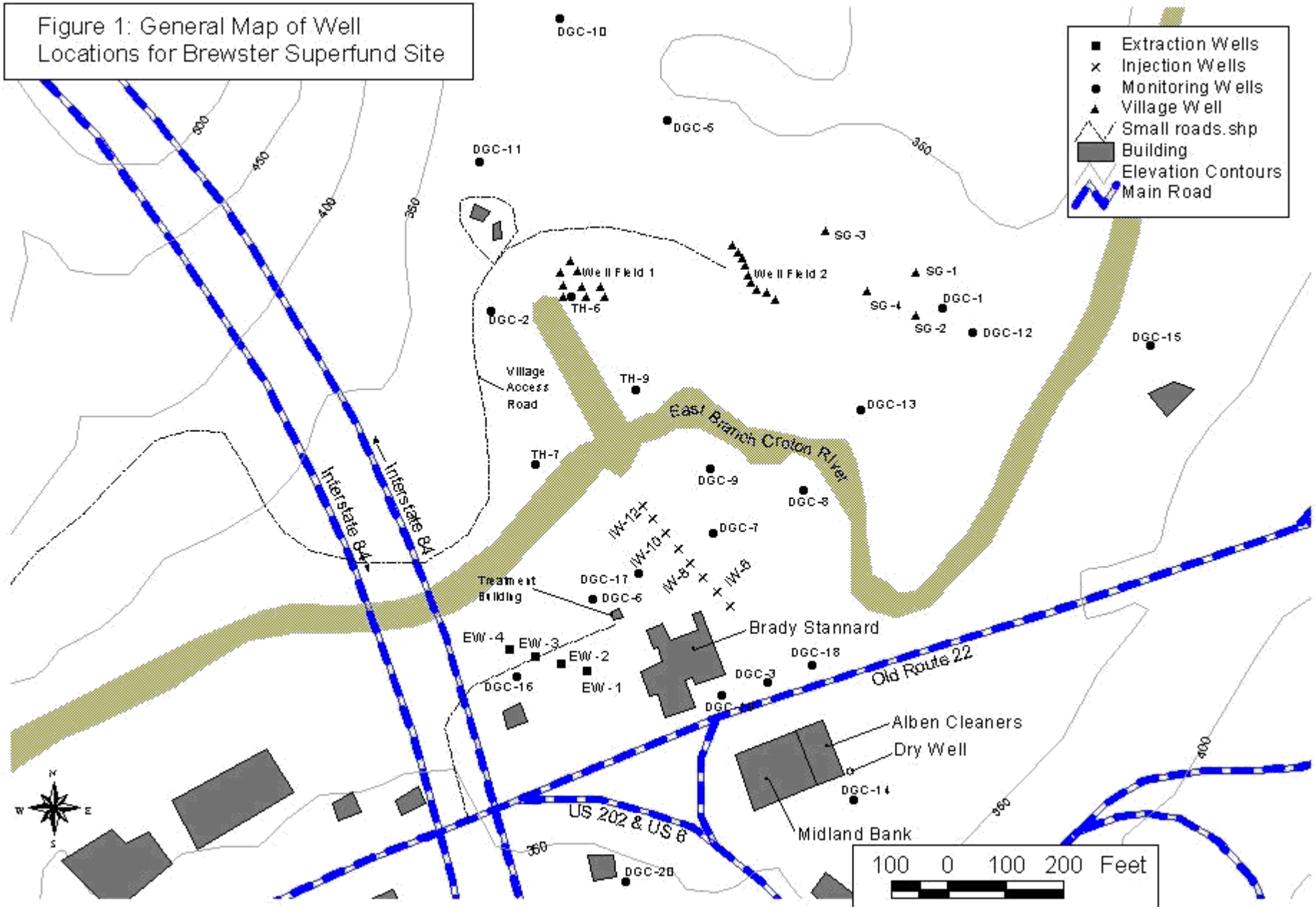

Table 2: Groundwater Management System Sample Results (December 2001)					
Contaminant	Influent (µg/l)	Effluent (µg/l)	EPA MCL (µg/l)	NYS Ground Water Quality Standard (µg/l)	SPDES Discharge Criteria (µg/l)
Benzene	ND	ND	5	5	5
Chlorobenzene	ND	ND	100	5	10
Chloroform	ND	ND	100	100	10
Cis-1,2-Dichloroethene	42.5	3.1	70	5	10
1,2-Dichlorobenzene	ND	ND	600	5	10
1,1-Dichloroethane	ND	ND	7	5	10
Methyl Tertiary Butyl Ether	5.0	4.1	100	50	50
Trans-1,2-Dichloroethene	0.5	ND	100	5	10
1,1,2,2-Tetrachloroethane	ND	ND	--	5	10
Tetrachloroethene	165	0.4	5	5	10
1,1,1-Trichloroethane	ND	ND	200	5	10
Trichloroethene	6.7	ND	5	5	10
Vinyl Chloride	1.2	ND	2	2	10

ND - Not detected.

Table 4: PCE, TCE, and DCE Concentrations Detected from 1985 to 2001															
	PCE (µg/l)						TCE (µg/l)						trans-1,2-DCE (µg/l)		
Well No.	1985	1994	Sep-98	Dec-98	Nov-00	Mar-01	1985	1994	Sep-98	Dec-98	Nov-00	Mar-01	Sep-98	Dec-98	Nov-00
DGC-1I	19	9.6	11.9	10	10.7	NS	4.1	2.6	1.4	1.1	1.3	NS	ND	ND	ND
DGC-3I	7.3	39.7	NS	NS	ND	NS	4.6	16.7	NS	NS	0.6	NS	NS	NS	ND
DGC-6I	5600	327	NS	NS	93.2	81	89	196	NS	NS	28.2	23	NS	NS	1.3
DGC-7I	53	3.8	1.8	4	0.9	2.2	38	19.1	3.8	NS	1.9	1.4	1.7	1.4	1.4
DGC-8I	79	21.1	13	9.3	6.9	NS	33	16.2	10.2	7	3.7	NS	0.1	ND	ND
DGC-9I	170	21.5	4	2.8	2.5	14	29	12.5	2.5	1.6	1.1	8.4	0.1	ND	ND
DGC-12IA	17	36.6	NS	NS	26.6	NS	ND	ND	NS	NS	ND	NS	NS	NS	ND
DGC-13I	2.7	ND	NS	ND	ND	NS	ND	1.9	NS	NS	ND	NS	NS	NS	ND
DGC-15I	ND	ND	NS	NS	ND	NS	ND	ND	NS	NS	ND	NS	NS	NS	0.6
DGC-15D	ND	4.3	NS	NS	ND	NS	ND	3.8	NS	NS	2.2	NS	NS	NS	ND
DGC-16I	9.2	33.9	NS	14	13.1	NS	ND	3.4	NS	1.5	1.5	NS	NS	ND	ND
DGC-19I	1600	3100	183	93	79.2	58	100	311	11.3	7.2	6	5.9	1.5	0.8	4.2
EW-1	NS	NS	NS	280	385	793	NS	NS	NS	14	11.2	22	NS	ND	1.3
EW-2	NS	NS	NS	NS	19.6	60	NS	NS	NS	NS	4	9.5	NS	NS	ND
EW-3	NS	NS	NS	NS	19.5	20.9	NS	NS	NS	NS	3.9	4.1	NS	NS	ND
EW-4	NS	NS	3.2	2.9	2.9	12	NS	NS	ND	0.3	ND	2	ND	ND	ND
IW-12	NS	NS	NS	NS	0.6	NS	NS	NS	NS	NS	1.1	NS	NS	NS	1.0
IW-8	NS	NS	4.6	6.9	ND	NS	NS	NS	1.9	3.2	0.8	NS	0.2	0.2	ND
TH-7	NS	216	512	480	77.6	158	NS	55.7	78.8	110	19	54	3.8	2.9	4

NA - Not analyzed
NS - Not sampled
ND - Not detected.

Table 4 continued: DCE and Vinyl Chloride Concentrations Detected from 1985 to 2001												
	cis-1,2-DCE (µg/l)						vinyl chloride (µg/l)					
Well No.	1985*	1994*	Sep-98	Dec-98	Nov-00	Mar-01	1985	1994	Sep-98	Dec-98	Nov-00	Mar-01
DGC-1I	ND	ND	0.5	ND	ND	NS	NA	ND	ND	ND	ND	NS
DGC-3I	9.9	ND	NS	NS	NS	ND	NA	2.7	NS	NS	ND	NS
DGC-6I	ND	11.5	NS	NS	74.6	69	NA	22.3	NS	NS	1.1	3.3
DGC-7I	140	2.5	130	120	104	128	NA	2.7	2.1	1.1	ND	1.6
DGC-8I	37	ND	9.4	5.7	2.7	NS	NA	ND	1.4	0.4	ND	NS
DGC-9I	90	ND	3.6	1.6	2.0	36	NA	3.5	2.0	0.5	1.1	3.3
DGC-12IA	ND	ND	NS	NS	ND	NS	NA	ND	NS	NS	ND	NS
DGC-13I	ND	ND	NS	NS	ND	NS	NA	ND	NS	NS	ND	NS
DGC-15I	ND	ND	NS	NS	0.6	NS	NA	ND	NS	NS	ND	NS
DGC-15D	ND	ND	NS	NS	ND	NS	NA	ND	NS	NS	ND	NS
DGC-16I	ND	ND	NS	0.1	ND	NS	NA	ND	NS	ND	ND	NS
DGC-19I	140	9.8	76	45	211	34	NA	150	64.8	27	277	45
EW-1	NS	NS	NS	140	103	195	NS	NS	NS	ND	2.8	4.9
EW-2	NS	NS	NS	NS	25	72	NS	NS	NS	NS	ND	2.8
EW-3	NS	NS	NS	NS	ND	13.3	NS	NS	NS	NS	ND	ND
EW-4	NS	NS	0.5	0.2	ND	2.0	NS	NS	ND	ND	ND	ND
IW-12	NS	NS	NS	NS	15.1	NS	NS	NS	NS	NS	3.2	NS
IW-8	NS	NS	12.3	19	15.8	NS	NS	NS	1.3	0.2	2.0	NS
TH-7	NS	3.5	213	350	388	448	NA	10.9	19.3	15	121	36

NA - Not analyzed
NS - Not sampled
ND - Not detected.

Vinyl Chloride was not reported in 1985
* Total 1,2-DCE. Separate cis and trans isomers were not analyzed.

Table 5: Village of Brewster Water Supply Results						
Influent Results (µg/l)	2000			2001		
Contaminant	High	Low	Average	High	Low	Average
Tetrachloroethene	7.8	4.1	5.6	7	3.9	5.3
Trichloroethene	4.4	1.6	2.8	4.0	2.4	3.0
cis-1,2-dichloroethene	8.4	2.1	4.9	7.2	3.3	5.1

{tc \l2 "**Table 5: Village of Brewster Water Supply Results**Influent Results (µg/l)
20002001ContaminantHighLowAverageHighLowAverageTetrachloroethene7.84.15.673.95.3Trichloroethene4.41.62.84.02.43.0cis-1,2-dichloroethene8.42.14.97.23.35.1}

NA - Not analyzed
NS - Not sampled
ND - Not detected.

Vinyl Chloride was not reported in 1985
* Total 1,2-DCE. Separate cis and trans isomers were not analyzed.